JOLT MAGAZINE

Haverford's student-led STEM publication

ISSUE 1 – SPRING 2022

The Parasitic Plant That Steals Genes

Stargazing Guide for May 2022

Could Virgin Births Save The California Condor?

ON THE COVER

A helium-neon laser used in Quantum Physics Laboratory (Hilles 301). Helium-neon lasers were the first and most common type of gas laser. The glass laser cavity in the photograph allows us to see the light waves being reflected inside. The creation of light waves is facilitated through both heating the lasing cavity using an applied voltage and through the combination of helium and neon gas inside the laser cavity. Light waves inside the tube are then reflected by mirrors at each end, creating the light we see in the photograph. 1% of the reflected light waves are emitted through a mirror at one end, creating the laser beam (not pictured).

Photo by Emmeline Riendeau '24

EDITOR'S NOTE

Dear Reader,

In January of 2021, we had the idea to start a science magazine at Haverford. By April, we posted our first set of articles online. Now, in May 2022, we are proud to present the inaugural issue of Jolt, in print.

When laying the foundation for Jolt, we had no clue where to start. Neither of us had any experience running a magazine. So we drew from the rich knowledge and experiences of those in the Haverford community. We spoke to countless peers and professors — everyone was excited and had something to contribute, whether it was an article, a piece of advice, or a question. One of the most important lessons we learned in the process was how supportive and enthusiastic this community is.

Online, Jolt publishes student and faculty writing about topics in science, technology, engineering, and mathematics, covering new advancements, interesting topics, and updates within the community. Within the past year, Jolt has become a space where students can engage in science journalism and connect with professors and peers who share their interests. In print, we hope to consolidate, connect, and celebrate everyone's hard work.

Thank you to every student and *Jolt* staff member who has contributed to the magazine through writing, editing, designing, or offering ideas. We are also so grateful for the faculty members whose excitement about our idea inspired us to continue the hard work — especially Josh Sabloff and Karen Masters, who, despite their busy schedules, helped us bring our idea to life. Lastly, we'd like to thank Students' Council for the financial support that made this issue possible.

Whether you are an avid reader, aspiring scientist, talented writer or contributor, or a curious learner, we invite you to celebrate along with us the wonderful intellect and nerdiness of our community. We hope you enjoy reading!

ANAGHA ANEESH
Co-Editor-in-Chief, Founder

EMI KRISHNAMURTHY
Print Editor, Co-Editor-in-Chief, Founder

CONTRIBUTORS

EDITORS IN CHIEF

Anagha Aneesh ’24
Emi Krishnamurthy ’24

SECTION EDITORS

Sidney Hwang ’22
Catherine Kim ’22
August Muller ’23
Ashley Schefler ’23

PRINT DESIGN & ART

Alex Canty ’25
Paola Delgado ’24

SOCIAL MEDIA

Scout Crooke ’24
Izzy Ray ’23

ADVISORS

Professor Karen Masters
Professor Josh Sabloff
Anubhav Sharma ’23
Trea St. Hillaire ’23

ARTICLES

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Emily Almgren ’24 – Writer, Editor
Lillian Belzer ’25 – Writer
Kate Braverman ’25 – Editor
Celeste Cubbage ’24 – Editor
Oscar Garrett ’23 – Writer
Atira Glenn-Keough ’24 – Writer
Lydia Guertin ’24 – Editor
Jaclyn Holtby ’23 – Writer
Izzy Johnson ’22 – Writer
Naomi Komatsu ’24 – Editor
Sarah McNamara ’24 – Writer, Editor
Gargi Nigam ’25 – Editor
Isabel Thornberry ’24 – Writer

DIGITAL CONTRIBUTORS

Zoe Frazer-Klotz ’22
Sooyeon Jung ’25
Marianela Luna-Torrado ’24
Norah Mayer ’25
Simon Thill ‘25
Andreas Wingert ’25

SPRING 2022

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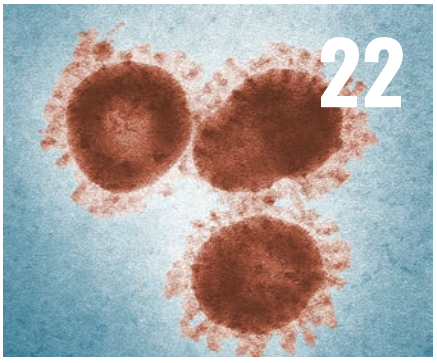


HAVERFORD BEE HANDBOOK

Emi Krishnamurthy

BEES RUN THE WORLD. Their little lives are integral to biodiversity and food security, the water carbon cycles, our GDP, and even our art and architecture. With summer just around the corner, bees are emerging, checking out our picnics on Founder's Green and chasing students away from their lunches. So, what should you do if a wasp lands on your sandwich? Which bees are friends, and which ones are foes? This is your guide to the bees on Haverford's campus.

HONEYBEES

First and foremost, the honeybee is an excellent pollinator, skilled honey maker, and close friend to Haverford's campus. Our own beehive hosts thousands of fuzzy, golden-brown bees that help pollinate produce at the Haverfarm. The honeybees you encounter on campus are most likely female worker bees collecting pollen and nectar from flowers so that they can return back to their nest and create honey. In the early summer, you might see male bees, called drones, which do not sting, collect nectar, or do any work for the hive. Their sole purpose is to mate with the queen (and then they die in the mating process).

Honeybees can sting, but only once, so it does so usually only if its life, nest, or queen is threatened. The verdict: Honeybees are friends, and if you see one, let it do its job and don't provoke it.

The Haverbees club, headed by Charlie Mamlin '23, aims to support pollinators in the greater Haverford community. This year, Haverbees is partnering with the Committee for Environmental Responsibility (CER) to plant a native pollinator garden around the Haverfarm beehives. "Whether it be through education, action, or raising awareness," Mamlin says, Haverbees "is working to help the bees in our area so they can continue to help us in return."

As a community, we cannot ignore that the world's honeybee populations are in grave danger. "There are more stresses on our honeybees today than there have ever been before," says Mamlin, adding that "the wide use of pesticides, global pollutants, and diseases and pests within the honeybee population have made it as important as ever to continue to support our bees in any way we can."

BUMBLEBEES

Another common social bee (bees that live together and interact with each other) is the bumblebee. These fuzzy, round bees are also great pollinators — like honeybees, they collect pollen in baskets on their legs. Unlike the honeybee, they do not make honey, which is why we don't domesticate bumblebees.

Although bumblebees can sting more than once, they are extremely docile and will only do so if their lives or nest is in imminent danger. The verdict: Bumblebees are also friends, but remember that they can sting repeatedly, so don't provoke them.

CARPENTER BEES

Carpenter bees look like bumblebees, but they are much bigger and their abdomens are hairless. They are called carpenter bees because they make their nests by burrowing into wood, so they can be a huge pain for homeowners. Some males will mock "divebomb" if you get too close to its nest, but male carpenter bees don't have stingers (the females do). The verdict: they look big and scary, but they actually can't do much harm.

HOVERFLIES

Hoverflies look like tiny bees, but they are actually flies and cannot sting. The verdict: They can be annoying but aren't anything to worry about.

WASPS

Wasps aren't technically bees. The most common types of wasps in Pennsylvania are yellowjackets, hornets, and paper wasps. Paper wasps and hornets build their nests above the ground, and yellowjackets build below the ground (though sometimes they build nests in places that resemble below-ground structures, such as in cracks in stone walls). They can sting repeatedly to protect their nests and hunt prey. Some wasps are more docile and others are more aggressive, but it definitely makes sense if you want to avoid wasps in general. Yellowjackets love food scraps and sugary drinks, so beware when eating outside or picnicking on Founders.

THE ASIAN GIANT HORNET, A.K.A. THE "MURDER HORNET"

The Asian giant hornet, a type of wasp, is an invasive species whose queens can grow up to two inches. Although their stings can be fatal to those who receive multiple stings or are allergic to its venom, they are no more deadly than regular bees and wasps. Their main threat is not to us, but to our home pollinators — Asian giant hornets are known to decapitate and kill honeybees, ants, and other wasps, and they can even slaughter entire hives.

To date, the Asian giant hornet has not been found in Pennsylvania. If you see a very large wasp, you are most likely looking at a cicada killer wasp or a European hornet. Cicada killer sightings usually increase as annual cicada populations increase in the early summer. They may be big and scary, but they are generally harmless if unprovoked. European hornets, also known as giant hornets, are brown-yellow and, like other wasps, will aggressively defend their nests. The verdict: If you leave a wasp alone, it'll leave you alone.

WHAT TO DO IF A BEE LANDS ON YOUR SANDWICH

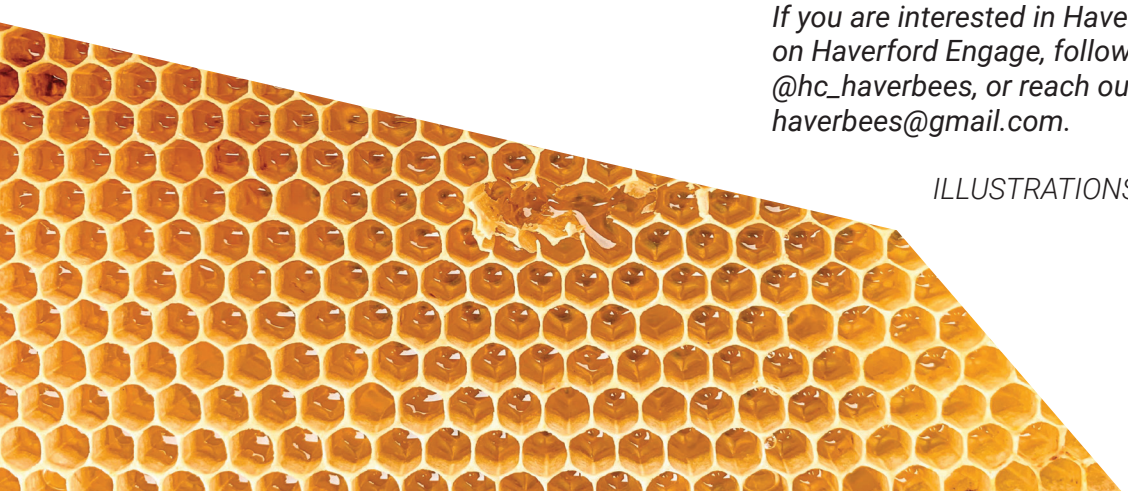
If a wasp or a bee lands on your food and you want to get it off, don't swat it or make sudden movements (including getting up really quickly). If it won't leave you alone, try to cover up your food, and if you can, trap the bee/wasp under a cup or a bowl and release it after you're done eating.

Mamlin's message to the Haverford community is that most bees, and honeybees in particular, are actually friendly. "Once they realize you're not a flower, they generally don't want much to do with you, so there's no reason to be afraid of them! Haverford is a home to so many bees, so if you see one on campus, go ahead and say hi and give it a thank you, because that little friend does more to support your life and the things you love than you realize."

"There are more stressors on our honeybees today than there ever have been before. It is as important as ever to continue to support our bees in any way we can" – Charlie Mamlin '23

If you are interested in Haverbees, you can register on Haverford Engage, follow them on Instagram @hc_haverbees, or reach out via email at haverbees@gmail.com.

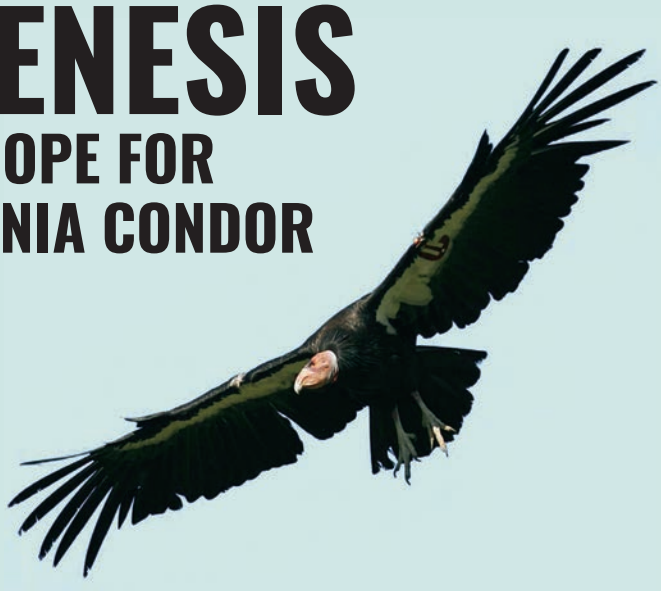
ILLUSTRATIONS BY PAOLA DELGADO



PARTHENOGENESIS

VIRGIN BIRTHS PROVIDE HOPE FOR THE ENDANGERED CALIFORNIA CONDOR

Isabel Thornberry



CALIFORNIA CONDORS are a species that have hovered on the brink of extinction for decades. The Recovery Program, a captive breeding program established in the 1980s, has brought the species' numbers back from just 22 in 1982 to 525 at the end of 2019.

A phenomenon called parthenogenesis, observed in two cases of California condors in 2021, raises questions about genetic variation and the birds' reproductive abilities.

Parthenogenesis is a form of asexual reproduction whereby a female's eggs develop into embryos without fertilization from a male. While this phenomenon is commonly observed in fish, reptiles, and plants, it is rare or unknown in birds such as the California condor.

In October 2021, researchers reviewed the genetic data of 911 California condors born in the Recovery Program. They found two parthenotes (offspring resulting from parthenogenesis): one born in 2001 and another born in 2009 (Ryder et al.). This is the first time reproduction of this kind has been observed in California condors.

California condors, like most animals, are diploid, meaning they have two copies of each of their chromosomes, one inherited from the egg and the other from the sperm. In the case of parthenogenesis, there is no male to provide half of the child's chromosomes, so both sets of genetic material come from the mother. In the two chicks identified as parthenotes, researchers observed that all 21 genes compared were the same on both copies of the chick's chromosomes and had the same sequence as the parthenote's mother. Researchers could identify a mother, but not a father.

Both parthenotes were male, which also supports their conclusions. The sex of bird species is determined by their combination of sex chromosomes: males have ZZ sex chromosomes, and females have ZW. Thus, female eggs will either contain a Z or W chromosome, and the offspring from parthenogenesis will be either ZZ or WW. Since the Z chromosome is critical for survival, all viable offspring from parthenogenesis will be ZZ and therefore male.

These instances of parthenogenesis in California condors were unusual because they were in a captive breeding program, meaning that males were present with the females. In previous cases, parthenogenesis is known to occur only when a female cannot find a male to mate with. This is likely because parthenotes have less genetic variation than offspring from sexual reproduction, so unfavorable traits are more likely to be inherited. While the two parthenotes died at the fairly young ages of 1.9 and 7.9 years old, their deaths weren't explicitly related to parthenogenesis and their lack of genetic diversity.

More research is needed to determine if parthenotes can reproduce themselves and how parthenogenesis may factor into the genetic diversity and range expansion for California condors. However, parthenogenesis could be beneficial for the survival of California condors in the long term.

PHOTO VIA U.S. FISH AND WILDLIFE SERVICES

THE AMAZON RAINFOREST'S SINKING CARBON SINK

Ashley Schefler

THE AMAZON RAINFOREST is one of the world's greatest natural wonders, and it once was an important carbon sink in the fight against climate change. However, a newly published study ten years in the making shows that the Amazon has switched from being a carbon sink to a carbon source, releasing more carbon dioxide into the atmosphere than it takes in.

The Amazon is the largest tropical rainforest on Earth, spanning 2.6 million square miles (roughly 70% the size of the United States). The Amazon contains at least 10% of the world's known species, and, for many years, it has functioned as an important carbon sink. If you've been following the news on climate change, you probably know that trees are some of the good guys, able to store a portion of the carbon we emit and keep it from polluting our atmosphere.

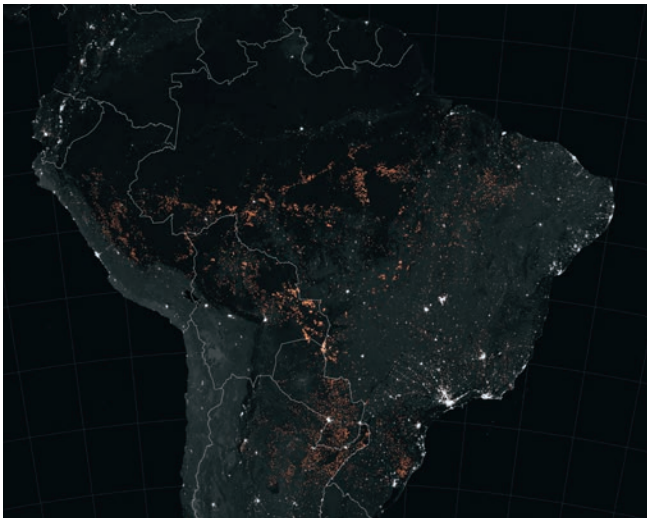
However, the Amazon has switched from being a carbon sink to a carbon source, releasing more carbon into the atmosphere than it takes in, according to a study published in Summer 2021 (Gatti, et al.).

The study used airplanes to sample the air above the Amazon, collecting data at four test sites over nine years. They measured carbon flux — the quantity of carbon entering or leaving the ecosystem — with positive values corresponding to net emission (a carbon source) and negative to net absorption (a carbon sink). Wildfires, often intentionally set to free up land, are a significant source of carbon emissions, and the study distinguished them from other sources by tracking levels of carbon monoxide, which is emitted by fires. Wildfire emissions were set apart from the natural, biological carbon flux of the ecosystem. This ecosystem flux includes factors such as trees using up carbon di-

PHOTO BY NEIL PALMER/CIAT

oxide in photosynthesis or bacterial and fungal decomposers releasing carbon dioxide as they break down dead trees and animals. The study found that the total carbon flux was positive (indicating a carbon source) for all four regions tested. Even more astonishingly, in one of the four regions, the ecosystem itself—even after removing the effects of fires—has become a carbon source.

So how did the Amazon become a carbon source? The answer is a combination of climate change and direct human interference. As the climate has warmed, the Amazon has become hotter and drier, particularly during the dry-season months of August, September, and October. Together with deforestation, this has created a degrading forest, where trees are either performing photosynthesis (the very process by which trees remove carbon from the atmosphere) at a slower rate, or just dying off.



Fires are a significant source of carbon emissions in the Amazon. Map of satellite-detected fires from August 15-22

The forces of climate change and deforestation are interrelated, working together to create a less healthy, less resilient ecosystem. For example, the forest needs evapotranspiration — water evaporation from plants and soil — to supply rainfall and cool the trees. The southeast portion, which has fewer lakes and rivers, is particularly reliant on this mechanism. Fewer trees means less evapotranspiration, increasing heat and drought in the area.

With the transformation of the Amazon into a carbon source, we have lost yet another asset in the battle against climate change, not to mention the direct danger to one of the most diverse ecosystems on Earth. As these natural ecosystems become less and less able to withstand the changing climate, the urgency of curbing our carbon emissions is greater than ever.

Deforestation, as is visible in this satellite photograph, is thinning the Amazon, compounding the effects of climate change and decreasing the resilience of the forest.

PHOTOS BY ESA/A. GERST AND NASA EARTH OBSERVATORY

IN SEARCH OF POLYNOMIAL TIME:
THE TRAVELING SALESMAN PROBLEM

Emily Almgren

IMAGINE YOU ARE PLANNING A ROAD TRIP. To save time and gas, you want to take the shortest route that goes through every city you hope to visit. But how do you figure out what path to take?

You could measure the distances of every possible route and compare them to identify the shortest one — the brute force approach. The issue is that the number of paths grows rapidly as you add more destinations. With 5 cities to visit there are 24 possible routes, but with 22 cities there are approximately 25 billion billion routes. An algorithm that checks every possible path would be too slow to be useful.

This problem is called the traveling salesperson problem, and it has captivated mathematicians and computer scientists for decades. The goal is to find a general and efficient method for finding the shortest path through a set of points that goes through each exactly once, and then returns to the starting point.

Traveling logistics is one of the varied applications of the traveling salesperson problem. Improving the effectiveness of delivery routes reduces the costs of delivery. In June 2021, Amazon awarded a $100,000 prize to the group that could provide the best machine learning model that learned from and predicted delivery routes taken by drivers. Methods for solving the traveling salesperson problem have also been used to sequence genes and produce circuit boards.

Solving the traveling salesperson problem would require a polynomial-time algorithm, a computer algorithm whose execution time is modeled by a polynomial function. As the number of stops increases, the time taken by the a polynomial-time algorithm would increase much more slowly than that of the brute force approach, which is an example of a factorial-time algorithm. To date, no polynomial-time algorithm that works for every possible set of points has been found. In fact, Richard Karp proved in 1972 that the traveling salesperson problem belongs to the NP-hard class of problems (Klarreich, 2013). This means that no efficient algorithm exists unless the conjecture P=NP is true. This conjecture asserts that problems whose solutions can be verified in polynomial time can also be solved in polynomial time. It is widely believed among computer scientists today that P=NP is false. The focus of current research is using mathematics to write algorithms that find an approximate solution: a path with a length within a certain percentage of the length of the shortest path. In 1976, Nicos Christofides wrote an algorithm that finds a route that is no more than 50% longer than the shortest route. Christofides's algorithm is fairly simple. It first finds the shortest tree, a network without closed loops, that connects all of the points. In a closed loop all points must have an even number of branches, so to turn the tree into a loop the algorithm connects the points with an odd number of branches to each other in an optimal way (Klarreich, 2020). Computer scientists believed at the time that a more accurate algorithm would soon be developed, but that breakthrough did not come for another 44 years.

In 2010, Shayan Oveis Gharan, Amin Saberi, and Mohit Singh began working together to beat Christofides's record. Instead of choosing the shortest tree that connects all of the points, they chose a tree where the points with odd numbers of branches are near each other. They then used Christofides's algorithm to turn the tree into a round trip (Klarreich, 2020). In June 2021, Oveis Gharan, Anna Karlin, and Nathan Klien published a paper proving that the new algorithm outperformed Christofides's by 0.2 billionth of a trillionth of a trillionth of a percent (Karlin et al., 2021). This improvement is incredibly small, but it breathed new life into the search for a more accurate algorithm because it showed that improving Christofides's algorithm is possible.

You may never have a polynomial-time algorithm to find the shortest route for your road trip, but researchers have come a long way at finding solutions to the traveling salesperson problem. These new understandings of the problem shed light on related optimization problems and have profound implications for answering a wide array of questions.

RAFFLESIA:
A STRANGE FLOWER WITH AN EVEN STRANGER GENOME

Catherine Kim

UPON FIRST GLANCE, *Rafflesia* looks like a creature that crawled straight out of the Upside Down from Netflix's Stranger Things. Originally from Southeast Asia, *Rafflesia* is a parasitic plant that smells like rotting flesh and holds the Guiness World Record for the largest flower in the world. The peculiarity of this demogorgon-like plant, however, does not end there: its DNA is even stranger.

Rafflesia plants are parasitic — they drain nutrients and water from other plants. As a result, it is common to find host plant genes in parasitic plant genomes. Based on this observation, scientists hypothesize that parasitic plants take advantage of host genetic material to enhance parasitic ability, motivating further research into parasitic genome structure and function.

These parasites have been stealing genes from their hosts for millenia.

For years, scientists have tried and failed to sequence the genome of plants in the *Rafflesia* genus. This is because the *Rafflesia* genome contains transposons, or "jumping genes," that cut and paste themselves at repeating intervals within the genome. In most cases, transposons are silenced, and their expression is shut down, but not in *Rafflesia*, which has gained notoriety in the science community for its troublesome genome. Nevertheless, Dr. Liming Cai and a team of bioinformaticians at Harvard recently produced the first draft genome for a species of *Rafflesia* called *Sapria himalayana*, and the results were surprising (Cai et al., 2021).

First, the team found that *Sapria* lost almost half of widely conserved plant genes, a much greater loss than observed in other plants. Typically, more parasitic species tend to lose more genes with vital functions, but *Sapria* lost 2-4 times as many genes as are lost in some other parasitic plants. As genomes are made smaller and more efficient, more genes typically get lost; however, *Sapria*'s genome is actually quite large. Thus, their first question was: What is filling up *Sapria*'s genome?

Second, they found that 90% of the *Rafflesia* genome consists of repeating DNA (transposons, for example), which is highly unusual and not well understood. Cai and her team were only able to assemble what they believed to be 40% of the genome; the other 60% was too repetitive. So, their next question was: Why does *Sapria* have so many of these jumping genes?

Third, they found that at least 1.2% of the *Sapria* genome consisted of stolen genes from host-to-parasite gene transfers and includes genes potentially adaptive for parasitism. Cai described the *Sapria* genome as "a huge graveyard of DNA" since these parasites have been stealing genes from their hosts for millenia. In addition, evolutionary history reconstruction of these gene transfers revealed a hidden past of host-parasite associations, including those with extinct host species. From these "DNA fossils," scientists were able to discover host-parasite associations dating back to the mid-Cretaceous period.

Overall, this work is revolutionary in its contributions to genome sequencing technology and our understanding of a mysterious parasitic plant. However, the team's findings also created more questions than it answered — so, as this field advances, future research can continue to contribute to our knowledge of parasite genomics and evolution.

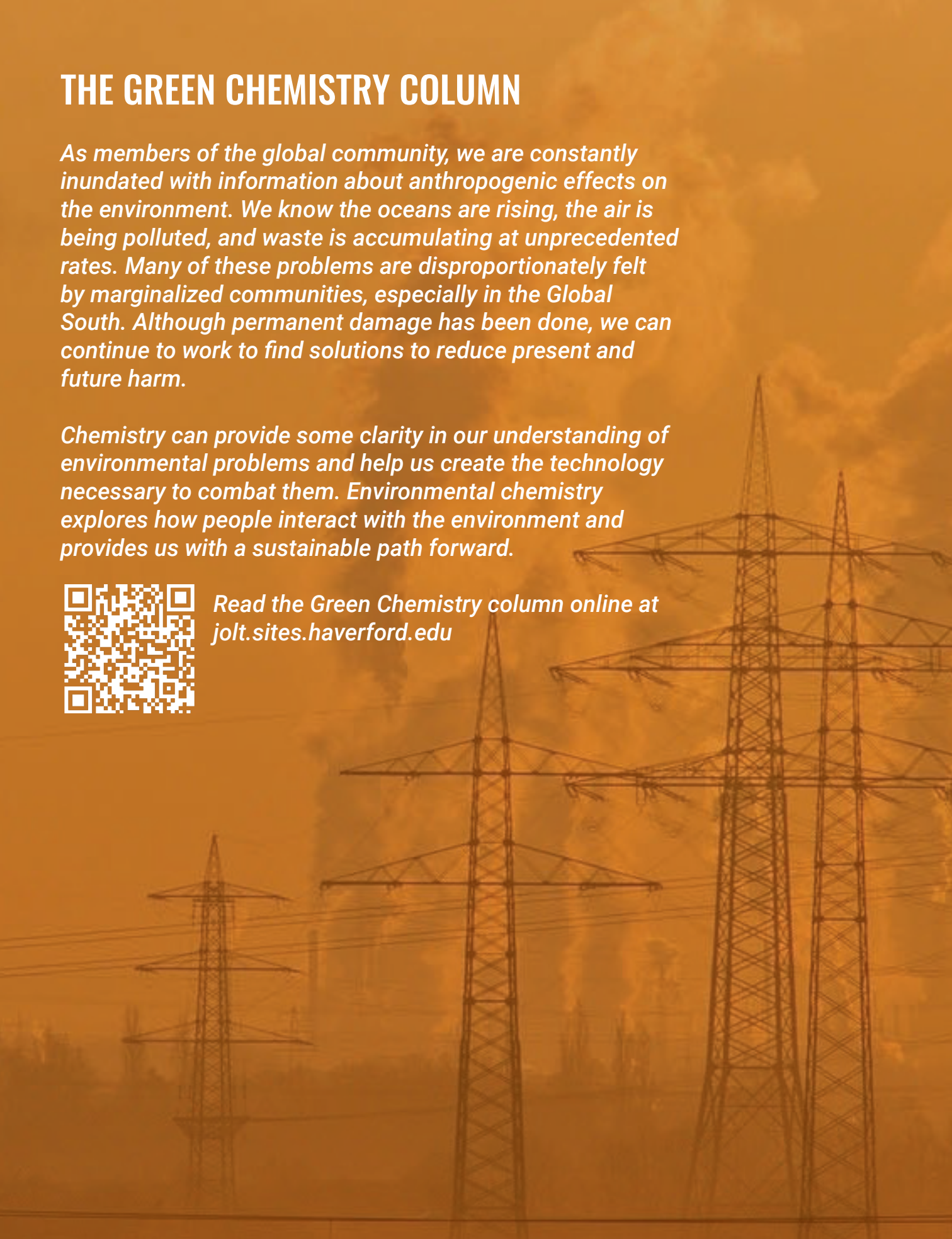
PHOTOS VIA SMITHSONIAN IMAGE LIBRARY

THE GREEN CHEMISTRY COLUMN

As members of the global community, we are constantly inundated with information about anthropogenic effects on the environment. We know the oceans are rising, the air is being polluted, and waste is accumulating at unprecedented rates. Many of these problems are disproportionately felt by marginalized communities, especially in the Global South. Although permanent damage has been done, we can continue to work to find solutions to reduce present and future harm.

Chemistry can provide some clarity in our understanding of environmental problems and help us create the technology necessary to combat them. Environmental chemistry explores how people interact with the environment and provides us with a sustainable path forward.

Read the Green Chemistry column online at jolt.sites.haverford.edu



FLASH JOULE HEATING
A SOLUTION TO THE GROWING E-WASTE PROBLEM?

Atira Glenn-Keough and Isabel Thornberry

WITH APPLE ROLLING OUT A NEW IPHONE EVERY YEAR and planned obsolescence encouraging consumers to buy and throw out more and more electronics, electronic waste is piling up in landfills.

Over 40 million tons of e-waste are produced annually, making it the fastest growing category of solid waste in the world. E-waste often includes toxic heavy metals that can leach into the surrounding environment, contaminating soil, water, and food sources. Workers who dispose of e-waste have been found to have higher lead content in their blood because of exposure to dangerous dust and smoke when working with the waste and in the recycling process. Intensive mining practices to recover precious metals found in e-waste further harm the environment by releasing toxic fumes.

Urban mining is a process by which precious metals like gold, silver, rhodium, and palladium are recovered from urban waste. Researchers have been working to develop new urban mining techniques that are more sustainable and efficient in an effort to reclaim precious metals from old electronics and minimize the need for further intensive mining. However, current techniques primarily involve smelting and leaching. Smelting involves melting down metals and can release toxic air pollutants that contaminate much of the surrounding environment. Leaching is the process of treating e-waste with chemicals that turn precious metals into salts that can later be extracted, but this process isn't efficient and often leaves behind large quantities of acidic and toxic residue.

Applying this technique to e-waste could be a breakthrough in dealing with what is now piling up in landfills.

In early October 2021, researchers at Rice University proposed flash Joule heating (FJH) as a method to better recover precious metals from e-waste by reducing the energy, time, and money involved in urban mining (Deng, et al., 2021). FJH was originally used to produce graphene, a usable form of carbon in a honeycomb structure, from food waste and plastics, and applying this technique to e-waste could be a breakthrough in dealing with what is now piling up in landfills (Williams, 2021). In around one second, electricity raises the temperature of the e-waste to 5,660ºF, vaporizing the precious metals and leaving behind heavy toxic metals. The precious metal vapors are then moved into a cold trap, where they are condensed back into solid, refined and purified, and later reused.

FJH as applied to urban mining has proven to have both higher recovery rates of precious metals and lower removal rates of hazardous heavy metals. Over ten times more silver is able to be recovered compared to traditional urban mining methods, and the recovery of other precious metals has also shown significant increase. With FJH, soil once polluted with toxic heavy metals such as mercury, lead, arsenic, and cadmium has returned to safe limits, and some agricultural land can now be reclaimed.

As our world becomes increasingly digitized, e-waste will continue to be a problem that we need to seek solutions for. Finding ways to reduce and reuse waste may be a vital method of combating the climate crisis and preventing further harm to the environment.

WHAT SHOULD YOU DO WITH YOUR E-WASTE?

Isabel Thornberry

IF YOU'RE ANYTHING LIKE ME, you might have a drawer full of ancient-looking tech at home. But the good news is, we can reduce e-waste by being more conscious about our own use of electronics, and there are several facilities and events that provide electronics recycling.

Sometimes marketing can make us feel as though we need a new device every six months, but by asking whether we truly need that new iPhone, we can save ourselves from e-waste before it's even produced. Repairing or refurbishing older electronics may also be an option, helping us get a longer life out of a single device. A lot of the burden of e-waste can't fall on consumers' shoulders, though, and producers must also consider the impacts of their own devices to sustainably reduce e-waste in the long-run.

Because many electronic devices contain heavy metals, they can't go directly into regular recycling or trash, but specific electronics recycling programs exist throughout the country. In 2010, Pennsylvania passed the Covered Device Recycling Act, which requires manufacturers of electronic devices to provide recycling programs. Electronics collection sites can be found in businesses such as Best Buy and Goodwill, and information for your specific community can be found on local and state government pages.

Programs and events like these are still being developed and expanded, so keep your eyes open for electronics recycling in your area.

COLLECTION SITES IN DELAWARE COUNTY

Amanita muscaria *(also known as "Fly Agaric"), a beautiful psychoactive, inedible mushroom with a rich history.*

DINNER IN THE WOODS

A CATALOG OF EDIBLE FUNGI ON HAVERFORD'S CAMPUS

Oscar Garrett

Disclaimer: Foraging is a fun hobby with tasty rewards, but it can result in injury or death with the wrong combination of ignorance and misfortune. Do not eat anything you find without being sure of its identity. The contents of this article are intended to help learn about, not identify, the fungi on campus. Consult a field guide or foraging expert before consuming any wild edibles.

Once you enter the strange yet magnificent world of fungi, you will never look at the forest floor the same — you'll be looking at it a whole lot more. Fungi are a very diverse kingdom, ranging from single-cellular yeast (used in fermentation) to the largest organism on earth (a giant honey mushroom colony in Oregon, spanning over 3 miles). Multicellular fungi can be filamentous, composed of tube-like cells called hyphae. These hyphae form a network called mycelium, which constitutes the vast majority of the fungi's body mass. Some of these fungi will produce a fruiting body, called a mushroom, whose function is to spread the fungi's spores.

There are hundreds of thousands of characterized mushrooms, and they are extremely diverse in their shapes, sizes, and biochemistry. Humans have been utilizing mushroom biochemistry for millennia. The Iceman (a name given to the mummified remains discovered in the Ötztal Alps of a human dated to have lived about 5000 years ago) was found with Chaga mushroom and birch polypore. These fungi are known for their firestarting and medicinal properties, respectively. Fungal biochemistry continues to be used extensively today, both in medicine and the culinary arts, and some mushrooms can be found right here at Haverford.

Each mushroom I discuss here is a species I have personally found on Haverford's campus, and I have even eaten a few of them. However, do not eat any foraged mushrooms you aren't completely confident in your ability to identify. That being said, many of these look quite unlike any toxic mushrooms and are relatively safe to identify for amateurs, provided you also consult a foraging field guide.

HEN OF THE WOODS (A.K.A. MAITAKE)

Hen of the woods, also known as maitake, is a parasitic polypore mushroom often found at the base of oaks, maples, and elms. With their dull brown color, they can look like a small pile of dead leaves. The "leaves" of the mushroom form a rosette, connecting to the base of the tree at a single point. The undersides of the caps have white pores — small visible holes from which spores are released. They are commonly around 2 or 3 pounds, but can get quite large. Hen of the woods is in season from late August to early November. On campus, they are quite common at the bases of oak trees, especially those near Founders and along the main entrance.

I have eaten this one and can personally attest to its deliciousness. The fronds can be quite dirty so take care in cleaning them. They do great in small, thin slices, marinated and grilled.

CHICKEN OF THE WOODS

Once you know chicken of the woods, it is unmistakable. Bright orange and yellow, it sticks out like a flame in the woods. It too has pores on its undersides and grows from living or dead wood. It is usually found from July through October. Truly a beautiful mushroom, and delicious too! It has the consistency of tofu when cooked and can be used similarly. When harvesting for consumption, look for the younger mushrooms since they can get tough as they age.

ENOKI

If you have ever been to an Asian grocery store, you might have heard of enoki. Enoki's appearance in stores differs vastly from its appearance in the wild because store-bought enoki mushrooms are farmed and not exposed to light. Wild enoki has a sticky red, orange, or brown cap with gills (thin, paper-like structures on the underside of the cap that release spores). Enoki is commonly found on dead logs. These mushrooms prefer cold weather, so they are found in late fall or early spring. Be particularly careful when foraging this mushroom, however, as it has a poisonous look-alike: the Deadly Galerina.

BLEWIT

Blewits vary in color and can be found in a strikingly beautiful lavender or a purplish white. They have a smooth cap, tightly packed gills, and a bare stipe. Blewits have a pink spore print, which can be used to distinguish them from some poisonous look-alikes. They can often be found growing in wood chips during the fall through early winter.

This is another mushroom I have not tried, as it is more commonly consumed in Europe. Like with honey mushrooms, it is advised to consume only a small quantity at first because they are known to sometimes cause allergic reactions.

ALL PHOTOS TAKEN BY OSCAR GARRETT IN THE HAVERFORD PINETUM

OYSTER

Oyster mushrooms are a very popular mushroom and a great beginner foraging find. They come in several colors, but grayish white is most common in this area. Their gills gradually merge with the stipe (the "stem") of the mushrooms. These mushrooms sprout from dead trees; you can often find them on the large standing stumps along the nature trail. Their season is quite wide, ranging from midsummer to early winter. These mushrooms are also super easy to cultivate at home. You can purchase mushroom growing kits online or you can grow your own from scratch with a little starting of mycelium and some organic waste like cardboard or coffee.

Oyster mushrooms have a firm consistency when cooked, almost like octopus or shellfish, though this changes depending on the age of the mushroom. They work well as meat substitutes and taste great sauteed with onion, garlic, and butter.

HONEY MUSHROOMS

Honey mushroom is the name of several species of mushroom; I will specifically be discussing *Armillaria ostoyae*. The color of the mushroom cap varies but is often brown with small dark hairs concentrated at the center. They have a ring on their stipe and a white spore print. (Spore prints are determined by placing the cap face down on a non-white flat surface for a few hours under a glass to allow the spores to fall on the surface.) They often grow in clusters and can be very prolific. Honey mushrooms can be found on dead or dying trees (or from wood buried under the ground) in the fall, with their peak in October. Important note: there is a deadly lookalike to this mushroom. The Deadly Galerina looks similar and grows in similar locations, but they can be distinguished by their rusty brown spore print.

I have not tried these before, but I have heard they are delicious and are prized in Europe. If it's your first time trying them, eat a small amount at first since some may experience gastrointestinal distress after eating this mushroom. Unfortunately, the name "honey" mushroom refers to their color, not their taste, but some say they do have a sweet finish.

CHICKEN FAT MUSHROOMS

Chicken fat mushrooms are bright yellow in color with a sticky, slimy cap. They are a type of bolete, which means they have pores on their underside despite having a stipe and cap. They have a brown spore print. These mushrooms can be found in late summer through fall, often near pine trees with which they have a mycorrhizal (symbiotic) association.

I have not tried these mushrooms, and with their texture, I do not plan on it, but some say they are underrated and compare their strong taste to organ meats. These mushrooms should be handled with care since some individuals can have skin reactions to the slime.

THIS IS THE TIP OF THE ICEBERG when it comes to fungal diversity on campus. There are many other interesting mushrooms like medicinal Reishi and Turkey Tail, deadly Death Cap, or psychoactive Fly Agaric. I hope this article sparks an interest in foraging, or at the very least, encourages you to look and think critically about the funny-looking masses sprouting from trees and dirt.

COVER CONTEST: HONORABLE MENTIONS

The spectral emission lines of a Helium-Neon gas sample, shown in the upper left as a vertical light orange bar. Passing the light through a diffraction grating produces a series of lines at different wavelengths whose characteristic spacing and strength are unique to different elements. This image was taken using a novelty pair of paper diffraction grating glasses, and all 4 series of spectral lines shown are spectrographs of the same HeNe sample at the top of the image. The red LED display reads voltage and current passing through the HeNe sample. Taken during the Laser Physics Lab of Physics 301 ("Intro Quantum Lab").
– Turner Johnson '22

Some soil bacteria have the special ability to make colorful molecules, which the Charkoudian Biosynthesis Lab uses to create "BioArt" and demystify science for a wide audience of learners. Some of these molecules are actually antibiotics used to treat illnesses! This BioArt collage features pieces made by Christina McBride '23, Bayan Mostaghim '23, Jared Sloan '23, Aaron Xu '23, Jiawen (Claude) Wang '23, Trisha Phan '24, Kenneth Hsu '25, and Associate Professor of Chemistry Lou Charkoudian. **– Christina McBride '23**

An illustration of the surface of a planet that orbits a pulsar, along with other planets that are shown mostly in shadow. The planet, covered in ice due to the lack of a normal star's warmth, along with the other planets shown, are representative of the first planets discovered outside of our solar system. Because planets in this situation lack an atmosphere, there is no snow, wind, or fog to be seen. The pulsar itself is shown to be red- and blue-shifted, indicating which of the beams are closer to and which is farther from the camera. **– Rachel McQueen '25**

YOUR GUIDE TO A SUSTAINABLE DINNER PLATE: WHY YOU SHOULD BUY AQUACULTURED FISH

Izzy Johnson

Shopping for fish can be stressful. Every time I walk into a grocery store, I'm slapped with signs advertising "sustainably farmed" salmon and shrimp. But exactly how sustainable are these farmed seafoods? Are they really better than the wild caught option?

Background Image: Seaweed aquaculture farms along the coast of South Korea. The rows of black dots are "fields" of seaweed, grown on ropes held near the surface by buoys.

PHOTO VIA NASA EARTH OBSERVATORY

Aquaculture is the farming of fish, shellfish or plants underwater. Some aquaculture products that you may recognize from your dinner plate are oysters, shrimp and yellowtail. These products are usually raised in ocean enclosures or massive tanks on land. You may have also noticed that the price tag on farmed fish is higher than on wild caught fish. Why would you want to spend more money? As it turns out, there are some very solid reasons to splurge.

Today, over 90% of wild marine fish are overfished (Atlas, 2017). As the ocean's fish populations continue to be exploited, it is crucial to find other means of seafood production to allow our oceans to recover. The ocean's ecosystem is like a well-oiled machine — each species is a cog that contributes to its function. Decimating one population causes ripple effects throughout the entire system. Buying aquacultured fish can help reduce the impact of fishing on our ocean's entire ecosystem.

Aquaculture is also vital to our economy. 50% of seafood consumed by humans is produced in aquaculture, and this is predicted to increase in future years. The global aquaculture industry itself was worth $285,359.7 million in 2019 and is projected to be worth $378,005.5 millon by 2027 (Lester et al., 2018). The industry itself is an opportunity for economic development and job creation as the fastest growing food production industry in the world.

One criticism of aquaculture is that it risks introducing non-native species into certain ocean regions. For example, China's native carp species is nearly extinct due to the accidental release of non-native cultured carp (Zhang et al., 2015). Another problem is that farmers often supplement fish with drugs like antibiotics, giving rise to antibiotic-resistant bacteria. When humans come into contact with these bacteria, consequent illnesses can be difficult to treat. Antibiotic resistance causes over 35,000 deaths annually in the U.S. alone, and these numbers are increasing as we continue to introduce more antibiotics into our bodies and the environment (Reverter et al., 2020).

Scallops at an aquaculture farm in Tongoy Bay

Although aquaculture has been practiced for thousands of years (its practice dates back to 500 BCE in ancient Rome and China), it is a new industry in the U.S. and hasn't been optimized to control disease or contain livestock. Natural livestock feed like garlic has shown promise in improving fish and shrimp immune systems, which would prevent bacterial infections while minimizing antibiotic resistance (Militz et al., 2013). Additionally, new innovations like weather-resistant marine enclosures and expansive land facilities are being developed to prevent non-native species from escaping enclosures (Monterey Bay Aquarium).

It seems there is truth in labels that flaunt terms like "sustainable" farmed fish. There are certainly improvements to be made in the aquaculture industry to reduce the negative effects it can have on the environment and human health, but I believe that it is a step towards a healthier ocean and economic growth. How will your dinner plate change now that you've read about sustainable seafood?

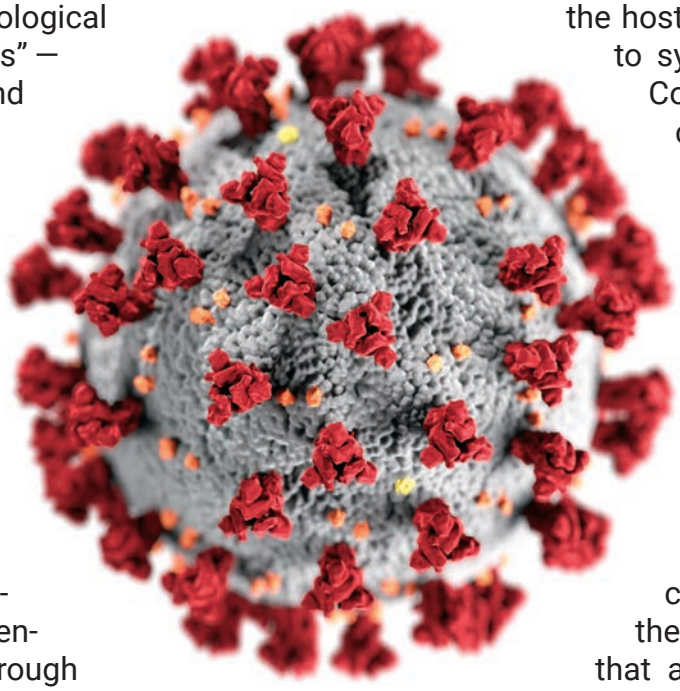
PHOTO VIA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

These past two years, many have faced the truth that science cannot be considered as separate from the society it affects. Here, we'll demystify some ideas relating to COVID while also recognizing the real, visceral tolls that this pandemic has taken on our community.

THE MUTATIONS BEHIND DELTA, OMICRON, AND DELTACRON

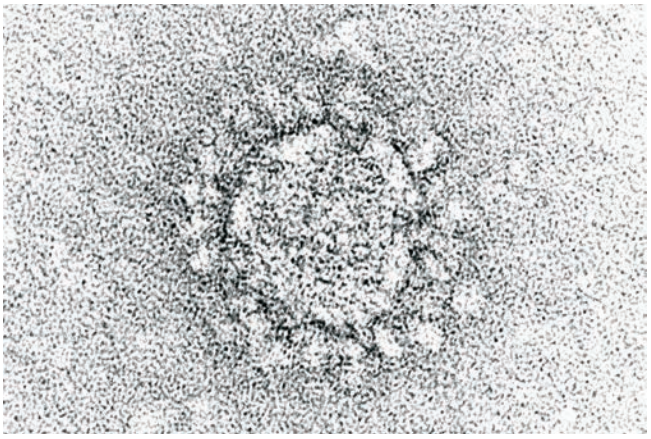
Jaclyn Holtby

COVID-19 is adept at commandeering host cells to efficiently create more viral particles, but if enough mutations are made in the process, the virus evolves, and new combinations of biological abilities — new "variants" — emerge. To understand the effects of these variants on public health, we must first understand the mechanisms by which they arise.



COVID-19, or SARS-CoV-2, is a type of coronavirus — a spherical virus with spike proteins extruding from its surface. When COVID-19 enters the human body through the eyes, nose, or mouth, its spike proteins recognize and latch onto human cells, fusing its own membrane with the human cell so the virus can inject its DNA into the host cell. Viruses do not live long outside of the host and cannot replicate on their own. Instead, they hijack the mechanisms built into its host cell to create new copies of themselves. Viruses force the host cell to work overtime to synthesize more SARS-CoV-2 particles until the cell bursts open and releases them into the body, and the cycle starts again. When these particles exit through our eyes, nose, or mouth, they can infect other people.

The infected host cell creates viral particles at high speeds, so there is always a chance that a mistake, or a mutation, will be made in the duplicated genetic code. Most mutations are inconsequential for the virus, but others can be either detrimental or beneficial. Detrimental mutations are not likely to be passed



Electron microscopic image of SARS-CoV-2. Note the prominent spikes from which the coronavirus gets its name for "corona", or "crown-like".

PHOTOS VIA CDC PUBLIC HEALTH IMAGE LIBRARY

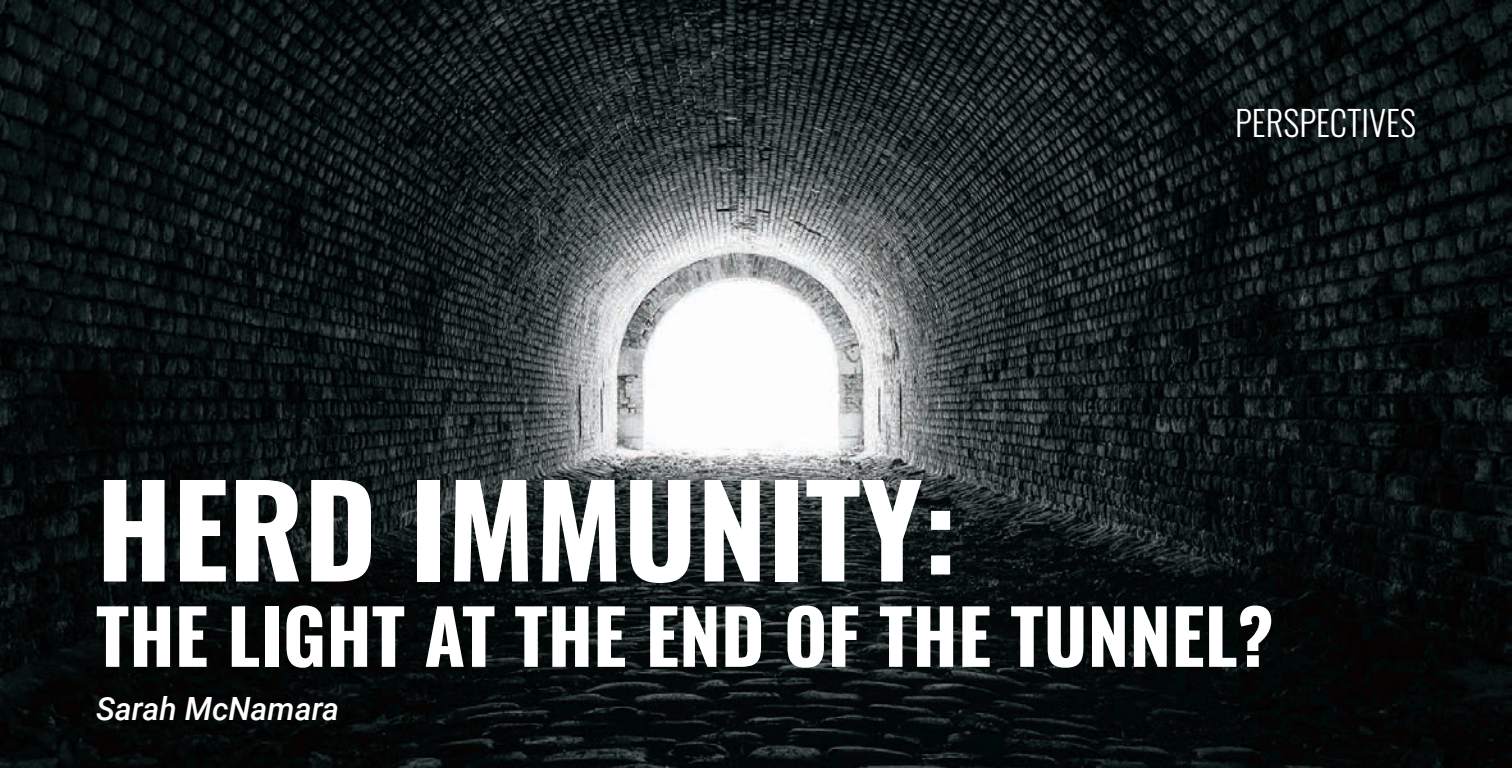
on to the next generation, leaving mutations that confer benefits such as more efficient transmission between human hosts, faster creation of future viral particles, or longer viral lifespan. Think of these mutations as a typo in a paper — usually the sentence will still be legible, but sometimes a particular typo can change its meaning. If the typos accumulate, the meaning of the entire paper can change. Once enough mutations accumulate, the virus is so different from the initial COVID-19 that it is considered a new variant of SARS-CoV-2.

In order for SARS-CoV-2 to inject its DNA into the host cell, its spike proteins must be cut twice by host proteins, modifications that make it easier for the spike protein to fuse to the host membrane. SARS-CoV-1, which caused the SARS epidemic from 2002 to 2004, must be attached to a host cell before receiving both cuts. In contrast, SARS-CoV-2 has a specific site that can receive the first incision just after it is synthesized, before the new viral particle is even released from the host cell. Essentially, this viral particle is "primed" to readily infect a host cell as it only needs one more incision (Whittaker, 2021).

Many of the mutations that cause certain variants to be labeled "variants of concern" occur in the viral spike proteins or this cleavage site. The Delta variant has a mutation that allows its spike protein to be cut much more efficiently, enabling higher rates of transmission from cell to cell, and thus person to person.

Omicron, less severe but much more infectious than Delta, seems to not be able to infect lung cells as well as it infects cells in the upper respiratory tract. Omicron has 30 mutations in the gene that encodes the viral spike protein. Some of these mutations help the virus bind more tightly to the host cell, while others change the spike protein's tip and prevent human antibodies from detecting the virus (Martin et al., 2022). Together, these many mutations dramatically change the way Omicron viruses infect host cells — instead of binding to the host cell membrane like previous variants, the entire Omicron virus enters the cell and then breaks open to release its DNA, which is a faster and more efficient process (Zimmer, 2022). Studying these mutations can help explain why Omicron is so much more transmissible, but less severe than previous variants.

Deltacron, a combination of Omicron and Delta discovered this February, has been confirmed as a newly circulating variant of SARS-CoV-2. Researchers have determined that the genes encoding Omicron's spike have combined with Delta's genome, creating a recombinant variant. It is suspected that during a simultaneous infection with Delta and Omicron, particles of both variants may have entered the same host cell at the same time. While creating new viral particles, the host cell may combine some of the genetic material, causing a genetic swapping event where characteristics of both variants are combined. The impacts of Deltacron are still unknown, but it is likely that its symptom severity will resemble Omicron because they have the same spike protein mutations (Zimmer, 2022).



HERD IMMUNITY:
THE LIGHT AT THE END OF THE TUNNEL?

Sarah McNamara

After over 79.9 million cases and 975,500 deaths in the U.S. alone, not to mention a loss of normalcy, the COVID-19 pandemic has sent people into a desperate search for a light at the end of the tunnel. The prospect of herd immunity presents itself as such; however, misconceptions and misplaced priorities make evident how this idea can be wielded as a double-edged sword.

Herd immunity is significant because it greatly reduces or eliminates the threat of a contagious disease, and individuals who are not immune are still indirectly protected. This indirect protection is derived from a substantial enough portion of the population being immune, either through natural infection or vaccination; how "substantial" this population portion must be depends upon the disease's degree of infectiousness, and is referred to as a "herd immunity threshold" (Barker et al., 2021). When this threshold is reached, the chances of the disease spreading as widely among immune individuals is significantly lowered, so overall viral circulation decreases. Analyses of initial COVID-19 genetic material estimated a herd immunity threshold around 70 percent; emergence of the more-contagious Delta variant brought this approximation to 90.

In terms of progress towards herd immunity, current U.S. vaccination and booster statistics speak for themselves: as of March 28, 2022, 66% of the population is fully vaccinated, and of these individuals, 45% have received boosters. While these statistics are not near the increasingly blurred herd immunity threshold, they are not discouraging. Current COVID-19 vaccines are certainly effective. No vaccine can confer 100% protection so long as there is still community transmission, but COVID-19 vaccines prevent risk of illness, illness severity, and death, and populations with greater vaccination rates ultimately have lower transmission risks. Vaccination is critical to arriving at a safe "new normal."

Moreover, safe progress is achieved through vaccination and nonpharmaceutical interventions, including social distancing, masking, and regular testing when appropriate.

The normalization of careless, preventable transmission events as desirable contributions to herd immunity, however, is harmful.

Blatant disregard for safety protocols is defended by one dangerously problematic question: If COVID is so contagious and common, isn't it inevitable at this point? COVID inevitability discourse de-emphasizes preventative measures in favor of dropping all restrictions. No restrictions means more widespread COVID transmission and therefore faster-accumulating natural immunity; but it also means overloaded hospital systems, and their consequent inability to treat even the patients with non-COVID related stays; more potential cases of long-COVID; and a sacrificing of innumerable lives.

It is particularly important to consider those who are not yet/not as protected by vaccines: children too young for the vaccine, people with comorbidities and weakened immune systems, and groups made more susceptible due to the effects of redlining's legacy and strategic disinvestment. Residential segregation and systemic neglect have exposed primarily BIPOC and low-income residents in formerly redlined areas to, for example, disproportionately more hazardous waste and pollution, causing and worsening asthma and COVID severity; cramped and unsuitable living arrangements that hinder abilities to social distance; and essential service jobs that have no remote alternatives and put workers at greater risk of contracting COVID. Readily exposed in the COVID age are "survival of the fittest" mentalities that treat higher-risk populations as disposable and excluded from scopes of consideration.

Haverford student receiving a vaccine in Spring 2021.

PHOTO BY ABIGAIL ISAKOV '24

Furthermore, misinformation also stunts safe progress towards herd immunity. Children's Health Defense, an anti-vaccination advocacy group, has at times received more engagement than even the CDC and the National Institutes of Health (Brill & Crovitz, 2021). Ensuring that vaccine-eligible people get the vaccine is especially crucial considering not everyone is able to get vaccinated and herd immunity thresholds consider entire communities, not just the vaccine-eligible community.

When misinformation spreaders target populations already more vulnerable to COVID — namely Black folks, other POC, and below-poverty-line individuals — they inspire greater distress while further exacerbating existing health disparities created by systemic inequity. Some surface-level inequities and misguided policies are easily identifiable, including disproportionate vaccine and testing accessibility, inadequate time off post-infection, and a lack of paid sick leave.

It will become increasingly difficult to define a clear herd immunity threshold as more strain mutations arise and as natural and vaccine-conferred immunity wanes over time. The bottom line, though, is simple: vaccination and safe practices, not "survival of the fittest" discourses and risky behaviors, are the key to managing COVID-19 and reaching the light at the end of the tunnel.

THE MENTAL HEALTH PANDEMIC

Lillian Belzer

Content Warning: This article contains mention of mental health issues and disorders, including self-harm and suicide.

As COVID cases have grown substantially across the United States in the past two years, hospitalizations of another kind also increased — those for mental health-related issues. As researchers investigate the long-term effects of COVID on the body, data about its long-term effects on mental illness is also surfacing: its toll has been massive, especially for young adults.

The rates of patients hospitalized in the United States who exhibited signs of "self-harm and suicidal ideation" increased from 11.8% in 2019 to 23.2% in 2020, with a greater number of female admissions, according to a survey by the US National Institutes of Health.

"It seems to be the phenomenon nationally and internationally that the rates of depression and anxiety among college students have increased during the pandemic," says Dr. Elizabeth Booma, Chief of Child and Adolescent Psychiatry at Newton-Wellesley Hospital. Hospitalizations for eating disorders in young adults is also on the rise, she adds. The huge spike in adolescent mental health-related hospitalizations may be partially due to fear of illness or loss, social isolation, and/or social anxiety.

Bonnie Henneman, a junior at Bryn Mawr College, comments, "The vibe on campus has become more stressful and intense in the last two years. I think stress is higher now because we all had nothing to think about but COVID restrictions and school work for two years, and it's hard to break that pattern in a healthy way." Since the pandemic has been such a large part of our young adult lives, it will be critical to observe how the rates of mental illness change as COVID restrictions loosen across the country.
There is evidence that the pandemic has exacerbated symptoms in those with existing psychiatric disorders, according to the NIH report. "As someone with social anxiety, being isolated for so long made it really hard to meet and feel connected to my peers when college started," says a sophomore at Haverford College, reflecting on her experience coming from high school. Dr Booma adds that "people who already suffer from mental health challenges, especially vulnurable groups such as sexual or racial minorities, may see long-term consequences and need long-term help."

"People sometimes assume that having classes in person will fix everything"

When addressing mental health in the classroom, it is crucial to understand that everybody is at a different stage in the process. In February, the Bi-Co Students for a Democratic Society created a Change.org petition to call, in part, for widespread safe and accessible hybrid options for courses. The petition advocates for immunocompromised students as well as those who feel uncomfortable attending classes in person for any reason. "People sometimes assume that having classes in person will fix everything," notes a student at Haverford, "but they don't realize that going to class takes so much more energy now than it used to."

If you or a friend has been struggling with mental health, like many other students around the globe, there is help available. Bryn Mawr and Haverford provide many resources, such as free counseling and telehealth options, so don't be afraid to seek professional help. As the world tries to readjust to the new normal, take small steps toward what you feel comfortable with. This might include getting dinner with friends, connecting with people whom you trust and care about, and checking in with those around you. "People are resilient," says Dr. Booma, "We are going to get through this. In some ways we are going to be even stronger."

HAVERFORD'S STEM DEPARTMENTS AFTER THE STRIKE

In the Fall of 2020, students returned to campus following the death of George Floyd and a summer filled with protests against the racist state of the nation. That summer, Black Students Refusing Further Inaction released an Open Letter to the Bi-College Community, outlining the issues facing both campuses.

At the start of fall semester, President Wendy Raymond sent out a controversial email, sparking a student protest on the night of October 29th. Bi-Co students marched across Haverford's campus and through the streets of Ardmore. Upon returning to campus, everyone was notified that a student strike had begun: students would not return to class until the demands listed in the Open Letter had been met. Student unity forced faculty to stop classes and postpone assignment deadlines.

The Open Letter specifically condemned the lack of diverse faculty and student retention in STEM departments and called on them to make a change. Here, we investigate how student groups have responded to and changed after the strike.

STEM DEPARTMENTS AFTER THE STRIKE: STUDENTS CONTINUE TO LEAD DEI EFFORTS

Anagha Aneesh

STUDENTS ARE THE LIFEBLOOD that bring integrity, curiosity, and humanity to every classroom and club at Haverford College. They are also the ones who call for and enact change to make the Haverford community a space of belonging, not of exclusion. As loud and as often as they would make that call, it took a measure as drastic as the fourteen-day student strike in the Fall of 2020 for STEM faculty to hear and respond. The Open Letter to the Bi-College Community from Black Students Refusing Further Inaction (BSRFI) specifically shed light on the lack of student retention within STEM departments.

"Students from historically underrepresented backgrounds disproportionately left STEM courses at a rate of 59% compared to other students at 28%."
– Open Letter from BSRFI

The letter called out departments by name, which forced faculty to prioritize the issue. Faculty response, however, has relied heavily on guidance from students. Before and after the strike, student groups have worked to resolve a plethora of departmental issues. Some of these groups include the Chemistry Student Group (CSG); the Biology Student Group (BSG); and HaverCode. "We are the voice of the student body. It is hard for students from underrepresented groups to be that voice themselves," says Megan Heflinger '23 a leader of the BSG.

THE CHEMISTRY STUDENT GROUP

The Chemistry Student Group, which formed before the strike, is exclusively composed of BIPOC[1] and/or FGLI[2] students who work to increase accountability in the chemistry department. Prompted by an email from the CSG, Chemistry was the

CSG members gather for a selfie.

first department to send a response to the Open Letter. The CSG is composed of smaller groups that focus on issues such as General Chemistry Course Content/Structure, Organic Chemistry Lab Credit, Racism, and Faculty Hiring. These "Issue Groups," as the CSG calls them, can adapt and expand based on relevancy.

General Chemistry (CHEM 111/112) has been a longstanding point of contention for the CSG. They are working to restructure the course to increase accessibility. Elizabeth Mari '23, a member of CSG, says that the course weeds out underrepresented students who don't have previous chemistry knowledge or access. The department prides itself on teaching material, like organic chemistry, that is not taught in intro courses at other institutions. However, some chemistry professors consider these materials to be nonessential additions to the course that prevent students from performing well.

General Chemistry is not the only course the CSG is trying to change. Based on feedback from students in CHEM 222 (Organic Biological Chemistry), the Organic Chemistry Lab Credit Issue Group is advocating for the course to be worth 0.5 instead of 0 credits. Although the CSG is still working toward this goal, they have succeeded in

1 Black, Indegenous, People of Color
2 First Generation, Low Income

reducing the SuperLab requirement from two semesters to one. SuperLab is a one-credit 300-level laboratory course that prepares chemistry majors for their future thesis work and exposes them to academic research. "This is a big win," says Trisha Phan '24, "especially for students who want to study abroad."

Throughout the 2020-21 academic year, the Racism Issue Group developed a socially relevant course that they hope will become a requirement for the major. This half-credit course, titled Seminar in the Social Relevance of Chemistry (CHEM 310), was taught by Professor Helen White in Fall 2021.

The Faculty Hiring Issue Group made significant progress this past fall in the hiring process of two organic chemistry professors. Previously, faculty would hand-pick student reps, however, this time the Hiring Issue Group developed an anonymous selection process. CSG members attended presentation talks of all prospective faculty, wrote a recommendation letter about the hiring process overall, and seemed to play a major role in who was eventually hired. Despite these efforts, the CSG felt their involvement was insufficient. "There was a lot of information that was confidential. Even information that should have been accessible never made it to us," says Phan '24. The CSG has been working to resolve this lack of transparency since long before the strike.

The CSG fully attributes its success to the demographics of its members. Phan '24 says, "Everything we do and say is from lived experiences."

THE BIOLOGY STUDENT GROUP

The Biology Student Group started to form during Summer 2020 but only gained visibility during the strike. The group consists of anyone who has taken a class in the biology department. The size of the department, says the BSG, is a core issue that limits communication between not only faculty and students, but also amongst students. There are almost 100 students enrolled in BIO 200/201, making it one of the largest classes at Haverford. In contrast to much smaller humanities/social science classes, many students are left feeling isolated and unsupported in BIO 200/201. In an effort to combat this issue, the BSG holds events like "Biology Sticker and Button Making Workshop" in conjunction with the VCAM Maker Arts Space that work to unite biology students and foster community.

"Resources can get lost in translation because of the sheer size of the major." – Ruanna Small '21

Historically, biology majors take the intro course (BIO200 and BIO 201) as sophomores. For many underrepresented students, this challenging course is their first exposure to the field of biology. This unusual start to the major gives students who took AP Biology in high school and have previous experience in biology an advantage. During the strike, the biology department canceled all their classes and instead offered DEIA[3]-centered seminars. One seminar focused on working with junior and senior biology majors to create a curriculum

PHOTOS BY KENT WATSON

The Biology Student Group organized a sticker and button making workshop at the VCAM.

3 Diversity, Equity, Inclusion, and Accessibility

for a 100-level biology course. The course, which was implemented in Fall of 2021, has an interdisciplinary focus on "biology beyond the textbook," explains Small '21.

Biology students interact with the chemistry department through the biochemistry concentration, the chemistry minor, and interdepartmental events. It is natural then that in its development, the BSG drew inspiration from the well-established CSG.The BSG is now attempting to model the student representative selection process created by CSG.

Although the BSG and the biology department do not have DEIA-specific goals, there are continuing conversations between faculty and students about necessary action and how to work in conjunction with the BSG to reshape the biology department.

HAVERCODE

HaverCode is a student-run organization that serves as a supportive and collaborative space for students to work on coding projects and attend resume and technical interview workshops. Recently, the group initiated Project Reboot, which aims to identify problems within the computer science department and propose effective solutions.

"We want to shift the conversation away from the lack of funding. We can't keep using that as an excuse."
– Computer Science Student

At the end of January 2022, HaverCode sent a feedback form to students and used the responses to create a comprehensive list of departmental issues, which is summarized in a 12-page document. For a department in such disarray, identification of the issues themselves is a wanting task. HaverCode has identified and categorized the problems into funding, curriculum, and logistical based levels.

The general lack of funding and high demand for the major has led to a faculty shortage within the department. The Project Reboot document outlines that the revolving door of visiting professors who teach introductory CS courses leads to inconsistencies in the content taught. Recognizing that this issue extends beyond the scope of HaverCode, they state, "We make attempts throughout Project Reboot to offer problems and solutions that don't directly stem from this shortage of professors."

Unlike other STEM departments, which struggle with large class sizes at the introductory level, strict enrollment limits in CMSC H105 prevent students from even taking the course. HaverCode proposes that the department expand their class sizes to increase the accessibility of the CS major.

Even when a student is finally able to take a class, they lack support aside from direct interactions with the professor. The teaching assistants (TAs) do not receive any training and are expected to grade assignments and lead TA sessions without clear expectations or examples. Havercode recommends that clear guidelines and rubrics are provided to TAs prior to the start of a course.

The Project Reboot document enumerates several changes to increase access and build community, such as updating the CS department website/individual faculty sites, creating a "lounge" similar to those of other STEM departments, hosting social events for students to interact with their professors informally, and advertising on/off campus summer research experiences.

The group acknowledges that the problems they have identified are complex and will require significant effort to resolve; however, addressing them is a necessary first step to improve the department.

"Only as a community of individuals working together will we be able to improve our department."
– Project Reboot

THESE STUDENT GROUPS are the driving force behind many of the DEIA initiatives in STEM departments. "It is important to recognize," Mari says, "that fulfilling anti-racism commitments fall on faculty, not on students." The way each student group enacts change may be unique, but they all share a common goal of creating the best learning environment for each student to thrive.

MARKING THE PASSAGE OF TIME:
MAY 2022 STARGAZING GUIDE

Karen Masters, Professor of Physics and Astronomy, KINSC Director

While it may feel like we're stuck in a repeating loop of Spring 2020, watching the night skies can remind us that the seasons do actually keep passing by. Indeed many cultures throughout history have used the night skies to mark the passing of time. In my home country of England, ancient peoples built Stonehenge, probably to track the motion of the Sun (the brightest star in the sky!) and mark the year. In New Zealand, the Maori used the first sighting of Matariki (also known as the Pleiades) to set the start of the new year. The hottest part of late summer in the Northern hemisphere is termed the "dog days of summer" because the Sun is in the same part of the sky as the "dog star," Sirius.

For me, the most obvious change in the night skies has always been the annual appearance and disappearance of Orion. In the early part of the spring semester, this iconic constellation has had center stage in the sky, rising in the Southeast at dusk and traveling across the southern skies to the west as the Earth turns in its daily motion. By the end of the semester, it will disappear into the sunset and be invisible for another year.

Orion is one of my favourite constellations, partly because it is one of the easiest to pick out in the sky, but also because includes two of the brightest stars in the skies: Betelgeuse, the redder star at the upper-left of the constellation, and Rigel, the blue supergiant at lower-right. Students in my classes know I like to use this pair (along with the binary stars Alberio, which you can only see through a telescope) as an example of how they can see for themselves that stars have different colours, set by their surface temperature. While our eyes are not good at seeing color at low light levels, sometimes we can pick out a faint hue, like in the reddish colour of Betelgeuse, which in contrast to the bluish white-hot supergiant Rigel is a relatively cool red supergiant star.

Every human on Earth looks up at the same skies, although their perspective depends a little bit on exactly when and where they are. I remember visiting the Southern Hemisphere once and being pleasantly surprised to see Orion inverted relative to how I had been used to seeing it. It makes complete sense once you think about it, since we don't live on a flat Earth, our perspective relative to the skies changes significantly when we move in latitude (towards or away from the Equator).

Orion through the 12" telecope at Strawbridge Observatory.

PHOTO BY JAMES GARLAND '22

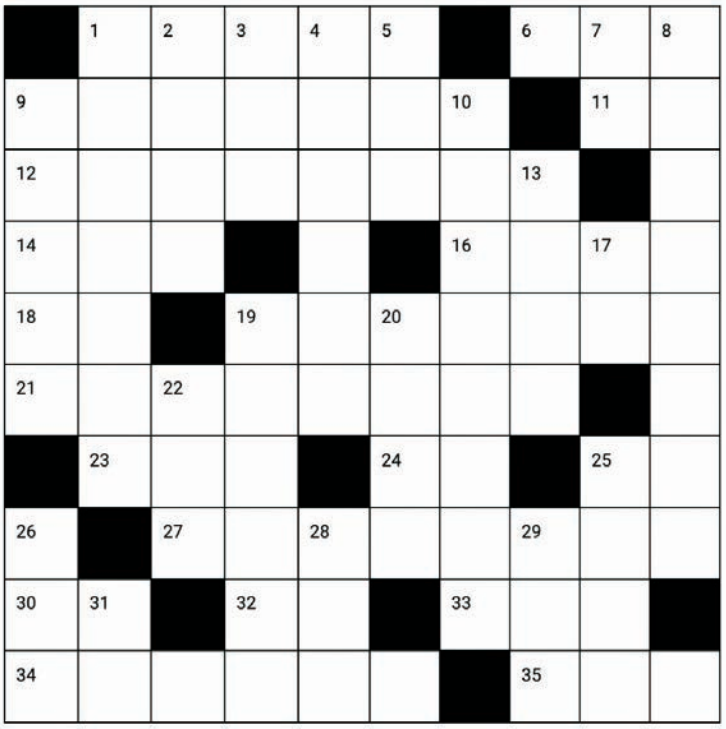
Of course, the constellations we name in astronomy are entirely human inventions, a giant dot-to-dot puzzle in the skies. We now know that the bright stars that ancient Greek astronomers joined together into the constellation Orion, vary from 245 to over 1300 light years away from us, not physically connected at all, apart from all being in the same Galaxy as the Sun! To explore how various different cultures have drawn different patterns in the night skies you might like to visit Figures in the Sky, which is also a beautiful example of artistic data visualization. And if you prefer just to look up at the skies, if you don't know the "names" of any constellations, you can enjoy stargazing and inventing your own patterns.

Happy Stargazing, and keep looking up.

MAY 2022 STARGAZING CALENDAR

- Launch of an expansion of the Chinese Space Station, Tiangong expected in May
- 5/6th Eta Aquarid Meteors - this shower, which comes from debris from Halley's comet, has a possibility of being quite impressive this year, possibly not just on the peak night, but for a few days either side.
- 16th: Full Moon (the "Flower" Moon), and Lunar Eclipse
- 30th: New Moon

CROSSWORD



Across

1. Curie with two Nobels
6. State of 7-down and 24-across
9. First Black woman astronaut Mae
11. College hall monitor
12. Nemo's home (pl.)
14. Mother's mother, nickname
16. Unlucky number in Roman numerals
18. Marvel foe
19. Lise nicknamed the German 1-across
21. Garb of lightsaber wielders
23. Call for help
24. Northeast
25. Who, what, when, where, and why
27. King, queen, bishop, knight, rook, and pawn
30. Tin
32. Audio-video
33. Bath destination
34. A-0 creator Grace, or Stranger sheriff
35. King James org.

Down

1. ___ to society (pl.)
2. Prayer conclusion
3. Lip to sip from
4. Follows constitutional and stereo
5. Geological time unit
7. Common rifle banned in some places
8. Poker of fun
9. Vaccine manufacturer
10. Second choice
13. Periodic wave
17. "In other words"
19. Something gone wrong
20. Charged particles
22. Dopey's friend
25. Recently launched space telescope
26. Debris left behind by Tonga eruption
28. 12/31, for one
29. UV source
31. Dissent

WORD SEARCH

Words are in all directions (up/down, left/right, diagonal). Words can also share letters. The unused letters form a hidden message when read left to right.

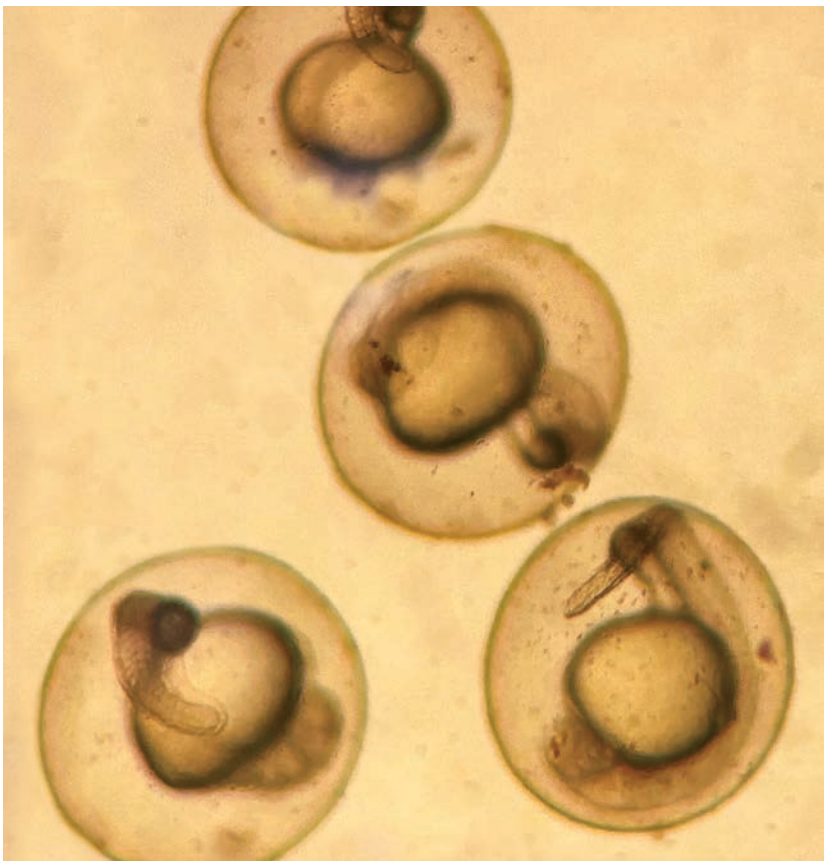
U M M I E D X A M F B S
L A U U X E F X U Z R F
L I D A T I B L B A P J
L T F O K A L Y T W D Y
I A Z O P M T S E R O F
F K N M O A F I M N D Y
D E M O G O R G O N O P
N F N V X U K A C N N H
A W D E E W A E S E O G
L N P O L Y N O M I A L
S T U J N L K F U E T A
L K V Q R F H K B M O E

COMET
DEMOGORGON
ENOKI
FOREST
FULLMOON
HONEYBEE
LANDFILL
MAITAKE
MUTATION
PARASITE
POLYNOMIAL
SEAWEED

View puzzle answers online at jolt.sites.haverford.edu/puzzles/

COVER CONTEST: HONORABLE MENTIONS

Genetic Diversity
– Fatema Mun '25



A fertilized 1-day-old TLF zebrafish embryo. Decision making has been extensively studied in the model organism Danio rerio, or zebrafish. This microscopic image was created in Superlab in a study that involves using CRISPR and drug treatments in zebrafish to clarify how serotonin modulates behavioral selection.
– Catherine Kim '21

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