ISSUE #6 FEB 2022

GXRLS IN STEM

Cover art:
Ella Majd '22
(SFS)

IN MEMORY OF SANJULA PINGALI, A BELOVED CONTRIBUTOR TO GXRLS IN STEM (MARCH 15, 2004 - JANUARY 22, 2022)

Just as sustainability is about treasuring what we have, senior year is about moving on.

As we've explored AI, breakthroughs in medicine, space, mental health, and robotics with you, we've developed faith in the power of our community. We've seen gxrls who kept their hands safely tucked under their legs in predominantly male STEM classes debating the merits of ecotourism, male-designed period-tracking apps, and initiatives for empowering womxn in STEM in our conversation spaces. We've seen gxrls see possibilities open up in front of them as they engage in casual conversation with math professors and marine biologists. We've seen our magazine grow from two schools to an international award-winning publication. We've created crosswords, drawings, articles, and memes.

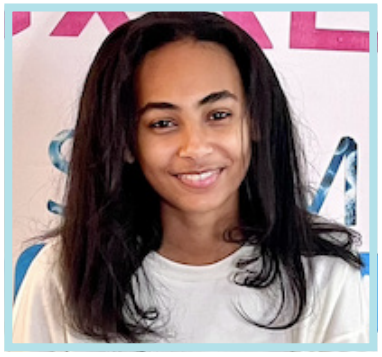
We wanted to dedicate this issue to you - the readers, writers, editors, and illustrators that have stayed with us through this incredible and tumultuous journey. Thank you for having faith in our initiative, thank you for strengthening the community with the connections that you built, and thank you for working with us. Thank you for helping us illuminate underrepresented narratives - female and non-binary doctors, roboticists, psychologists, and biologists - in our journey to solve the gender disparity in STEM. Thank you for the emails, comments, suggestions and presentation opportunities.

As much as we want to hold on to our community, our magazine, our layout design, our illustrators, our editors, our writers, and our crosswords, we have to let go. We get to let go. Because part of building a community is making sure that it can continue without us.

And with you at the helm, we have no doubt that it will.

Signing off,
Avani and Layla

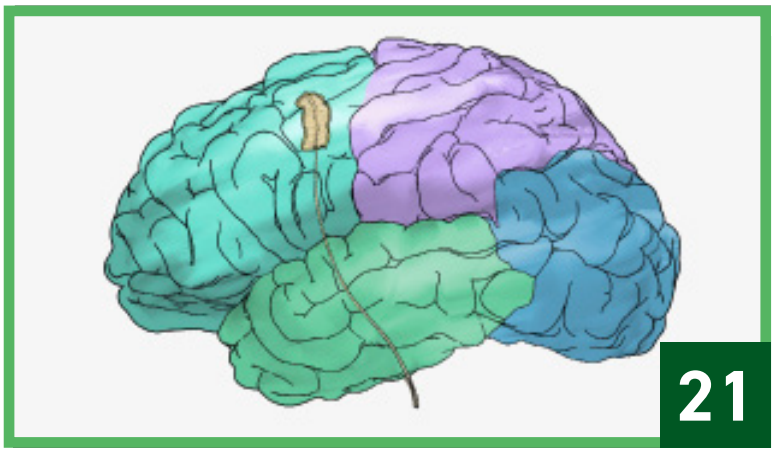
SPOTLIGHT: SUSTAINABILITY

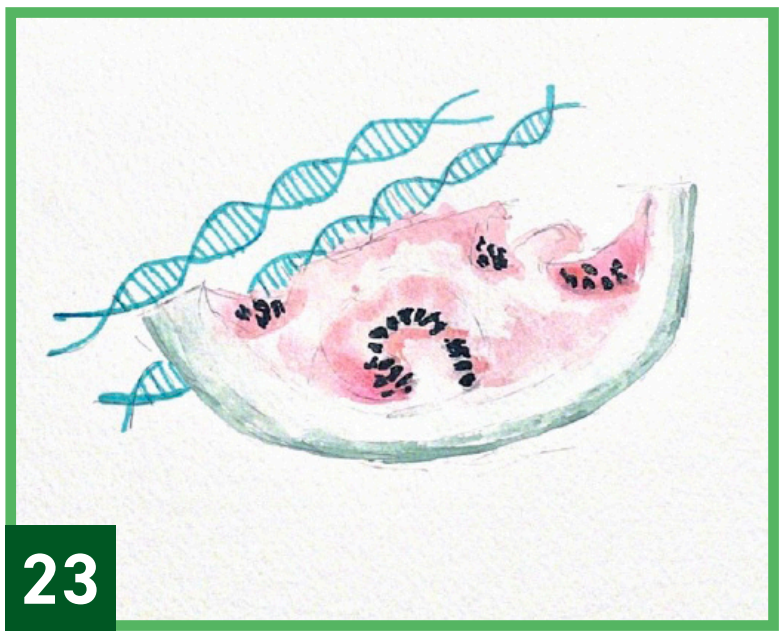


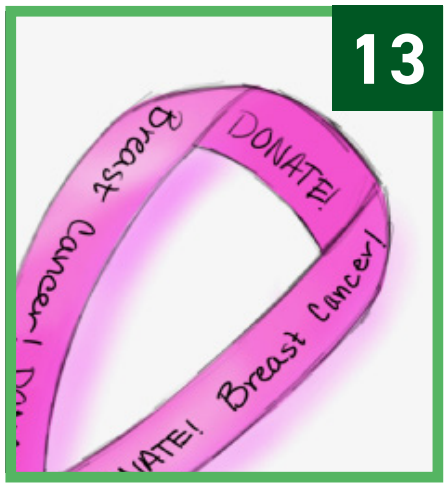
EDITOR-IN-CHIEF/CO-FOUNDER/GRAPHIC DESIGNER

AVANI AHUJA '22 (GDS) **LAYLA DAWIT '22 (SFS)**

GXRLS IN STEM WAS CREATED TO BRING TOGETHER GXRLS ACROSS THE WORLD AND INSPIRE US TO PURSUE OUR INTERESTS IN STEM.







Eunice Foote and the Foundation of Climate Science

Hana Sakr '24 (GDS)

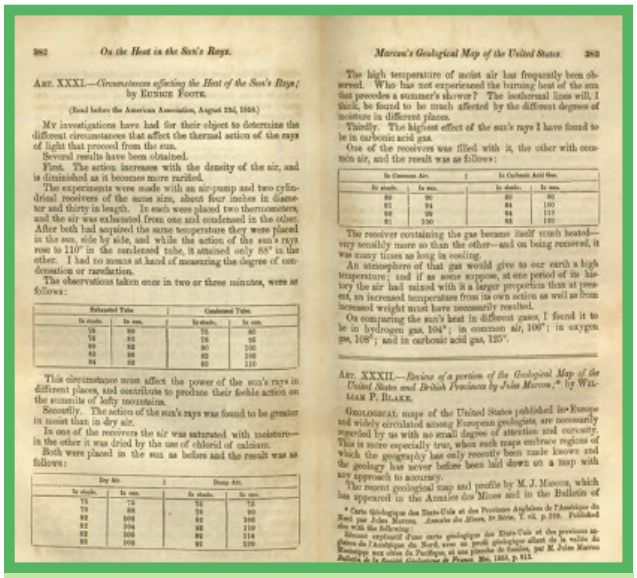
IMAGE CREDIT: HANA SAKR ' 24 (GDS)

On July 17, 1819, around 200 years ago, the American scientist who discovered the foundations of climate science was born. Her name was Eunice Newton Foote, and in 1856 she conducted an experiment that changed the path of her field forever.

Foote was a "natural philosopher" who was extremely curious about gases and how they affected the world.

According to an article by Climate.gov, "In Foote's time, geologists were discovering the world's climate and vegetation had once been radically different. In the periods when coal deposits were forming in swampy seas, geologists concluded that the atmosphere had once had much higher levels of carbon dioxide. Foote correctly speculated that this would have made Earth much warmer."

Foote tested this phenomenon using glass cylinders, each encasing a mercury thermometer. One cylinder had carbon dioxide molecules trapped inside, the other had "normal" air. After leaving them both in the sun and measuring the temperature of the gases, Foote found that the heating effect was greater in moist air than dry air, and the tube which contained carbon dioxide stayed hot for longer because it could trap the heat more effectively. The conclusion of her experiment was this: "An atmosphere of that gas would give to our earth a high temperature; and if as some suppose, at one period of its history the air had mixed with it a larger proportion than at present, an increased temperature...must have necessarily resulted."



382 *On the Heat in the Sun's Rays.*

ART. XXXI.—*Circumstances affecting the Heat of the Sun's Rays;* by EUNICE FOOTE.

(Read before the American Association, August 23d, 1856.)

My investigations have had for their object to determine the different circumstances that affect the thermal action of the rays of light that proceed from the sun.

Several results have been obtained.

First. The action increases with the density of the air, and is diminished as it becomes more rarified.

The experiments were made with an air-pump and two cylindrical receivers of the same size, about four inches in diameter and thirty in length. In each were placed two thermometers, and the air was exhausted from one and condensed in the other. After both had acquired the same temperature they were placed in the sun, side by side, and while the action of the sun's rays rose to 110° in the condensed tube, it attained only 88° in the other. I had no means at hand of measuring the degree of condensation or rarefaction.

The observations taken once in two or three minutes, were as follows:

Exhausted Tube.		Condensed Tube.	
In shade.	In sun.	In shade.	In sun.
76	86	76	86
76	87	76	96
80	92	80	106
83	96	82	106
84	92	85	110

This circumstance must affect the power of the sun's rays in different places, and contribute to produce their feeble action on the summits of lofty mountains.

Secondly. The action of the sun's rays was found to be greater in moist than in dry air.

In one of the receivers the air was saturated with moisture—in the other it was dried by the use of chlorid of calcium.

Both were placed in the sun as before and the result was as follows:

Dry Air.		Damp Air.	
In shade.	In sun.	In shade.	In sun.
75	75	75	75
75	86	75	90
82	103	82	106
82	104	82	110
82	103	82	114
83	103	82	120

Marcou's Geological Map of the United States. 383

The high temperature of moist air has frequently been observed. Who has not experienced the burning heat of the sun that precedes a summer's shower? The isothermal lines will, I think, be found to be much affected by the different degrees of moisture in different places.

Thirdly. The highest effect of the sun's rays I have found to be in carbonic acid gas.

One of the receivers was filled with it, the other with common air, and the result was as follows:

In Common Air.		In Carbonic Acid Gas.	
In shade.	In sun.	In shade.	In sun.
80	90	80	90
81	94	84	102
86	99	84	111
91	100	86	120

The receiver containing the gas became itself much heated—very sensibly more so than the other—and on being removed, it was many times as long in cooling.

An atmosphere of that gas would give to our earth a high temperature; and if as some suppose, at one period of its history the air had mixed with it a larger proportion than at present, an increased temperature from its own action as well as from increased weight must have necessarily resulted.

On comparing the sun's heat in different cases, I found it to be in hydrogen gas, 104°; in common air, 106°; in oxygen gas, 108°; and in carbonic acid gas, 125°.

ART. XXXII.—*Review of a portion of the Geological Map of the United States and British Provinces by John Marcou,* by WILLIAM P. BLAKE.

GEOLOGICAL maps of the United States published in Europe and widely circulated among European geologists, are necessarily regarded by us with no small degree of attention and curiosity. This is more especially true, when such maps embrace regions of which the geography has only recently been made known and the geology has never before been laid down on a map with any approach to accuracy.

The recent geological map and profile by M. J. Marcou, which has appeared in the Annales des Mines and in the Bulletin of

* Carte géologique des États-Unis et des Provinces Anglaises de l'Amérique du Nord par John Marcou. *Annales des Mines*, 5e Série, T. viii. p. 398. Published also with the following:

Résumé explicatif d'une carte géologique des États-Unis et des provinces anglaises de l'Amérique du Nord, avec un profil géologique allant de la vallée du Connecticut aux côtes du Pacifique, et une planche de fossiles, par M. John Marcou. Bulletin de la Société Géologique de France. Mai, 1856, p. 612.

IMAGE CREDIT: HANA SAKR ' 24 (GDS)

On August 23, 1856, Joseph Henry of the Smithsonian Institution presented her (Eunice's) paper "Circumstances Affecting The Heat of Sun's Rays" at the 10th annual meeting of the American Association for Advancement of Science (the AAAS), most likely because if she had done so, nobody would have taken her results seriously. Henry prefaced her discoveries by stating that science is of no country and no sex, and that the sphere of woman embraces not only the beautiful and the useful, but the true. Still, her paper and the reading of it were not included in the conference proceedings.

However, Eunice was not discouraged. The September 1856 edition of Scientific American included her in their issue titled "Scientific Ladies—Experiments with Condensed Gases".The author wrote, "The columns of the Scientific American have been oftentimes graced with articles on scientific subjects, by ladies, which would do honor to men of the highest scientific reputation; and the experiments of Mrs. Foot afford abundant evidence of the ability of woman to investigate any subject with originality and precision."

Foote then published her work in the 1857 edition of the American Journal of Science. Unfortunately, this was when the credit for her work went to an Irish physicist, John Tyndall, who made the same discovery three years later by experimenting with water vapor. Whether Tyndall knew about Foote's discovery was unclear, although he had another paper published in the same journal as hers, and he was very opposed to women's suffrage. In a letter, he wrote that women have "more feeling and less intellect than men. According to the Audubon organization, "Tyndall's historical prominence where Foote's should be, plays into the Matilda Effect, or the trend of men getting credit for scientists' achievements. This is a common narrative across scientific history. One of the most famous examples is the case of Rosalind Franklin, whose work was essential to the discovery of the shape of DNA, though only James Watson and Francis Crick gained recognition."

And because Tyndall had more access to resources and scientific equipment, he could advance the research further than Foote could. For example, "Her experimental design wasn't sophisticated enough to reveal how these atmospheric characteristics could influence solar heating. Her experiments didn't show that water vapor and greenhouse gases raise Earth's temperature not by absorbing incoming sunlight, but by absorbing heat radiated by the surface." Because of this, people have overlooked Eunice Foote's experiments with atmospheric gases and her insights about climate change for over a century.

In fact, Eunice's work might not have been found if not for Raymond Sorenson, a retired geologist and amateur historian who spends his free time looking through old scientific books and documents. By chance, he read about an oral presentation she gave in The Annual of Scientific Discovery.

"Once John Tyndall got name recognition and got credited for being the originator, people just didn't go back to look," Sorenson said. "He was a recognized scientist and people accepted his claim."

But now that the story is being brought to light, Liz Foote, a marine biologist (who is also Eunice's descendant), is hoping to find more information and perhaps even a picture of her ancestor, potentially from the Women's Rights Convention. Eunice Foote was a Women's Rights Campaigner and close friends with American suffragist Elizabeth Cady Stanton. Her name was on the list of around 100 signatories on the 1848 Seneca Falls Declaration, a manifesto created during the first women's rights conventions in the United States. The Declaration states "to unify women's efforts to create equity in health, education, economy, politics, peace and security, and beyond with the climate justice movement." as its manifesto.


Our Roll of Honor
Containing all the
Signatures to the "Declaration of Sentiments"
Set Forth by the First
Woman's Rights Convention,
held at
Seneca Falls, New York
July 19-20, 1848
LADIES:
Lucretia Mott, Harriet Cady Eaton, Margaret Pryor, Elizabeth Cady Stanton, Eunice Newton Foote, Sophronia Taylor, Cynthia Davis, Hannah Plant, Lucy Jones, Sarah Whitney, Rachel D. Bonnel, Betsey Tewksbury, Rhoda Palmer, Margaret Jenkins, Cynthia Fuller

IMAGE CREDIT: HANA SAKR ' 24

In return, other women scientists are pushing to make sure that her legacy lives on. Annarita Mariotti of NOAA's Climate Program Office mentioned in the journal Nature, "I found Foote's story inspiring and very relevant in today's world." Adding on to that, as Dr. Katherine Wilkinson put it in her article of TIME magazine's commemoration of Eunice Foote's 200th Birthday, "Some 163 years after Foote's experiment, conditions for women in climate have certainly improved... But if we want that 'urgent upsurge', it will take commitment, dollars, and platforms. It will demand giving credit where it's due and continuing to improve inclusion. Now is the time to champion women and girls who lead on climate. And to honor those who came before, whose insight and ability ought not to have been ignored.

Cheers to you, Eunice.

A Look Into DOLPHYN: A Model to Sustain our Energy Systems

Dia Bonsu'24 (ESHS)

Without hydrogen, we would have never existed. It's the first element listed on the table, and can make balloons float in air. Now, it may be just the pathway needed to help a sustainable energy system come to life.

Introduction

Research into hydrogen as a possible method to combat the world's carbon emission problem is increasing, helping the effort to decarbonize our atmosphere. According to the journal article "Shared vision for a decarbonized future energy system in the United States" by Deidra Miniard, Joseph Kantenbacher, and Shahzeen Z. Attari, "The United States is responsible for ~15% of global carbon dioxide emissions, and 93% of carbon dioxide emissions in 2017 in the United States were attributed to fossil fuel combustion for energy generation" (para. 3). Decarbonization is intended to decrease the number of fossil fuel energy sources in our energy system, increasing the amount of variable renewable energy (VRE) in our environment. Hydrogen, which can be utilized as a source of VRE, is efficient, and does not emit carbon dioxide. Decarbonization can be applied to many areas of our sectoral energy system through sector-coupling, the practice of maneuvering and integrating multiple end-use energy sectors as a whole instead of one region. Sector-coupling indicates that several technologies from many areas of study may need to be used in order to optimally decarbonize as many areas as possible. A research team has recently created a framework to help us do just that.

DOLPHYN

A team consisting of researchers from the Massachusetts Institute of Technology (MIT) and from Shell published a paper in the Journal Energy & Environmental Science earlier this year. The group's members were Guannan He, Dharik S. Mallapragada, Abhishek Bose, and Emre Gençer from the MIT Energy Initiative (MITEI), and Clara F. Heuberger-Austin from Shell Global Solutions International B.V.

According to their abstract, the team created a model to examine hydrogen's importance in low-carbon environments in order to further improve energy efficiency in hydrogen structures. The team then applied their findings to an energy sector in the Northeast region of the United States to determine both the best cost and value. This model is the Decision Optimization of Low-carbon Power-HYdrogen Network, or the DOLPHYN model. In their case study of the U.S. Northeast region, the team highlighted an array of demand and price in a model of a 2050 greenfield energy system (comparing clean energies). Their examination focused on hydrogen in transportation, but hydrogen may also have applications in other areas.

Conclusions

Three major conclusions were found by the end of the case study: In the energy system modeled in their research, the team postulated that their findings could be interpreted to show that carbon capture and storage is more efficient in the hydrogen supply chain rather than power generation. Secondly, there is no longer a need for as many flexible VRE resources with the use of hydrogen storage and electrolysis, which would reduce the cost of energy systems. Finally, instead of focusing on each energy sector individually, sector coupling was found to have reduced the cost of decarbonization, which is even more helpful as the demand for hydrogen is low in other electricity sectors.

So... What Now?

Well, that is up to us! With this new information at our fingertips, the DOLPHYN model could be a step forward to help us solve the global-warming crisis ever-climbing in our environment today. Hydrogen is just one of the many possible ways to decarbonize our environment, and it may be one worth looking into.

The Pioneer of Renewable Resources: Iceland

Tara Prakash '25 (SFS)

IMAGE CREDIT: SARAH MURAD ' 22 (SFS)

Known as the land of fire and ice, Iceland is a place of extreme geological contrasts. From glaciers and active volcanoes to lagoons and hot springs, the country's topography is unusual and unique. Iceland has been a huge supporter and action taker for the environment, and has been ahead of the rest of the world in action towards a greener future.

One of these steps is geothermal plants. Geothermal power is electrical power generated from geothermal energy. Geothermal power plants use hydrothermal resources that have both water (hydro) and heat (thermal). People use these resources by drilling wells into the earth and then piping steam or hot water to the surface. The hot water or steam powers a turbine that generates electricity. Some geothermal wells are as much as two miles deep. Iceland, a pioneer in the use of geothermal energy, is home to more than 200 volcanoes and a large number of hot springs, and therefore has an abundant source of hot, easily accessible underground water (ONU, 2021).

The high concentration of volcanoes in the area is often an advantage in the generation of geothermal energy. Generating electricity with geothermal energy has increased significantly in recent years. According to the National Energy Authority, geothermal power facilities currently generate 25% of Iceland's total electricity production. Geothermal energy is mainly utilized for electricity generation and space heating, but is also used for swimming pools, snow melting, greenhouses, and farming. Iceland's economy, ranging from the provision of heat and electricity for single-family homes to meeting the needs of energy intensive industries, is largely powered by green energy from hydro and geothermal sources.

"We are a small country, but we try to focus our efforts in certain areas and this is one of them," said Guðmundur Ingi Guðbrandsson, Iceland's Minister of the Environment and Natural Resources (Newsroom, 2020). There are several topographical effects of geothermal energy usage, related to surface disturbances, the physical results of fluid withdrawal, and chemical discharge. This is natural and expected, as all energy production causes some changes to the environment. Due to technological innovations, widely available low temperature geothermal zones can be developed for space heating and cooling.

In terms of its impact on citizens, it seems to be positive. Iceland is the second happiest country in the world, according to the National Happiness Index, and many correlate that to the utilization of its geothermal energy. One of the benefits of using geothermal energy is that it increases accessibility for people regardless of economic status. Largely due to its reliance on renewable resources, the poverty rate has been below 0.1% every year for the past decade, according to MacroTrends. Factors such as cost, resource availability, production efficiency and politics played an important role in Iceland's transition to renewable and green energy, according to the United Nations (Reykjavik University, 2010).

"Geothermal is hundred percent indigenous, environmentally friendly and a technology that has been under-utilized for too long in the continent," said Meseret Teklemariam Zemedkun, Energy Programme Manager at the United Nations Environment Programme (ONU, 2021).

During the course of the 20th century, Iceland went from what was one of Europe's poorest countries to a country where practically all stationary energy is derived from renewable resources. According to the National Energy Authority, in 2014, roughly 85% of primary energy use in Iceland came from indigenous renewable resources like wind and hot water springs. Geothermal sources account for 66% of Iceland's primary energy use.

Iceland can be looked to as an example of a flourishing country paving the way towards an environmentally green future.

Autumn Peltier: the "Water Walker" of the Youth

Isabel Dower '25 (SFS)

At age 12, Autumn Peltier made history by criticizing Prime Minister Justin Trudeau's inaction in the preservation of First Nations clean water. She leveled this criticism in a face-to-face meeting with the Prime Minister while in pursuit of making clean drinking water accessible to everyone.

Autumn, now a 17-year-old clean water advocate from the Anishinabek First Nation, has been pressuring the Canadian Government and delegates from 195 different countries at the United Nations Assembly to make clean water more accessible to millions of people around the world. Autumn was appointed Chief Water Commissioner for the Anishinabek people in April 2019 and has continued advocating on behalf of her people in order to re-establish a supply of clean drinking water.

The young advocate was born on September 27, 2004, in the Wikwemikong Unceded Territory, Manitoulin Island Ontario, where she lived with her two sisters, Naomi and Ciara, and mother, Stephanie. In 2012, at age eight, Autumn was inspired to advocate for clean water after attending a ceremony at Serpent River First Nation. At the reserve, she noticed signs warning people not to drink the tap water as it was unsafe and toxic, something entirely new to her. After questioning her mother later, Autumn was shocked to learn that for over ten years the Serpent River Community had been on a boil-water advisory as a result of pipeline leaks and pollution.

At the annual winter meeting of the Assembly of First Nations, Autumn was instructed by her superiors to give the gift she had prepared and smile. Against these directions, she criticized Prime Minister Justin Trudeau's inability to help provide clean water for the First Nation reserves. When she said that she was "very unhappy with the choices [he'd] made and broken promises to [her] people," Trudeau replied with "I understand that. I will protect the water." Autumn later stated that she would

hold the Prime Minister to that promise as long as he held his position in the Canadian Government.

Autumn's great-aunt Josephine Mandamin, otherwise known as the "water walker," had been the previous Anishinabek Nation Chief Water Commissioner. She was a clean water advocate and a strong supporter of her grand-niece. After her passing in 2019, Autumn was appointed Chief Water Commissioner in her place and took over the title "water walker" for her work in bringing drinkable water.

Autumn was nominated for the International Children's Peace Prize in 2017, 2018 and 2019 for her activism. She spoke at the UN twice - in 2018 for the introduction of the International Decade for Action on Water for Sustainable Development, and in 2019 before the Global Landscapes Forum. As of February 2020, 88 boil-water advisories have been lifted in reserves, but 61 others remain. While the goal of full coverage has not been met, this is still tremendous progress for First Nation communities.

IMAGE CREDIT: ELLA MAJD '22 (SFS)

"Water is a basic human right. Everyone deserves access to clean drinking water, no matter what our race or color is, or how rich or poor we are."
-Autumn Peltier

An Unexpected Solution to the Question of Cattle and Carbon-neutrality

Lucie Johnson '23 (GDS)

A future where humanity's very existence is no longer threatened by bovine bodily functions is closer and requires less sacrifice from the more carnivorous individual than one might expect. The solution—seaweed.

Cows's Digestion and Environmental Impact

As ruminant animals, cows extract the necessary nutrients from their food, much of which is indigestible for humans, through a system of four stomachs. The food first travels to the rumen, where it ferments, before the cow regurgitates it, rechews the partially digested food, and finishes digesting.

The enteric fermentation produces volatile fatty acids, organic acids that are typically absorbed through the intestinal lining and meet around 70% of a cow's energy needs. The same process, however, also produces hydrogen, which is then converted into methane by methanogens, archaea, in the rumen.

While methane remains in the atmosphere only a fraction of the time carbon dioxide does, it traps around 30 times more heat. Currently, cattle account for 62% of agricultural sectors, one of the largest sources of greenhouse gases, through both the production of methane and carbon dioxide.

Additionally, cattle need more resources than other protein sources do. They require twice as much land per gram of protein as chicken and pigs and 20 times as much land per gram protein as beans. Clearing the land to make the necessary space has damaging effects on the environment.

Forests, wetlands, and savannas are carbon sinks, areas in which carbon-containing compounds accumulate, lowering the concentration of carbon dioxide in the atmosphere. Clearing those spaces and turning them into pastures for livestock turns carbon sinks into carbon sources.

Methane-Reducing Solutions

Due to methane's significant impact on the environment, a number of solutions spanning over multiple fields have been proposed to mitigate cow's methane emissions. Researchers have tried to breed cows that produce less methane, and researchers at UC Davis have tried to vaccinate cows against the methanogens but found that there were too many to account for.

Another solution is feed supplements, such as seaweeds, which have shown great promise. As Ermias Kebreab, an animal science professor at UC Davis exploring the effects of seaweed supplements on cows, said, "since much of a dairy's methane emissions come from the animal itself, nutrition can play a big role in finding solutions."

Seaweed isn't the only potential supplement to be added to livestock's feed. Alexander Hristov, a professor of dairy nutrition at Penn State University, found that adding 3-nitrooxypropanol (3NOP), a compound that inhibits the catalyzing enzyme of methanogenesis, the production of methane by methanogens, the enteric methane produced was decreased by 30%. However, the Food and Drug Administration (FDA) has not yet approved the compound.

Seaweeds as Feed Supplements

While 3NOP produced significant results, certain seaweeds have proven to reduce the methane produced by cows even more. *Asparagopsis taxiformis,* a tropical red seaweed, was projected to decrease methane production by 98% if it made up 5% of the feed.

A 2020 study found that over a 90 day period, *A. taxiformis* could achieve up to a 98% reduction in methane production when only 0.20% of the feed. In that same study, the researchers found that the cows with 0.20% *A. taxiformis* in their feed also

IMAGE CREDIT: DANA VILLAMIN '23 (ISZL)

gained 42% more weight than the cows in the control group, which would benefit the beef industry while also striving toward a more carbon neutral industry.

While *A. taxiformis* showed an enormous reduction in enteric methane produced, not all seaweeds are as effective. In a study done by Kinbreab using *Asparagopsis armata*, another red seaweed, methane production was only reduced by 67% when the seaweed was included as 1% of the feed.

The difference in efficacy is correlated with the amount of bromoform compounds, which inhibit the production of methane, in the different types of seaweed. *A. taxiformis* has a higher concentration of such compounds (6.55 mg/g) than *A. armata* (1.32 mg/g).

Brown seaweeds, such as *Ascophyllum nodosum*, have also been tested, but they have less significant effects on methane production and have to be included in the feed at higher rates. Despite seaweed having beneficial effects on milk production and oxidative stress (an imbalance between the production of reactive oxygen species and a system's ability to detoxify them or repair any resulting damage), lower percentages of seaweed in the feed are preferable because they have heavy metals like iodine, bromine, and arsenic, high levels of which can be toxic to both livestock and humans.
Dairy cows that consumed iodine rich seaweed for extended periods of time produced iodine rich milk, which could be a solution to iodine deficiency in an estimated 2 billion people. However, for those with enough iodine, excess iodine should be avoided.

Additionally, the aforementioned bromoform compounds in the *Asparagopsis species* are trihalomethanes, many of which are carcinogenic. Trihalomethanes are limited to 0.08 mg/L in drinking water, so exceeding that limit in milk could be potentially unsafe.

Growing Enough Seaweed

While growing seaweed is, in itself, relatively environmentally friendly. However, land, fresh water, and fertilizer are all inadequate and producing enough to support the global beef and dairy industries would be an intensive process that could, unless properly planned, have adverse effects on the environment.

Seaweed species that are both native to a farming region and have significant effects on enteric methane production are the ideal candidates. Further research is required to identify more species that reduce the production of methane at sufficiently low inclusion rates both for farming and for diversifying the number of seaweeds allowed in livestock feed by the Food and Drug Administration.

Additionally, because of the high water content in seaweeds, they typically need to be dried before transported or stored. The effects of such processing on compounds in the plant need to be studied more before large-scale production of seaweed grown to supplement livestock's diets can be undertaken.

Although there are many potential challenges in producing enough seaweed, ocean seaweed farming is beneficial for marine ecosystems. The seaweed uses excess nitrogen and carbon dioxide (both of which make the ocean more acidic) while also providing a habitat for other marine life.

A future of the wide-spread use of seaweed feed supplements will bring both the beef and dairy industries one step closer to counteracting their significant contributions to global warming. Shifting away from beef and dairy products is another good step forward, and if people were limited to 1.5 hamburgers a week (the average American currently eats three a week), humans would produce approximately 5.5 billion fewer tons of greenhouse gas emissions a year than they do currently. However, such a shift must work in tandem with farming practices, and seaweed supplements promise results with the potential to change the world.

Green Sports Alliance

Megan Chopra ‘25 (SFS)

In 2010, Paul G. Allen’s Vulcan Inc. and the Natural Resources Defense Council founded the Green Sports Alliance. By March 2011, they had made their national debut, holding their first summit in Portland, Oregon. Since then, the Green Sports Alliance has partnered with nearly 600 venues, fans, and sports teams, including the Seattle Seahawks and Portland Trail Blazers.

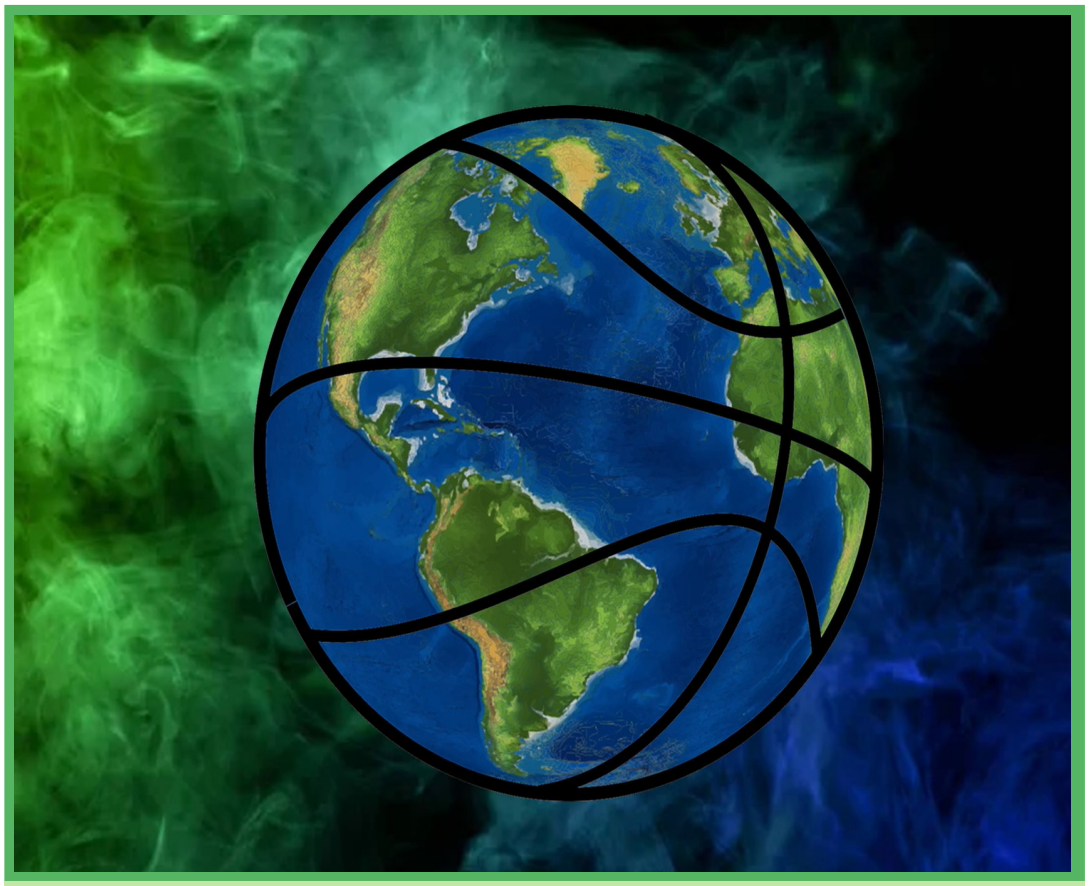


IMAGE CREDIT: MEGAN CHOPRA ’25 (SFS)

The Green Sports Alliance is an organization focused on providing a universal platform that fosters meaningful change through environmental efforts among fan bases around the world. The Alliance hopes to use the influence of sports to promote healthy and sustainable communities through direct support and focused research. This goal is accomplished by networking with recognized leaders in the sports and sustainability industry, compiling and sharing the best practices for venue operations and team communications, through workshops, webinars, and more. The Alliance mobilizes sports organizations, communities, athletes, and fans to create sustainable progress and behavioral changes by encouraging the sports industry and its partners to advance their environmental and social impact.

Since its opening, The Green Sports Alliance has spread its message across the world, impacting environmental sustainability for the better. On October 6th, 2016, the Green Sports Alliance proclaimed the inaugural Green Sports Day with support from the White House, President Barack Obama, and the Office of Science and Technology Policy. In 2018, the alliance was launched in Japan as an independent organization, the Green Sports Alliance Japan. Additionally, the 10th Annual Green Sports Alliance Summit, “Game On! The Future of Sports & Sustainability,” was held in 2020. The event brought leaders in the sports and sustainability world together to facilitate the exchange of ideas, solutions and innovations.

More recently, on April 19th, 2021, the Alliance and Arc, a technology company working towards a future of green design, announced a “Playing for the Next Generation” (PLAY) campaign. The initiative hopes to harness the transformative power of sports to drive global climate and environmental action. “PLAY will allow us to deliver new sector-specific offerings that will not only add substantial value for sports organizations at all levels but will engage whole communities and inspire the next generation of fans, athletes, and leaders,” said Mahesh Ramanujam, President and CEO of Arc. This powerful cultural platform will bring leadership recognition and rewards to sports leagues and teams in the global fight for climate action and justice.

But the Alliance still has a lot more work to do. As explained, “in our first ten years, we mobilized a movement; but in the next ten, we must leverage our collective influence and data to protect the communities and industry that we’ve dedicated our lives to.”

The Alliance’s most exciting upcoming event is the Green Sports Alliance Summit in June of 2022. The summit will showcase how sports venues, teams, leagues and corporate partners around the world continue to take action on environmental and social issues to create a more sustainable future for everyone. The annual Green Sports Alliance Summit is one of the largest and most prominent gatherings for the sports community to unite around sustainability. The event will unite hundreds of industry stakeholders to learn and share better practices and new innovations in greening operations. The sports industry is interestingly positioned to make a large scale impact on pressing environmental and social issues facing our world. The industry can bring about this progress by decreasing the carbon footprint of many of our largest public spaces and mobilizing communities to take action. The Summit therefore seeks to highlight better practices for enhancing performance and to foster a dialogue with stakeholders and fans about environmental stewardship and social justice.

The Green Sports Alliance Foundation advances social and environmental responsibility using the influence of sports to engage athletes, fans, youth, and communities in sustainable behaviours and practices. Sports has a global reach, and the Alliance is uniquely positioned to amplify environmental causes and activate passionate fan bases the world over. The Alliance is expected to continue to progress regionally, nationally, and internationally as the leading trade organization dedicated to sustainability and sports.

The Heroines of CRISPR

Lindsay Lamken ‘25 (GDS)

In 2020, Jennifer Doudna and Emmanuelle Charpentier won the Nobel Prize for a revolutionary technology known as CRISPR. CRISPR is a gene editing technology that has potential to cure diseases and better the world. It did not come easily. It was the product of years of hard work and collaboration—Doudna at University of California and Charpentier at University of Vienna. Despite their advances, and for years after their invention, Doudna and Charpentier were frequently omitted from articles discussing the new technology. But the Nobel Prize committee identified where credit was due.

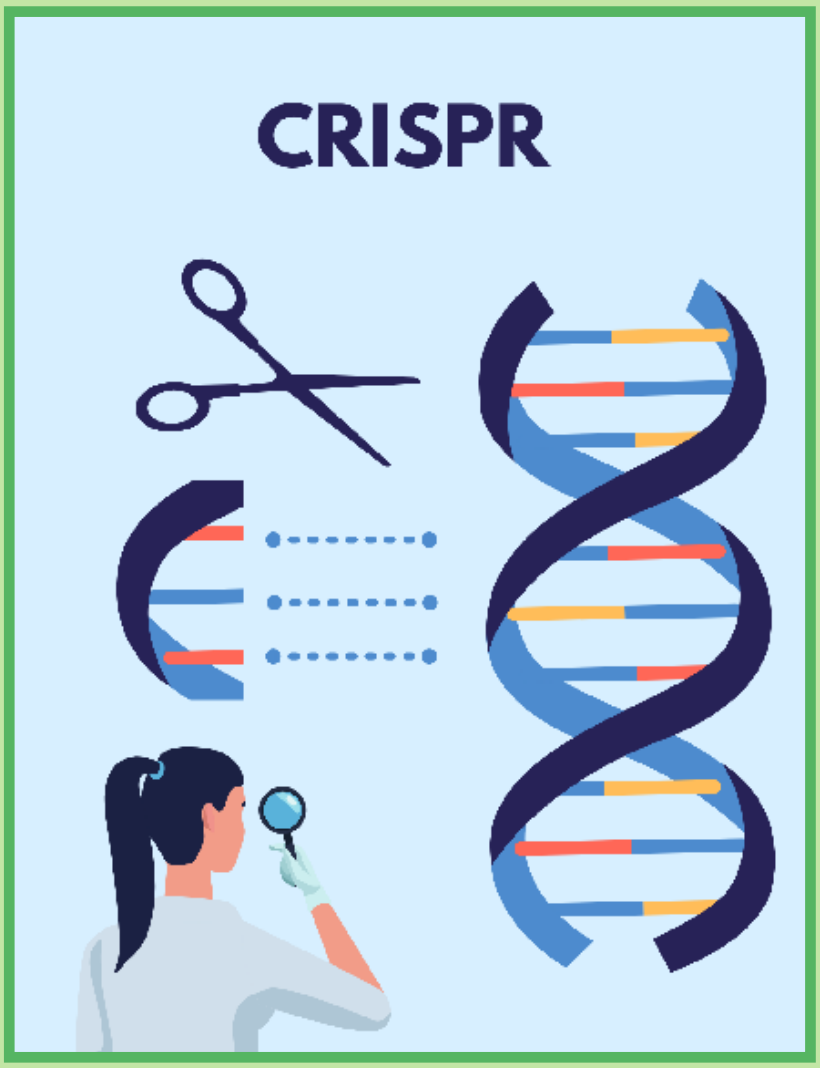


IMAGE CREDIT: LINDSAY LAMKEN ’25 (GDS)

CRISPR stands for “clustered regularly interspaced short palindromic repeats,” a mouthful that doesn’t really capture the innovation’s promise. Everything begins with bacteria and their defenses against invading viruses. Bacterial DNA includes copies of small pieces of viral DNA, which were copied from viruses that had invaded bacteria in the past. Bacteria use those copies to defend themselves against being invaded by the same type of virus again. How that worked was not known until Doudna and Charpentier made their discovery.

That copy of viral DNA plays a specific role, acting almost like a mugshot to help the bacteria recognize reinvading viruses. The bacteria uses that little snippet of DNA to create an RNA molecule that will target and bind to anything that has the same DNA pattern as the copy of viral DNA in the bacteria. What happens once that virus is found by the RNA molecule? That’s where a special enzyme called Cas9 comes in. Cas9 acts like a pair of scissors and snips the invading virus’s DNA. Linked together, the Cas9 and the targeting molecule find the invader, and then snip, snip, snip — the virus, along with its DNA, is destroyed.

Doudna and Charpentier harnessed the power of that bacterial defense system to create a gene-editing method. In place of the RNA molecule that bacteria would produce, scientists can produce RNA that targets a defective segment of DNA in a human cell. For example, they can target the genetic defect that causes sickle cell anemia, a devastating disease in which deformed red blood cells (shaped like sickles) clog arteries, producing enormous pain and potentially fatal circulatory problems. The RNA guides Cas9 to that new target, and Cas9 snips at exactly the right point. Either the cell will attempt to repair that break, potentially repairing the defect, or scientists can introduce a different DNA segment that the cell will use in place of the removed, defective segment.

Charpentier and Doudna’s experiments showed that the system they developed would work very effectively in vitro (in a test tube). It effectively targeted and cut the DNA of eukaryotic cells (cells with a defined nucleus that are typical of plants and animals). They published a paper explaining their results to the scientific community. Once they did, a race was on. Everyone tried to make the new discovery work in vivo (in actual cells) because the scientific community was confident that it would work. In fact, the discovery was so monumental that many had it up and working efficiently within a matter of a couple months. At their university laboratories, and in collaboration with others, Doudna and Charpentier made it work as well. The only question was whether it would work better than existing technologies.

In articles written about CRISPR at the time, however, discussions of the numerous (often male) scientists who exploited Doudna and Charpentier’s discovery (and often attempted to claim credit) dominated. For example, Eric Lander (currently the head of the White House Science Office) authored an article called “The Heroes of CRISPR” that emphasized the work of others and seriously diminished Doudna and Charpentier’s work. Lander’s article was the subject of great criticism. He eventually apologized. “I felt terrible,” Lander told the Senate commerce and science committee about how he described the Nobel Prize–winning work of Jennifer Doudna and Emmanuelle Charpentier. “I made a mistake.” Dr. Lander hardly stands alone. Even a very helpful article on the basics of CRISPR, published by Science News for Students, originally omitted Doudna and Charpentier while quoting others. Only after Doudna and Charpentier won the Nobel Prize in October 2000 was the article updated to mention their efforts.

The Implications of Fast Fashion: How are we Contributing?

Mallory Stack '24 (SFS)

The term 'fast fashion' was coined by the New York Times in the 1990s after Zara stated their mission to get new pieces in stores 15 days after they were on the runway. Fast fashion has grown exponentially since then, with the brand Shein becoming the most downloaded shopping app in America. Stores like Shein, Romwe, Forever 21, Zara, Pretty Little Thing, and more seem like great options because of their affordable prices and trendy styles. However, these shops have caused widespread pollution and environmental harm.

Fashion trends are constantly changing, so some fast fashion companies have hundreds to thousands of new styles coming in each week. The rush to put clothes on the market results in low-quality clothing that quickly goes 'out of style.' So, garments are thrown away quickly. According to Fast Fashion is Creating an Environmental Crisis, "approximately 85% of the clothing Americans consume, nearly 3.8 billion pounds annually, is sent to landfills as solid waste, amounting to nearly 80 pounds per American per year."

"These shops have cause widespread pollution and enviromental harm."

The Sustainable Apparel Collection reports that "when natural fibers, like cotton, linen, and silk, or semi-synthetic fabrics created from plant-based cellulose, like Rayon, Tencel and Modal, are buried in a landfill, [...] they act like food waste, producing the potent greenhouse gas methane as they degrade. But unlike banana peels, you can't compost old clothes, even if they're made of natural materials. Synthetic fibers like polyester, nylon, and acrylic, have the same environmental drawbacks." Most of these materials take several centuries to biodegrade, with some possibly taking several millennia.

The production of clothing can harm the environment as well. "Natural fibers go through a lot of unnatural processes on their way to becoming clothing," explains Jason Kibbey, CEO of the Sustainable Apparel Collection. "They've been bleached, dyed, printed on, scoured in chemical baths." These chemicals can percolate from textiles and landfills without proper sealing into the groundwater. Using incinerators - machines designed to burn waste - to dispose of these chemicals can issue toxins into the air.

The cheap materials used to create these clothing pieces further contribute to pollution. The majority of cheap clothing is made from polyester and non-organic cotton. According to The global environmental injustice of fast fashion, "polyester, a synthetic textile, is derived from oil, while [non-organic] cotton requires large amounts of water and pesticides to grow. Textile dyeing results in additional hazards as untreated wastewater from dyes are often discharged into local water systems, releasing heavy metals and other toxicants that can adversely impact the health of animals in addition to nearby residents."

"Most of these materials take several centuries to biodegrade, with some possibly taking several millennia."

Pope Francis has said, "Purchasing is always a moral act." Sustainability advocate and author Anna Lappe emphasizes the same idea, saying, "every time you spend money, you're casting a vote for the kind of world you want." The companies and institutions we support represent what is important to us. It may be easy to detach ourselves from this idea while shopping, but we must still uphold our ethical values. As journalist Lucy Siegle states, "fast fashion is never free. Someone somewhere is paying."

IMAGE CREDIT: ELLA MAJD' 22 (SFS)

All Cancers deserve Equal Funding

Ellen Carrier '22 (WHS)

IMAGE CREDIT: ELSA CUTLER '23 (GDS)

Imagine you are scrolling through Tiktok or any social media surface at that. You swipe to see a woman grabbing her breasts. Catches your attention, doesn't it?

This is the exact same thing that happened to me when I came across Kate Hudson's Tiktok video in the middle of October. Immediately, I felt a sense of guilt as she started her video with "Now that I have your attention."Hudson continues her video by addressing her audience a second time, asking "if you are going pink [for breast cancer], did you go gold last month?" In all honesty, I had no idea how to rhetorically answer this question. I had no idea what gold represented, nor did I know which cancer September represented.

Hudson explains that this past month was childhood cancer awareness month, represented by the color gold. Hudson's daughter, Eliza, became an internet sensation after Hudson started posting videos following Eliza's struggle with childhood cancer.

From what I understood, the point of Hudson's video was to explain how underrepresented other cancer awareness months were compared to breast cancer. She proposed that this is due to the commercial side of the cancer industry. "They can't romanticize, or sexualize, childhood cancer." Likewise, breast cancer may be more appealing to men, women, or sponsors rather than a colon or pancreas. Hudson finishes her video by proposing "tits, sex, that sells, that'll get you funding."

In no way was Ludwig shaming the support that breast cancer awareness month gets, nor was she blaming the breast cancer community for the underrepresentation of other cancers. As of 2021, one in eight women will develop breast cancer over the course of their lifetime. Within that statistic, one in three women will be metastatic. Breast cancer is a concern that plagues women from as early as the age of 25.

However, Hudson's complaints stem from a statistical difference in funding across funding for cancer research. On average, three and a half billion dollars goes towards breast cancer research annually, which is 40 percent of the National Cancer Institute's (NCI) federal budget. Strikingly, the funding towards childhood cancer research is vastly smaller. Less than four percent of the federal budget goes towards funding which is a measly 170 million dollars.

As a woman, reading this information about the divide in funding was heartbreaking. In my opinion, there should not be a divide in the amount of funds allocated towards cancer research, and I am sure I am not alone. While one may be more common, each life is one worth saving.

Interview with Lidia Al-Zogbi: Saving Lives with Robots

Avani Ahuja '22 (GDS)

Growing up in Lebanon, Al-Zogbi was always aware of the gender disparity in science professions, especially engineering. Regardless, in her last two years of high school, she decided to commit herself to science. Her parents came to accept her decision, but when Al-Zogbi chose to pursue mechanical engineering in college, they had mixed feelings: "They were happy that I was doing something math-y and science-y, but they weren't particularly happy about my decision to go into mechanical engineering." She explained, ""Mechanical engineering is a very male-oriented field..., so usually girls tend not to find a lot of jobs in the field."

In spite of the discouragement of her parents, Al-Zogbi described her college experience as a stimulating and invigorating place to pursue her dual passions for mathematics and robotics. Although only 12 percent of her mechanical engineering graduates were female, she described her overall experience as positive, joking, "Yes I did feel like a guy by the end of my graduation, but I didn't have any problems."

After graduating from college, she immigrated to the United States for graduate school, and she is currently a Ph.D Student in the Laboratory for Computational Sensing and Robotics at Johns Hopkins University. Her research in medical robotics has groundbreaking applications in both abdominal trauma injuries and in preventing the transmission of COVID-19. Al-Zogbi works with doctors, professors, other labs, industrial partners, undergraduate students, high school interns, and other graduate students to develop robots ranging from autonomous diagnostic ultrasound robotic systems for diagnosing COVID-19 to robots that autonomously conduct needle-steering for prostate surgeries. Despite being a minority in her field, she describes her research environment as incredibly supportive - in fact, her lab is predominantly female.

Still, she recognizes that the gender disparity is a significant issue in fields of engineering, especially robotics. She believes that a more comprehensive STEM education would result in a larger influx of women in mechanical engineering, naming one of the biggest causes for the gender disparity in STEM as "stereotypes." Misconceptions of the field as extremely harmful to young girls - "When people think about mechanical engineering, they think about fixing cars. If these girls have fathers working in the mechanical engineering industry and then see that all the people working with their dad are all men, they start to think that all of the people in a field already associated with mechanical labor are predominantly male. We need to explain what the field actually is about, potential career paths, and potential research alternatives. We need to broaden the perspective of the whole field and expose it to people from many different perspectives to break the stereotype."

But she acknowledged the progress that has been made so far, praising the initiatives that are taking place right now in universities and in local programs - "They bring in girls and have these research and tech weekends, exposing them to all kinds of STEM fields." Beyond tech and research weekends, Al-Zogbi describes the importance

of starting research early: "Getting students involved in research will expose them to all of these different things. Making sure that the maximum number of people are aware about these opportunities is a big step forward and helps counter misconceptions about the field."

For now, though, Al-Zogbi will continue building robots and empowering young gxrls to pursue careers in mechanical engineering.

Lidia Al-Zogbi is a Ph.D Student in the Laboratory for Computational Sensing and Robotics at Johns Hopkins University. She specializes in medical robotics, and she has developed robots from autonomous diagnostic ultrasound robotic systems for diagnosing COVID-19 to projects that autonomously conduct needle-steering for prostate surgeries.

How Underwater Forests are the Answer to Sustaining Earth and Resolving Climate Change, Once and for All

Sophia Stylianos '25 (SFS)

A wonder to all, even those that study it, the ocean is 80% undiscovered. It is an amazing place; eerily quiet life flourishes, swims by, and sustains itself symbiotically. The blue of the water changes, from a deep and clear blue to a greenish tint. Temperature ranges on average from 86 to 30 degrees fahrenheit. A body of water that covers 71% of earth's surface, it is vital to environmental understanding, change, and sustainability. However, the bright colors of coral are slowly becoming bleached, temperatures are becoming warmer and warmer, and water-levels are rising. The ocean houses so many possibilities for a more sustainable earth, from kelp and seagrass to Ocean-based renewable energy. Because this magical, almost otherworldly place is starting to be impacted by climate change, its ability to inform and provide solutions is dwindling.

IMAGE CREDIT: SARAH MURAD ' 22 (SFS)

Every year, about 25-30% of humans' carbon emissions enter the ocean. The ocean has incredibly high carbon-capturing abilities, especially within naturally growing species such as kelp and seagrass. Kelp grows 30 times faster than trees and can capture 20 times more carbon. Seagrass is similar to kelp but can capture even more carbon. According to Seagrass expert and marine science professor Carlos Duarte it is a "game changing" plant because it also provides habitats for marine ecosystems, purifies water, and even traps microplastic. In its various roles, Seagrass is one of the most diverse and valuable marine ecosystems on the planet, even helping ensure food security. Given the effectiveness of seagrass as a more sustainable and beneficial solution than even trees, more funding and replanting efforts should be made.

Another way the ocean supports sustainability is through ocean-based renewable energy. With technologies such as tidal energy, floating, and fixed windmills, the ocean is a large place to expand sustainable technology and energy uses. There are already efforts in place to develop and demonstrate projects to make all forms of ocean-based renewable energy—including wind, wave, tidal, current, thermal and solar—cost-competitive and accessible to all. This would transform oceans from dumping grounds to environmentally sustainable and helpful ecosystems.

To maximize the effect that ecosystems such as kelp and seagrass have while storing carbon, the ocean must become healthier. We can turn to environments that have been protected and become resilient to model policies and treatments towards marine ecosystems. One of the most pristine and highly preserved marine environments is that of the Jardines De La Reina, or Gardens of the Queen, in Cuba. In comparison to other islands, Cuba is home to much fewer nonative plant, reptile, and amphibian species than their other Caribbean counterparts. Cuba's political climate may have heavily contributed to this lack of biodiversity; the country has a largely self-sustaining economy with limited trade from the outside world because of embargos and the closed Cuban market. Tourism is also linked to increased numbers of non-native, and with Cuba's limited tourism starting in the 1950s, it is understandable why Cuba has fewer invasive species.

Just 50 miles off the south coast lies the "Galapagos of the Caribbean," a plethora of marine creatures and life. In 1996, the Cuban government made a 367-square-mile marine preserve, which restricted tourism and all fishing, except for lobster. The Jardines De La Reina is resistant to pollution and the effects of climate change. One of the reasons it is thought that the reef is doing so well is because there is no industrialized agriculture or extensive development off of the coastline, protecting the area from chemical run-offs.

In regards to long term sustainability, the Jardines De La Reina shows that with fewer factories and industrialization along the coastline, it is possible for healthy marine life to thrive and contribute to Earth's health. Efforts such as planting more kelp and seagrass and increased technologies within the marine hemisphere will not only allow ocean life to grow and thrive, but will contribute to overall global sustainability. While the ocean has been used as a dumping ground for too long, it is a large part of helping solve climate change. Not only does the ocean provide bounds of sustainable solutions, it also is the answer to unlocking humanity's potential to live in symbiosis with the Earth and having a whole, healthy ecosystem, once and for all.

Eonef Balloon

Carolina Warring ‘23 (SFS)

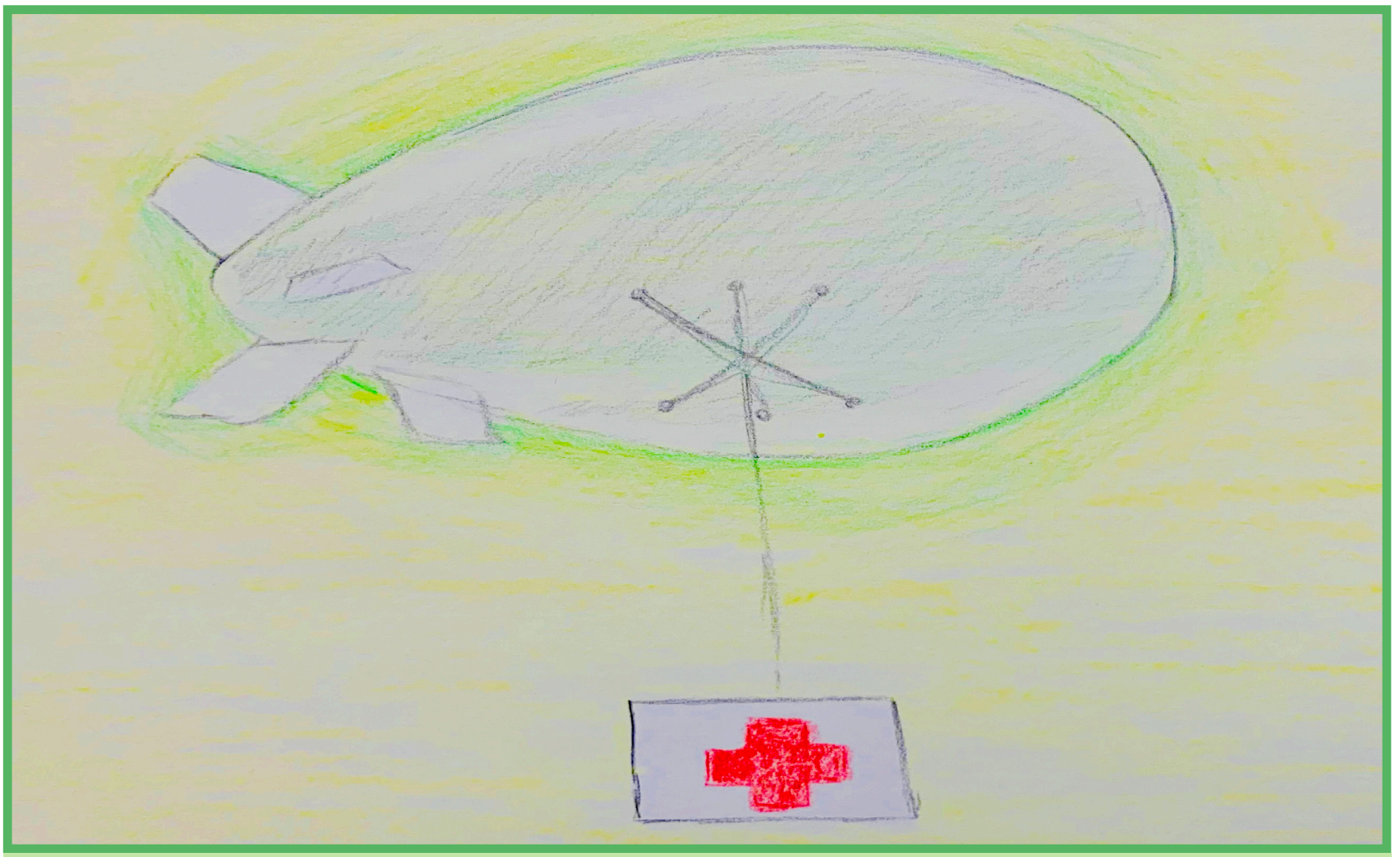


IMAGE CREDIT: SARAH MURAD ’ 22 (SFS)

What is Eonef?

Eonef is a start-up based in France created by Julie Dautel and Cédric Tomissi that recently created a unique helium balloon. The balloon is made of a multi-layer plastic membrane, can fly up to 120 meters in the air, and can carry up to 5 kilograms. It’s 4.3 meters long, two meters wide, and two meters tall. Attached to the balloon are solar panels that allow it to generate enough energy to send and receive data through a telemetry base station. The Eonef balloon has a variety of practical applications ranging from natural disaster aid to wildlife research.

Natural Disasters

After natural disasters occur, the Eonef balloon can be deployed to take on a variety of tasks that help with natural disaster relief. It can help improve and stabilize communication between several affected areas with a large distance between them by using communication antennas. The balloon can also be used to deliver lightweight emergency supplies, like first-aid kits, water, flashlights, and food, to hard-to-reach areas. In addition, it can help first responders identify places where people are trapped under wreckage and determine whether disaster locations are safe enough to enter.

Wildlife

Recently, Pilliga State Conservation Area, a national park in Australia, started using Eonef’s helium balloon to help with its wildlife conservation and research efforts. The balloon was able to access information from animal tags located up to nine kilometers away. This means that one balloon could gather information from tags all over Pilliga and any of theAustralian Wildlife Conservatory’s other reserves, increasing the efficiency of collecting data. Additionally, cameras on the helium balloons allow researchers to observe animals in a way that does not disturb them and their habitat.

Other Potential Uses

The Eonef balloon has many other potential uses. Since it can establish a wifi signal, it can help upgrade infrastructure in remote areas. In the entertainment industry, the Eonef balloon is being considered as a way to film and stream outdoor events, including the 2024 Paris Olympics. The balloon would reduce both the number of film personnel required and the cost of film equipment, while also preventing the equipment from disturbing athletes and intruding on events. Lastly, the balloon can be used for surveillance purposes. The cameras on the balloon reduce the number of security personnel needed at large events, and just one balloon can secure a large area.

“After natural disasters occur, the Eonef balloon can be deployed to take on a variety of tasks that help with natural disaster relief.”

Pacific Garbage Patch

Maya Landweber '22 (GDS)

On October 20th, 2021, a huge step in cleaning the world's oceans was taken. The Ocean Cleanup's trash collection system 002 returned to shore after a twelve week trial program in the Great Pacific Garbage Patch. The boats returned with over 63,000 pounds of trash and something even more exciting: certification that the system can successfully extract significant amounts of waste from the ocean efficiently.

With ten more systems in use, the nonprofit pledges to clean 90% of the garbage patch by 2040. But, there's much more to the story. To understand the magnitude of the problem and this accomplishment, we have to start at the beginning.

Plastic was created in the late 19th century to be a more durable and versatile, as well as less expensive alternative to naturally occurring materials. While very effective, it's also virtually indestructible. Even with the introduction of recycling programs, 91% of plastic is not recycled and at least 8 million tons of it ends up in the ocean each year. It's not just bottles or fishing nets, but mostly microplastics--microscopic pieces of plastic that can filter into water supplies. Because plastic is manufactured with various harmful chemicals, ocean plastic poses a large threat to marine and human health.

One of the problems posed when trying to clean up the ocean is the sheer amount of ocean there is on the Earth. So, The Ocean Cleanup's effort focuses on The Great Pacific Garbage Patch, an area where a lot of trash tends to accumulate. The patch is located at the convergence of multiple large currents, creating a vortex for any debris. The area is split into two main regions, eastern (off the coast of California) and western (off the coast of Japan). Trash is moved between the two sections via an ocean 'highway' known as the north pacific subtropical convergence zone.

Scientists have been attempting to pinpoint the actual size of the garbage patch for a long time to no avail. Due to the concentration of microplastics, satellite imagery shows more of a cloudy soup rather than a distinct area with floating trash. Additionally, 70% of marine debris sinks to the bottom of the ocean, making it difficult to quantify and even more so to clean.
The Ocean Cleanup has been working to tackle this problem for almost a decade. Its founder, Boyan Slat, started the organization in 2012 when he was only 18 after encountering marine plastic on a scuba trip with friends. His idea: why go to the plastic when the plastic can come to you?

IMAGE CREDIT: LILY PANGELINAN '23 (WHS)

System 002, also nicknamed 'Jenny' is the organization's seventh iteration of a large-scale cleanup project. Initially, the prototypes were designed to be large, stationary vessels with permanent collection nets underneath to passively collect trash. Then, they tested a fleet of small, stationary buoys that individually collected waste. However, after multiple trials, passive models were not able to collect significant amounts of trash. If meaningful progress was to be made on the patch, there would need to be some targeted movement involved.

This is where system 002 comes into play. 002 consists of three cargo ships and two nets. Two of the ships pull a gigantic, specially designed net between them at a slow speed, moving against the natural current. Trash between the boats is funneled into the back of the net, which detaches and is emptied onto the third boat. Then, the process is repeated.

Jenny uses computer software to predict where concentration of trash will be the highest based on currents to maximize the system's efficacy. In their most fruitful test run, the system was able to bring in over 20,000 pounds of trash. And, the company claims that they can collect even more when running at full force.

After the storage on the boats reaches capacity, the system must come back to shore to unload. Then, the company works to recycle as much of the plastic as possible, as well as turning some of it into merchandise to raise money for further work.

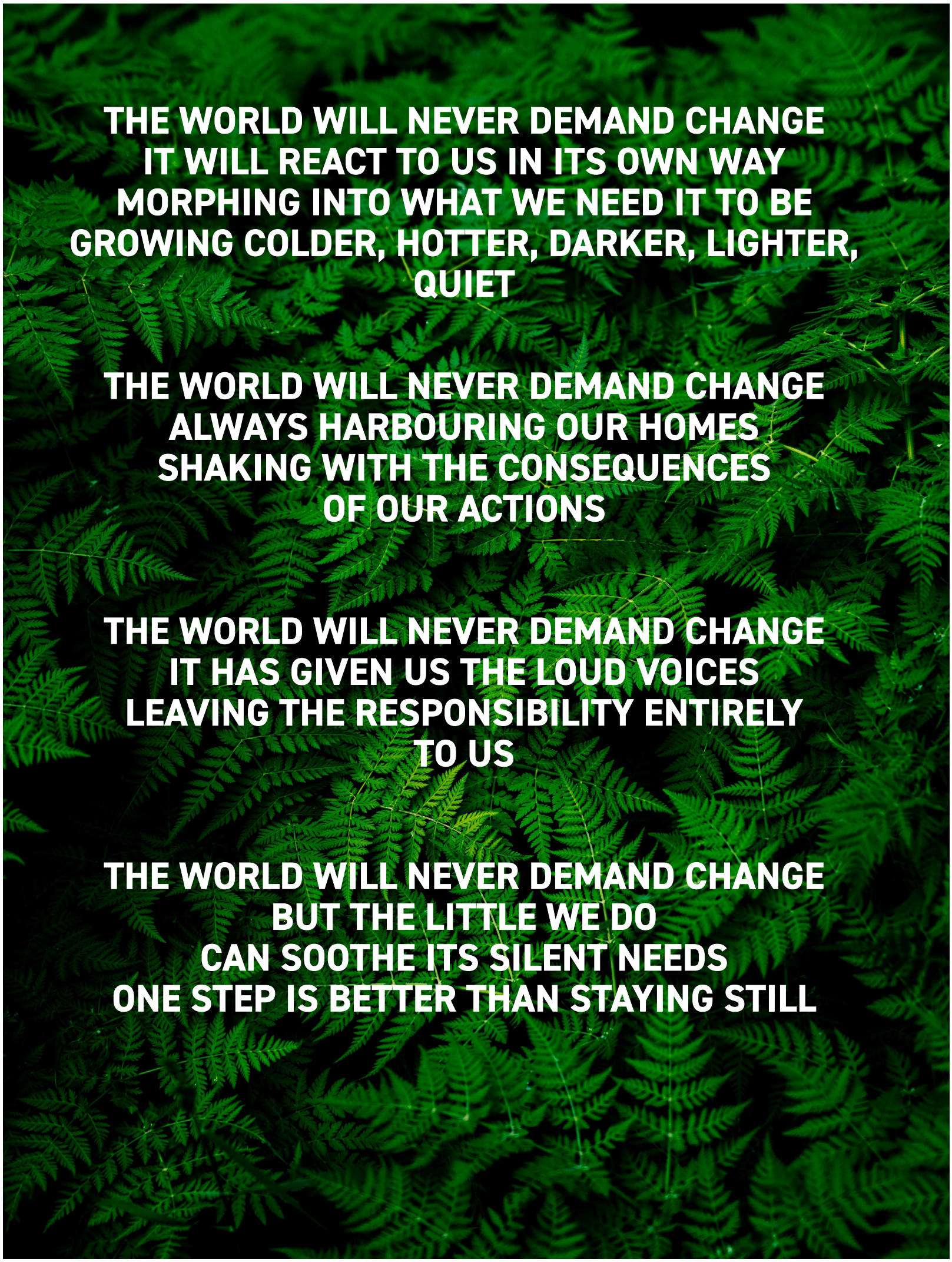
While it has a lot of potential, system 002 has also been met with some criticism. For one, the net is designed to catch even the finest microplastics and is therefore very difficult for marine life to get out of. The method is very similar to trawl fishing, which has largely diminished fish populations. As well, the ships generate a lot of ecological waste and have a large carbon footprint, so may be contributing to one environmental crisis in the name of solving another.

The nonprofit has been working to combat concerns and make sure that their system is doing more good than it is harm. For example, they have installed lights and escape paths for fish that get caught in the net, and tow the boats at a slow speed so marine life can swim out. As well, they are working to offset the carbon footprint of the boats. But, some worry these measures will not be enough.

Armed with proof of technology, The Ocean Cleanup pushes on despite the critiques. As Jenny goes back out into the eastern garbage patch to continue working, the development team will be workshopping improvements and upgrades to the next round of models. They hope to release a new fleet of systems into the ocean soon and begin substantial efforts to fix one of humanity's biggest ecological concerns.

Change the World

Prarthna Midha'22 (JPIS)



Sustainability in Aviation

Abigail Vanasse ‘23 (ESHS)

IMAGE CREDIT: SARAH MURAD ’ 22 (SFS)

Introduction:

Environmental activists have urged that humanity needs to decrease its use of greenhouse gases to prevent global warming. A key contributor to this problem is aviation. Although aircraft accounts for a small portion of CO2 emissions as compared to road vehicles, it is still the main factor in the rise of global temperatures and energy waste. So how can we combat the ever-present problem of global warming? We must turn towards looking for ways to maintain sustainability in the aviation industry.

Problems in Aviation

A plane requires immense energy and fuel to power its flights, especially long-distance ones. For the past 100 years, we have used non-eco-friendly aircraft materials that cause drag and in turn, the use of more carbon-rich fuel that pollutes the environment with carbon monoxide.

To reverse these negative effects and maintain green aviation, we must look towards sustainable solutions that are not only good for the environment but are easy for us to support in the long run.

How to Reduce these Problems:

Renewable energy, fuel-efficient planes, and net-zero emissions are crucial to reaching sustainability.

Many aircraft today use heavy-weight materials that require considerable energy to move. The heavier the plane, the more fuel it will require for its flight. The more fuel the plane requires, the more carbon emissions it will produce, in turn polluting the air. Chemical & Engineering News reports that “Airlines [such as Delta and JetBlue] are looking to new materials and coating technologies to make planes lighter, more aerodynamic, and more resistant to wear and tear.”

In terms of renewable energy, Boeing and Air BP have turned to use sustainable aviation fuel (SAF). This fuel is made from cooking oil and animal and plant waste. It is designed to reduce carbon emissions and improve air quality compared to traditional jet fuel which does the opposite. According to Air BP, “SAF gives an impressive reduction of up to 80% in carbon emissions over the lifecycle of the fuel compared to traditional jet fuel it replaces, depending on the sustainable feedstock used, production method and the supply chain to the airport.” By using fuel that is made from renewable resources and reducing carbon emitted into the atmosphere, air travel can become more sustainable, making the idea of reaching net-zero emissions possible. The biggest problem with using SAF now is that it is very expensive. The production efficiency and availability of raw materials are making more companies hesitant to turn to SAF. When this process becomes more effective, companies will be more likely to switch because it will cost less money than products currently in use in addition to reducing carbon emissions.

In 2018, Boeing became the first company to complete a commercial flight using 100% sustainable aviation fuels. Many other companies are currently using a combination of traditional jet fuel and SAF to create a hybrid fuel that is better for the environment than traditional fuel. Taking this a step further, Boeing hopes to run commercial airplanes on 100% sustainable aviation fuel by 2030 through their ecoDemonstrator program. In Boeing's 2021 Sustainability report, the company states that “The Boeing ecoDemonstrator program takes promising technologies out of the lab and tests them in the air to make flying safer and more sustainable. The ecoDemonstrator [program] has tested over 170 projects on seven airplanes to date, including the advanced technology winglets that save fuel, a laser system that can detect clear air turbulence, and landing gear that lessens noise.” Through these cutting-edge innovations, Boeing feels that it can achieve carbon emission reductions for a cleaner environment.

Worldwide Compliance:

Net-zero emissions are an important part of reaching sustainability. The Intergovernmental Panel on Climate Change (IPCC) has expressed that, “net emissions must be reduced to zero in order to stabilize global temperatures. The report also states that any scenario that “does not involve a reduction to zero will not stop climate change.”

In an attempt to combat climate change and reach net-zero emissions, 81 countries have pledged to take part in the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). As stated by CNBC, “[This organization] aims to put a cap to any increase in carbon emissions through the purchase of carbon offsets. Purchasing a carbon offset essentially means compensating for the carbon emissions produced by reducing emissions elsewhere.”

Conclusion:

With commercial airline and fuel companies committing to making more efficient and lightweight planes, the development of 100% sustainable aviation fuel, and the current worldwide effort to reduce carbon emissions, there is hope for a cleaner and greener world of sustainability in aviation.

Brain Implant that Fights Depression

Carmen Gitchell '22 (GDS)

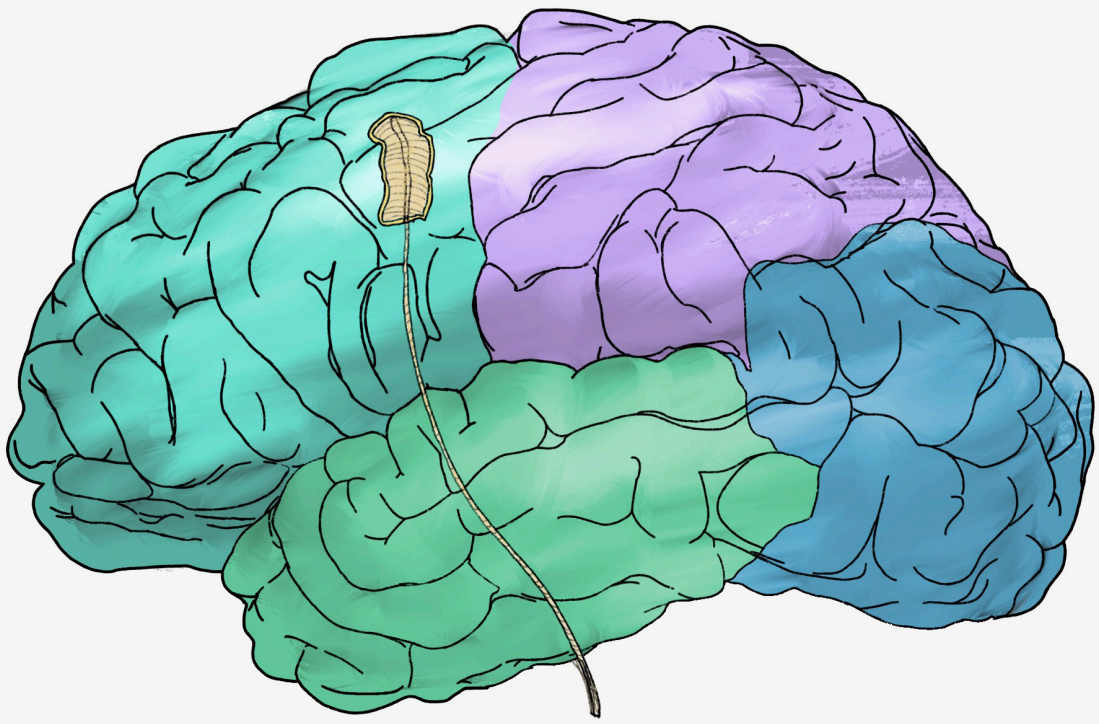


IMAGE CREDIT: SHREYA AGRAWAL '22 (LHS)

Alongside psychotherapy, the main treatment for depression is pills. These include tricyclic antidepressants, selective serotonin reuptake inhibitors (SSRIs), and selective serotonin noradrenaline reuptake inhibitors (SNRIs). Pills are typically prescribed together to fight depression. 40% to 60% of people experience fewer days in a depressive state with pills such as SNRIs which also prevent relapses in 27% of people.

Thanks to new research, there is a new treatment: a brain implant that involves small electronical shocks to specific regions of the brain in a sequence over a few months to lessen individuals' depression. It has been successful in an anecdotal case of a woman named Sarah. Sarah experiences severe depression, and the implant has helped raise her mood. Because she is the first patient to undergo the treatment, the longevity of the positive effects is still unclear. Said uncertainty has brought into question the true success of the experiment. Electroconvulsive therapy, which this brain implant is a version of, has existed since the 1930s, but was initially both dangerous for patients and unsuccessful.

The brain implant was specially made for Sarah. Sarah's brain was first mapped so the brain implant stimulated the right regions to lessen her depression. The researchers found that, in Sarah's case, the region that they needed to simulate to help alleviate her pain was the ventral capsule/ventral striatum.

There are a few different reasons for whether or not the brain implant is the best way forward. Firstly, it can be very dangerous if it isn't built right because the electronic shocks could be too strong or stimulate the wrong part of the brain. Additionally, this implant technology only has one person that it has been tested on, making the technology only anecdotally successful. Sarah's brain had to be mapped for months before the device could be implanted, and this process would have to be followed with all future patients, making it a very time-consuming process.

However, as said by scientist Mark George, "we think nothing of taking a pill to change our mood and improve our emotions." He believes that the nature of the device and its inherent risks shouldn't be the main reason one may not want to try it because commonly used antidepressants such as SSRIs and SNRIs have their own dangers but can greatly improve one's quality of life. George has been working on the brain implant device since the mid-2010s and thinks that it could also help with addictions to drugs such as opioids. The experiment with Sarah was incredibly successful with her chronic depression lessening more and more everyday. Sarah herself said, "I laughed out loud, This was the first time I had spontaneously laughed and smiled where it wasn't faked or forced in five years."

Reduce, Reuse, or Recycle?

Sarah Murad ‘22 (SFS)

Reduce, Reuse, Recycle.” It’s a phrase we have all heard before. However, we often place a lot of emphasis on the third of these so-called “Three R’s”: recycling. This may be because recycling is easier than the other two, especially since it does not require a significant change in consumption or lifestyle. But, are recycling efforts actually successful, and should we be drawing more attention to reducing and reusing instead?

IMAGE CREDIT: ELLA MAJD ‘22 (SFS)

The campaign to increase recycling has certainly had its rewards. In America, recycling reportedly keeps about one-third of solid waste out of landfills, and it has been especially useful with materials like paper, glass, and metal. It takes significantly less energy to recycle aluminium than it does to produce it. But, with other materials, notably complex plastics, recycling becomes an almost entirely unprofitable endeavor. Moreover, American recycling rates have stagnated since the early 2000s, begging the question: is it even possible to increase the efficacy of recycling?

In place of recycling, other environmentally sustainable actions tend to be far more potent. Project Drawdown, a non-profit organization which looks at the efficiency of actions in addressing global warming, found that out of 80 different actions, the contributions of recycling were below the median.

One problem with recycling is that it costs additional energy, especially when considering transportation. The easiest way to address this problem would be to limit consumption in the first place - to reduce. The benefits of reusing follow in a similar vein, because items that continue to be used are not discarded.

So why do we focus so much on recycling? Should it be included in the Three R’s if it is so much less effective?

While recycling may not be as effective as reducing or reusing, it retains importance through spreading environmental consciousness. Since recycling is fairly simple to do, it is often the first step people take in reducing their carbon footprint, and can be the gateway to a more sustainable lifestyle.

Although the percentage of Americans that choose to recycle has plateaued, one possible method of increasing this number is an economic incentive. San Francisco, for example, has been lauded for its high recycling and composting rates of over 77% - and rising. These rates are due to the city’s “pay-as-you-throw” fees for trash and free recycling policies. Seoul has also successfully implemented a similar program.

Though many other methods of decreasing waste and carbon emissions are more fruitful than recycling and deserve additional attention, by no means ought we leave recycling behind entirely. For certain materials, recycling is useful and energy-efficient, and as a straightforward and accessible way to be environmentally conscious, recycling’s ability to lead people to more meaningful lifestyle changes is invaluable.

GMO Sustainability in the Farming Industry

Rihanna Arouna '25 (WWHS)

IMAGE CREDIT: LILY PANGELINAN '23 (WHS)

When people hear about GMOs it's often in a negative light. Although people are encouraged to steer clear of them, 90% of scientists confirm that they aren't harmful, and many governmental organizations corroborate these findings. In fact, GMOs have made many foods a lot better. For example, they've made banana and watermelon seeds less large and hard, making them easier to eat and providing more room for the actual edible parts of the fruits.

Many everyday foods contain GMOs, like cereal, hamburgers, hotdogs, crackers, chocolate, chips, pasta, bread, and many more.

GMO stands for genetically modified organisms. Anything that's had its genetics manually altered is considered a GMO, and this altering could have been in a lab.

GMOs are becoming increasingly popular in food production, and with this increase in popularity, the question of their environmental sustainability has been proposed numerous times.

GMOs are in fact environmentally sustainable by many sources, including Raoul Adamchak, a farmer and educator at the University of California Davis. He states that GMO crops can be altered so that they produce natural pesticides, or so that they can grow under very harsh circumstances, for example, with little water or sunlight.

With these changes, the way crops are produced can be broadened, so that it takes less of a toll on the environment. This could mean saving resources or lessening deforestation since the crops need less space, or even reducing the number of pollutants going up into the atmosphere due to pesticides.

Not only do GMO crops help lessen the effects on our environment, but they will also protect the food supply from diminishing as global warming gets worse because the crops will continue to survive under harsh circumstances.

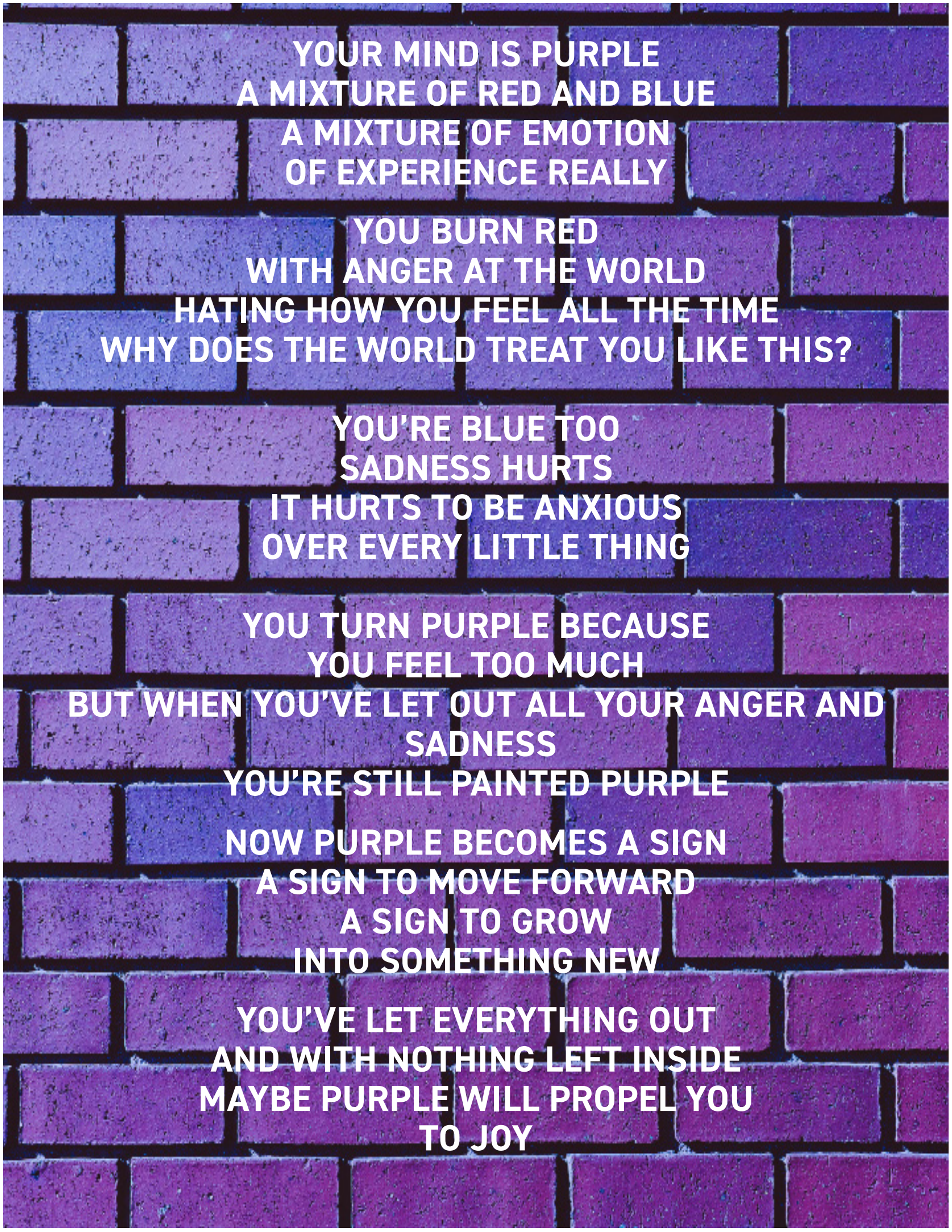
Although sustainability is a large perk of GMO crops, it's not the only one. Since farming will become more widely available in climates that it wasn't suitable for before, this means more food production and fewer people without food. The crops could also be modified so that a portion size has more nutrients than normal, which would also increase the amount of food since a smaller portion will give the same amount of nutrients. This would also lower the amount of malnutrition. The benefits of GMOs aren't just speculation though, they are being introduced currently. For example, the species of banana that is eaten and sold in 99% of grocery stores, the Cavendish, was (and still is) being wiped out by a fungus.

In response to this, scientists used a gene-editing technique called CRISPR to take a gene from a different species of banana that is resilient against the fungus and insert it into the Cavendish to prevent the species' extinction. If the Cavendish hadn't been edited in this way, there would no longer be any domesticated banana species and many banana farmers would lose a large source of income.

GMO crops hold a lot of power for the future and can benefit plenty of people when the power is used to the fullest, may that be providing opportunities for more food production or preserving the food we have now, they are sure to be an important part of the farming industry's future.

Purple Heart

Prarthna Midha'22 (JPIS)



References by Article

Eunice Foote and the Foundation of Climate Science

Santora, T. (2019, July 17). The Female Scientist Who Discovered the Basics of Climate Science—and Was Forgotten By History. Audubon. Retrieved November 17, 2021, from https://www.audubon.org/news/The-female-scientist-who-discovered-basics-climate-science-and-was-forgotten

Wilkinson, D. K. (2019, July 17). The Woman Who Discovered the Cause of Global Warming Was Long Overlooked. Her Story Is a Reminder to Champion All Women Leading on Climate. Time. Retrieved November 17, 2021, from https://time.com/5626806/eunice-foote-women-climate-science/

A Look Into DOLPHYN: A Model to Sustain Our Energy Systems

Miniard, Deidra, Joseph Kantenbacher, and Shahzeen Z Attari. "Shared Vision for a Decarbonized Future Energy System in the United States." Proceedings of the National Academy of Sciences of the United States of America. National Academy of Sciences, March 31, 2020. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7132305.

He, Guannan, Dharik S. Mallapragada, Abhishek Bose, Clara F. Heuberger-Austin, and Emre Gençer. "Sector Coupling via Hydrogen to Lower the Cost of Energy System Decarbonization." Energy & Environmental Science. The Royal Society of Chemistry, August 4, 2021. https://pubs.rsc.org/en/content/articlelanding/2021/ee/d1ee00627d.

Kelly Travers | MIT Energy Initiative, K. (n.d.). Coupling power and hydrogen sector pathways to benefit decarbonization. Retrieved November 16, 2021, from https://news.mit.edu/2021/coupling-power-hydrogen-sector-pathways-benefit-decarbonization-1021.

Green Sports Alliance

"Green Sports Alliance and Arc Announce New 'Playing for the next Generation' Campaign." Pac, 19 Apr. 2021, https://pac-12.com/article/2021/04/19/green-sports-alliance-and-arc-announce-new-playing-next-generation-campaign.

Green Sports Alliance, 28 July 2021, https://greensportsalliance.org/.

Autumn Peltier: the "Water Walker" of the Youth

CBC Kids News. (2020, November 20). On National Child Day, meet clean water activist Autumn Peltier | CBC Kids News [Video]. YouTube. https://www.youtube.com/watch?v=A33XRMLBbOc

CBC News. (2018, March 22). Autumn Peltier, 13-year-old water advocate, addresses the UN [Video]. YouTube. https://www.youtube.com/watch?v=zg60sr38oic

CBC News. (2019, September 28). Water protector Autumn Peltier speaks at UN [Video]. YouTube. https://www.youtube.com/watch?v=0usN4mWmDKQ&t=1s

CBC News: the National. (2018, March 21). The teen fighting to protect Canada's water — meet Autumn Peltier [Video]. YouTube. https://www.youtube.com/watch?v=xqdE_7OZaqE

Gallant, David. "Autumn Peltier". The Canadian Encyclopedia, 25 October 2021, Historica Canada. https://www.thecanadianencyclopedia.ca/en/article/autumn-peltier. Accessed 14 November 2021.

North American Association for Environmental Education. (n.d.). Autumn Peltier. Retrieved November 10, 2021, from https://naaee.org/about-us/people/autumn-peltier

An Unexpected Solution to the Question of Cattle and Carbon Neutrality

Fox, A. (2021, March 23). Seaweed-Fed Cows Burp Less Planet-Warming Methane. Smithsonian Magazine. Retrieved November 10, 2021, from https://www.smithsonianmag.com/smart-news/seaweed-fed-cows-burp-less-planet-warming-methane-180977296/

How Do Cattle Produce Methane? (2019, October 23). CLEAR Center UC Davis. Retrieved November 10, 2021, from https://clear.ucdavis.edu/explainers/how-do-cows-produce-methane

Kaplan, S. (2019, November 18). Are my hamburgers hurting the planet? The Washington Post. Retrieved November 10, 2021, from https://www.washingtonpost.com/climate-solutions/2019/11/18/are-my-hamburgers-hurting-planet/

LMernit, J. L. (2018, July 26). How Eating Seaweed Can Help Cows to Belch Less Methane. Yale Environment 360. Retrieved November 10, 2021, from https://e360.yale.edu/features/how-eating-seaweed-can-help-cows-to-belch-less-methane

Nelson, D. (2018, May 24). Can Seaweed Cut Methane Emissions on Dairy Farms? Expert Sees Dramatic Reduction When Cows Consume Seaweed Supplement. UC Davis. Retrieved November 10, 2021, from https://www.ucdavis.edu/climate/news/can-seaweed-cut-methane-emissions-on-dairy-farms

Vijn, S., Compart, D. P., Dutta, N., Foukis, A., Hess, M., Hristov, A. N., Kalscheur, K. F., Kebreab, E., Nuzhdin, S. V., Price, N. N., Sun, Y., Tricarico, J. M., Turzillo, A., Weisbjerg, M. R., Yarish, C., & Kurt, T. D. (2020). Key Considerations for the Use of Seaweed to Reduce Enteric Methane Emissions From Cattle. Frontiers in veterinary science, 7, 597430. https://doi.org/10.3389/fvets.2020.597430

The Heroines of CRISPR

Lander, E. S. (2016). The Heroes of CRISPR. Cell, 164(1-2). https://www.cell.com/fulltext/S0092-8674%2815%2901705-5

Mervis, J. (n.d.). Biden's nominee for science chief issues apology, defends character at confirmation hearing. Science. https://doi.org/10.1126/science.abj2478

Morange, M. (2016, February 17). Why Eric Lander's Controversial Paper "The Heroes of CRISPR" Is Not Solid Historical Research. American Scientist. https://www.americanscientist.org/blog/macroscope/why-eric-lander%E2%80%99s-controversial-paper-%E2%80%9Cthe-heroes-of-crispr%E2%80%9D-is-not-solid-historical

Rogers, K. (2020, December 7). Emmanuelle Charpentier. Encyclopedia Britannica. https://www.britannica.com/biography/Emmanuelle-Charpentier

Rogers, K. (2021, February 15). Jennifer Doudna. Encyclopedia Britannica. https://www.britannica.com/biography/Jennifer-Doudna

Saey, T. H. (2017, July 31). Explainer: How CRISPR works. Science News for Students. https://www.sciencenewsforstudents.org/article/explainer-how-crispr-works

The Implications of Fast Fashion: How are we Contributing?

Wicker. Alden. "Fast Fashion is Creating an Environmental Crisis." Newsweek, 1 Sept. 2016. https://www.newsweek.com/2016/09/09/old-clothes-fashion-waste-crisis-494824.html

Bick, R., Halsey, E. & Ekenga, C.C. "The global environmental injustice of fast fashion." Environ Health, 21 Aug. 2018. https://doi.org/10.1186/s12940-018-0433-7

Hobson, John. "To die for? The health and safety of fast fashion." Occupational Medicine, 2 July 2013. https://academic.oup.com/occmed/article/63/5/317/1451439

All Cancers deserve Equal Funding

[Sources might be there in the article, not sure if that's all of them, but need to be put in APA format]

How Underwater Forests are the Answer to Sustaining Earth and Resolving Climate Change, Once and for All

Leahy, S. (2019, July 4). How to erase 100 years of carbon emissions? plant trees. Environment. Retrieved December 13, 2021, from http://www.shualiao.cn/environment/article/how-to-erase-100-years-carbon-emissions-plant-trees.

Educator, C. N. E., & Melissa Kreye Assistant Professor of Forest Resource Management More by Melissa Kreye Articles Understanding the Value of Wildlife in Pennsylvania Articles Voter Behavior Towards Natural Areas Protection Articles Why Do Unplanned or Poorly Planned Timbe. (2021, December 10). How forests store carbon. Penn State Extension. Retrieved December 13, 2021, from https://extension.psu.edu/how-forests-store-carbon.

Tong, T. (2021, March 10). Kelp forests: Restoring a lifeline for the ocean: Earth.org - past: Present: Future. Earth.Org - Past | Present | Future. Retrieved December 13, 2021, from https://earth.org/kelp-forests-lifeline-for-the-ocean/.

Seagrass could replace forests as the Ideal Carbon Sink. Earth.Org - Past | Present | Future. (2021, August 20). Retrieved December 13, 2021, from https://earth.org/seagrass-ideal-carbon-sink/.

Seagrass, an important ocean plant, is making a comeback. Earth.Org - Past | Present | Future. (2021, June 7). Retrieved December 13, 2021, from https://earth.org/seagrass-is-making-a-comeback/.

Panel, O. (n.d.). Transformations for a sustainable ocean economy. Retrieved December 13, 2021, from https://www.oceanpanel.org/ocean-action/files/transformations-sustainable-ocean-economy-eng.pdf.

WHOImedia. (n.d.). How microbes reflect the health of coral reefs. EurekAlert! Retrieved December 13, 2021, from https://www.eurekalert.org/news-releases/633156.

Eonef Balloon

Dautel, J., & Tomissi, C. (n.d.). EONEF. http://eonef.com/#S5

Eonef, un ballon à hélium pour accompagner les équipes d'urgence et les scientifiques. (2021, April 9).

Brut. https://www.brut.media/fr/science-and-technology/eonef-un-ballon-a-helium-pour-accompagner-les-equipes-d-urgence-et-les-scientifiques-7b6a10a9-b99e-4757-a90c-26b4e2ab6d51

La mission d'EONEF : Mettre la technologie solaire au service des zones exclues ou sinistrées. (2019, March 14). Les Echos Executives. https://business.lesechos.fr/directions-generales/partenaire/partenaire-2088-la-mission-d-eonef-mettre-la-technologie-solaire-au-service-des-zones-exclues-ou-sinistrees-327734.php

Pacific Garbage Patch

Cannon, J. (2021, October 29). They pulled 63,000 pounds of trash from the Great Pacific Garbage Patch, but that's just the start. USA Today. Retrieved November 17, 2021, from https://www.usatoday.com/story/news/world/2021/10/29/great-pacific-garbage-patch-ocean-cleanup-nets-63000-pounds-trash/6138815001/

The Great Pacific Garbage Patch. (n.d.). In National Geographic. Retrieved November 17, 2021, from https://www.nationalgeographic.org/encyclopedia/great-pacific-garbage-patch/

Marine plastic pollution. (2021, November). International Union for Conservation of Nature. Retrieved November 17, 2021, from https://www.iucn.org/resources/issues-briefs/marine-plastics

Oceans. (n.d.). The Ocean Cleanup. Retrieved November 17, 2021, from https://theoceancleanup.com/oceans/
Weise, E. (2018, August 7). A giant floating trash collector will try to scoop up the Great Pacific Garbage Patch. USA Today. Retrieved November 17, 2021, from https://www.usatoday.com/story/tech/science/2018/08/07/giant-floating-trash-collector-heads-pacific-garbage-patch/831803002/

Wetzel, C. (2021, October 19). This new installation pulled 20,000 pounds of plastic from the Great Pacific Garbage Patch. Smithsonian Magazine. Retrieved November 17, 2021, from https://www.smithsonianmag.com/smart-news/this-new-installation-just-pulled-20000-pounds-of-plastic-from-the-great-pacific-garbage-patch-180978895/

The Pioneer of Renewable Resources: Iceland

Newsroom (Ed.). (2020, June 24). Iceland, a world leader in clean energy, supports Africa's push for geothermal power. Modern Diplomacy. Retrieved October 27, 2021, from https://moderndiplomacy.eu/2020/06/25/iceland-a-world-leader-in-clean-energy-supports-africas-push-for-geothermal-power/.

ONU. (n.d.). Iceland, a world leader in clean energy, supports ... - UNEP. Iceland, a world leader in clean energy, supports Africa's push for geothermal power. Retrieved October 27, 2021, from https://www.unep.org/es/node/27789.

University, R. (n.d.). Iceland's Sustainable Energy Story: A Model for the world? United Nations. Retrieved October 27, 2021, from https://www.un.org/en/chronicle/article/icelands-sustainable-energy-story-model-world.

Sustainability in Aviation

Anwar, N. (2020, February 28). Eco Travel: What are our current options for Green Aviation. Retrieved December 22, 2021, from https://www.cnbc.com/2020/02/28/eco-travel-what-are-our-current-options-for-green-aviation.html

Aviation's contribution to global warming higher than expected. (2021, November 4). Retrieved December 21, 2021, from https://www.ukri.org/news/aviations-contribution-to-global-warming-higher-than-expected/

Boeing releases First Sustainability Report, charting path to Sustainable Aerospace. (2021, July 26). Retrieved December 21, 2021, from https://boeing.mediaroom.com/2021-07-26-Boeing-Releases-First-Sustainability-Report,-Charting-Path-to-Sustainable-Aerospace

Boerner, L. K. (2021, September 3). Airlines want to make flight more sustainable. How will they do it? Retrieved December 21, 2021, from https://cen.acs.org/environment/sustainability/Airlines-want-make-flight-sustainable/99/i32

Facts & Figures. Air Transport Action Group. (2020, September). Retrieved December 21, 2021, from https://www.atag.org/facts-figures.html

Sustainable Aviation Fuel. (n.d.). Retrieved December 22, 2021, from https://skynrg.com/sustainable-aviation-fuel/saf/

What does "net zero emissions" mean? (n.d.). Retrieved December 21, 2021, from https://www.myclimate.org/information/faq/faq-detail/what-does-net-zero-emissions-mean/

What is sustainable aviation fuel (SAF) and why is it important? (2021, July). Retrieved December 21, 2021, from https://www.bp.com/en/global/air-bp/news-and-views/views/what-is-sustainable-aviation-fuel-saf-and-why-is-it-important.html

Brain Implant that Fights Depression

InformedHealth.org [Internet]. Cologne, Germany: Institute for Quality and Efficiency in Health Care (IQWiG); 2006-. Depression: How effective are antidepressants? [Updated 2020 Jun 18]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK361016/

Sanders, L. (2021, October 4). A custom brain implant lifted a woman's severe depression. Science News. Retrieved October 25, 2021, from https://www.sciencenews.org/article/brain-implant-severe-depression-activity-stimulation

Sanders, L. (2019, February 10). Brain-zapping implants that fight depression are inching closer to reality. Science News. Retrieved October 25, 2021, from https://www.sciencenews.org/article/brain-electric-implants-treat-depression-closer-reality

Reduce, Reuse, or Recycle?

Crunden, E. A. (2021, January 28). How Useful Is Recycling, Really? The Atlantic. https://www.theatlantic.com/science/archive/2021/01/recycling-wont-solve-climate-change/617851/

Rosenbaum, E. (2021, May 22). Is recycling a waste? Here's the answer from a plastics expert before you ditch the effort. CNBC. https://www.cnbc.com/2021/05/22/is-recycling-a-waste-heres-the-answer-from-a-plastics-expert.html

Scheer, R., & Moss, D. (2012, December 20). After 40 Years, Has Recycling Lived Up to Its Billing? Scientific American. https://www.scientificamerican.com/article/has-recycling-lived-up-to-its-promises/

Tweed, K. (2011, October 25). Why Recycling in the US Is Not a Success. Greentech Media. https://www.greentechmedia.com/articles/read/why-recycling-in-the-u-s-is-not-a-success

GMO Sustainability in the Farming Industry

Baker, Katherine. "Could GMOs Help Create Sustainable Food Systems?" Planet Foward, 6 Dec. 2018, https://www.planetforward.org/idea/gmos-sustainable-food#:~:text=GMOs%20and%20gene%2Daltering%20techniques,%2C%20in%20fact%2C%20be%20useful.&text=GMOs%20already%20have%20been%20shown,a%20more%20sustainable%20food%20system. Accessed 2 Nov. 2021.

"Genetic engineering." Britannica School, Encyclopædia Britannica, 13 Nov. 2021. school.eb.com/levels/elementary/article/genetic-engineering/600760. Accessed 19 Nov. 2021.

"Genetic engineering." Britannica School, Encyclopædia Britannica, 13 Nov. 2021. school.eb.com/levels/middle/article/genetic-engineering/274518. Accessed 19 Nov. 2021.

"GMOs in Food." Institute for Responsible Technology, Jeffrey Smith, www.responsibletechnology.org/the-basics/gmos-in-food/. Accessed 2 Nov. 2021.
Maxmen, Amy. "CRISPR Might Be the Banana's Only Hope against a Deadly Fungus." Nature, vol. 574, no. 7776, 24 Sept. 2019, p. 15, https://doi.org/10.1038/d41586-019-02770-7. Accessed 2 Nov. 2021.

Sims, Tamika. "GMO Crops: Safety, Regulation and Sustainability Insights." Food Insights, International Food Informational Council, 11 Dec. 2020, foodinsight.org/gmo-crops-safety-regulation-and-sustainability-insights/#:~:text=The%20GMO%20crops%20available%20in,as%20their%20non%2DGMO%20counterparts. Accessed 3 Nov. 2021.

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ESHS	Elizabeth Seton High School, Bladensburg, MD United States
ISZL	International School of Zug and Luzern, Switzerland
JPIS	Jayashree Periwal International school, Jaipur India
LHS	Lynbrook High School, San Jose, CA, United States
NAFL	National Academy for Learning, Bangalore, India
SFS	Sidwell Friends School, Washington DC, United States
WWHS	Walt Whitman High School, Bethesda, MD, United States
WHS	Woodrow Wilson High School, Washington DC, United States