

Miss Porter's School

# HYPATIA

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# 2022 TEAM

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ANGEL SHI '24

## DESIGNER IN CHIEF

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# GOOD NEWS FROM 2021 ENVIRONMENTALLY

JIANING LIN

*The new year started on a horrible note. Covid has been taking over the country, and there doesn't seem to be an end any time soon. However, it turns out that 2021 wasn't too bad in terms of environmental news.*

The 26th United Nations Climate Change Conference (also known as COP26) yielded some very positive results. Following the COP26 conference, the Australian government declared two new marine protected areas. These two areas will cover more water than twice of the size of the Great Barrier Reef Marine Park. Together the reserves will cover 740,000 square kilometers (286,000 square miles) of the Indian Ocean. The Panama government declared a new protective area that is almost the same size as the country's land. The Ecuador government declared an extension to the Galápagos Marine Reserve of 60,000 square kilometers (23,200 square miles). These new protected reserves will make a huge difference in the protection of marine life, ocean pollution, and the coral reefs.

In October, the Human Rights Council of the United Nations recognized access to

to a clean and healthy environment as an universal human right. It took years for the United Nations to finally recognize this right and now that they have, more efforts will be made to clean up the environment.

In September, nine organizations including Bloomberg Philanthropies, the Rob and Melani Walton Foundation, Bezos Earth Fund, and Re:wild pledged 5 billion dollars over the next 10 years for environmental protection. This money will go to the preservation, development, maintenance, and protection of water, land and species. This is the biggest private funding for environmental causes ever.

Over the past year, there has been great news from London. For the first time in 60 years, sharks, seals, and seahorses have occupied the River Thames. Parts of the River Thames have

previously been declared biologically dead, the river is heavily polluted with plastic and chemicals. The overall temperature of the river has also increased in the past decades. Despite all of these challenges, the Thames continues to grow in biodiversity.

Lastly, for the first time in 50 years, a footprint of an Amur (or Siberian) Tiger was found in Russia. These tigers are considered to be extremely endangered in Russia, with the population of them in the wild being around 330 in 2005. It has since grown to more than 600 today thanks to conservation efforts. The fact that the footprint was found is proof of the growing population.

Despite all the negative events that have happened in the past year, there has been good news in terms of the environment that can provide us with a hopeful outlook for the future. Let's work together to make a bigger difference in the environment this new year!



*Let's work together to make a bigger difference in the environment this new year!*

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# DECLARING A CLIMATE EMERGENCY IN FARMINGTON

SU LI

As the world enters the new year, it's time to reflect on what happened during 2021. Last year, the U.S. spent \$145 billion dollars on disaster costs. 668 deaths resulted from these natural disasters. In Connecticut, we experienced record-breaking rainfall from three tropical storms in one year, along with the first flash flood emergency in the state's history. According to research done by the University of Connecticut, Connecticut has experienced an increase of 8 to 9 inches of global sea-level rise since 1880.

In order to combat the oncoming climate crisis, on December 16th, 2021, Governor Lamont signed Executive Order 21-3 to reduce carbon emissions and fund resilient infrastructure. He announced that "climate change is

here, and it's only going to get worse if we don't take meaningful action." Some believe that this executive order will not be enough. The Citizens Climate Lobby (CCL), a nonpartisan nonprofit organization dedicated to climate education, has been proposing a Climate Emergency Act and Resolution since the start of 2022. This proposal seeks to significantly increase federal funding against climate change in order to meet Connecticut's emissions and net-zero goals. Bridgeport, Hartford, New Haven, Middletown, and 26 other communities in Connecticut have declared climate emergencies or support for a carbon fee and dividend system of pricing carbon. Now, CCL would like Connecticut's State Representative, Mike Demicco from Farmington and Unionville, to support this Climate Emergency Act.

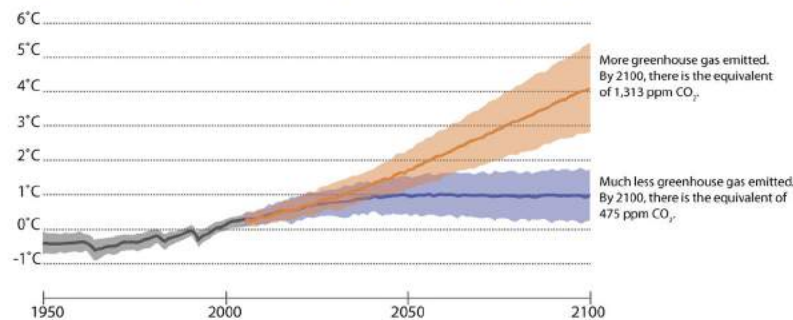
*“Climate change is here, and it’s only going to get worse if we don’t take meaningful action.”*

*- Governor Lamont*

Looking into the future, experts believe that climate change is the greatest threat to public health. The Connecticut Governor’s Council on Climate Change (GC3) predicts that by 2050, Connecticut could experience an increase in sea level of 20 inches, five times the flood risk factor, increased drought risk, and an overall higher frequency of natural disasters. This disaster will end up affecting certain groups of people unequally, especially Black and Latino communities, which are likely to face higher impacts of climate change. Lauryn Holloway’s article (Hypatia Fall 2021 Edition on page 6) further delves into the examples and effects of environmental racism.

Around the world at the rate greenhouse gases continue to rise, global temperature is predicted to rise 7.2 degrees Celsius. By the end of the century, the Arctic Ocean is likely to be ice-free during the summer and sea levels are predicted to rise between 12 to 39 inches. However, if the greenhouse gas emissions are reduced, Earth will only warm approximately 1.8 degrees Celsius and the impacts of climate change will be lessened. Hopefully, Farmington, Connecticut, and the rest of the United States will continue to move in the right direction to prevent climate change and the disparities it causes.

global average surface temperature change projections



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# WATER CONSERVATION: NOW, TOMORROW, AND THE NEXT DAY

LAURYN HOLLOWAY

For years water conservation organizations have emphasized the importance of paying attention to a person's water usage. Organizations, such as the Thirst Project, taught me about the 3% of freshwater that our world has and how so many people waste it. Water is wasted when: the faucet is running while brushing teeth, using the washing machine to wash one or two pieces of clothing, taking long showers, etc. This is an ongoing issue that so many people disregard because people see water everywhere. Water is in the ocean, rivers, ponds, etc. 71% of the earth is water. The idea that we could end up with a drastic water shortage is hard for many to grasp because more than half of earth's 3% of freshwater is located in ice caps and glaciers, making it unusable.

On top of this, although many Americans can take advantage of the freshwater we have access to, many people around the world do not have access to safe, clean, water already. Many people have been living in a state

where they have to preserve the little freshwater they have. Understanding that clean water is not a luxury to all, it is important that those that have easy access, use it more intentionally.

Lake Mead, located in Nevada, is the largest reservoir in the United States. The freshwater lake supplies water to many farms, cities, and more. Unfortunately due to drought, the lake has been reaching its lowest water level point ever. Officials located in Arizona, Nevada, and California recognized this issue and decided to take action, creating the 500+ plan. This plan invests 200 million dollars in reducing the amount of water usage from the lake. The minimum goal is to preserve 500,000 acre-feet of water per year. For this to happen, the plan seeks to implement new water conservation systems in the lake. This plan is a step in the right direction towards more water conservation practices in the US. The 500+ plan demonstrates the necessary work to be done in order to prevent such a drastic freshwater





The time to conserve is now, if people continue to waste the water that we have, in the year 2040 there will be a water shortage that will affect the entire world. We need to practice water conservation individually to make a collective impact. Do not put it off for another day, start now.



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# SYLVIA ALICE EARLE

JESSICA HUA

Sylvia Alice Earle was born in Gibbstown, NJ on August 30, 1935. She is a marine biologist, explorer, oceanographer, author, and lecturer. Since 1998, Earle has been a National Geographic explorer-in-residence and currently holds the record for the deepest walk on the seafloor. Additionally, she is the first woman to lead the National Oceanographic and Atmospheric Administration within the United States Department of Commerce.

Sylvia Earle was raised on a small farm near Camden, NJ, with her parents and her two brothers. While Earle's parents did not attend college, they still instilled a love for learning in Sylvia from a young

age. Earle often recalls spending hours by a pond in her backyard, filling jars with fish and tadpoles, while recording her observations in notebooks. Later at age 13, Sylvia's family moved to Florida near Clearwater on the Gulf of Mexico. Here she became interested in the wildlife at the Gulf Coast and was an excellent student graduating high school early at the age of 16. She went on to gain a scholarship to Florida State University to study botany and became a certified scuba diver to study ocean plant life firsthand. She graduated at 19 and went to Duke to earn her master's in botany by 20.





After earning her master's, Earle began her doctoral studies at Duke where she focused on algae. Though she took a break from her studies when she met and married John Taylor, a graduate student in zoology, she resumed studying after giving birth to her son and daughter. In 1964, Earle was invited on a six week trip to the Indian Ocean on a National Science Foundation research vessel. Though a demanding job that was not offered often to women at the time, Earle was used to being the only woman in scientific settings and accepted the offer. She then continued her voyages in the Galápagos Islands, the Chilean coast, and the Panama Canal Zone from 1964 to 1966, all while completing her doctoral coursework and writing her dissertation. In 1966, Sylvia received her Ph.D. in botany and collected more than 20,000 samples of algae to catalog plants in the Gulf of Mexico for her dissertation. Her project remained a landmark study for decades because she was the first scientist to use scuba to document

marine life firsthand.

After Earle and Taylor divorced, she met and married Dr. Giles W. Mead, a curator of fishes at the Harvard Museum of Comparative Zoology. In 1966, Earle was appointed as a research scholar at Harvard, and in 1968 she joined the Smithsonian Institution's Man-in-Sea project, an experimental underwater habitat, in the Bahamas. She went 100 feet below the surface in a submersible vehicle and entered the habitat as the first woman scientist to do so in that manner while four months pregnant with her third child. The following year, Earle applied to the Tektite II Project sponsored by the U.S. Navy, Department of the Interior, and NASA near the U.S. Virgin Islands. However, government officials did not want men and women living together in the habitat, so Earle led an all-female team to the habitat. There, she observed and photographed marine life. When she



and her team returned, they were celebrities; they were honored at the White House and received a parade in Chicago.

With her newfound spotlight, Earle shared her passion for marine life with broad audiences to help the public understand the value of the ocean. In 1970, she and her family moved to Los Angeles to begin teaching at UCLA. Earle presented around the country to describe her underwater explorations and wrote for various publications. In 1990, Earle was appointed as the first woman to hold the position of Chief Scientist at the National Oceanographic and Atmospheric Administration (NOAA). Later, in 1992 she returned to her work in exploration, education, and deep ocean engineering.

Earle has also received many honors and awards internationally; most notably, she was awarded Time magazine's first Hero for the Planet (1998), the TED Prize (2009), and the United Nations Champion of the Earth (2014). Throughout her entire career, Earle authored 200+ publications, lectured in 80+ countries, and led 100+ marine expeditions. All her work has contributed to protecting the ocean and its wildlife, particularly in light of the accelerating threat of climate change.



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# THE STEM GAP

ELIZABETH CARGAN

*“I still remember asking my high school guidance teacher to take a second year of algebra instead of a fifth year of Latin. She looked down her nose at me and sneered, ‘what lady would take mathematics instead of Latin?’”*

*- Nancy Grace Roman*

Girls and women are systematically pushed away from careers in science and math throughout their education, their opportunities to enter STEM fields as adults become more limited. Women only make up 28% of the workforce in STEM fields, they are vastly outnumbered by men. The gender gap is particularly high in fields like computer science and engineering.

## Women in STEM Occupations:

- Women make up 46% of biological sciences. (red)
- Women make up 40.4% of chemists & material sciences. (orange)
- Women make up 25.2% of computer & mathematical occupations. (black)
- Women make up 16.5% of engineering and architects. (blue)

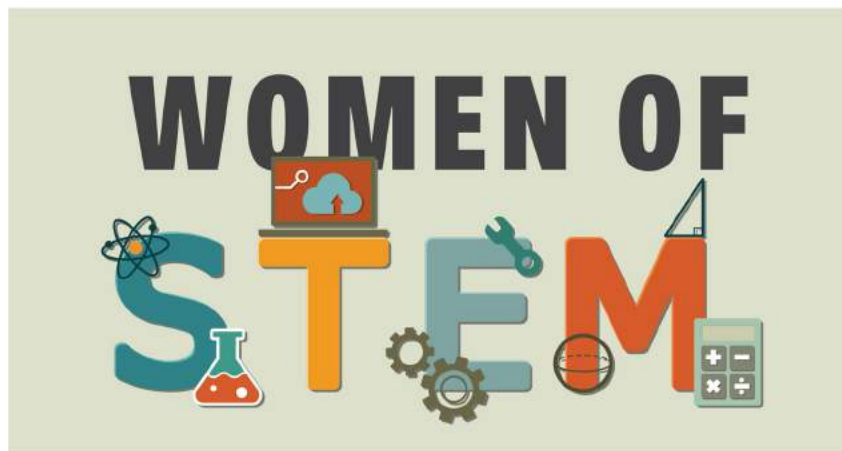
Women in STEM Occupations



SOURCE: U.S. Bureau of Labor Statistics, "Employed persons by detailed occupation, sex, race, and Hispanic or Latino ethnicity," Labor Force Statistics from the Current Population Survey, Table 11, 2020.







## Closing the STEM Gap:

***There are steps we can take and things we can do to close the STEM gap --***

- Give women the skills and confidence to succeed in math and science:
- Raise more awareness that girls are just as capable as boys
- Give girls the same encouragement and educational opportunities as boys
- Promote more public awareness to parents about how to support their daughters in math and science
- Promote a growth mindset that empowers girls to embrace challenges
- Emphasize strong role models of women and women of color in STEM fields

***Improve STEM education and support for girls k-12:***

- Address implicit and systemic biases to raise awareness about girls math abilities in the education field, avoid female teachers passing on math anxiety and train teachers to ensure that girls and boys are held to the same standards
- Encourage girls and women to take as many STEM and advanced STEM classes as they want

- Reduce high-stake assessments in early grades that reinforce stereotypes
- Ensure that every student is exposed to engineering and computer science
- Change classes by connecting STEM to girls lives, emphasize the ways that SEM is community-oriented
- Teach girls math through open-ended discovery
- Example after-school and summer STEM opportunities for girls
- Increase awareness of education and career opportunities -- especially for women of color -- in STEM for girls

***Work to attract and retain women in STEM majors in college/university:***

- Design courses and change environments in STEM to be welcoming for women
- Prioritize inclusive and respectful environments, incorporate diverse leadership
- Diffuse the dependent relationships between trainees and faculty to change the power dynamic in STEM fields

- Make the academic community responsible for preventing sexual harassment and support targets of sexual harassment

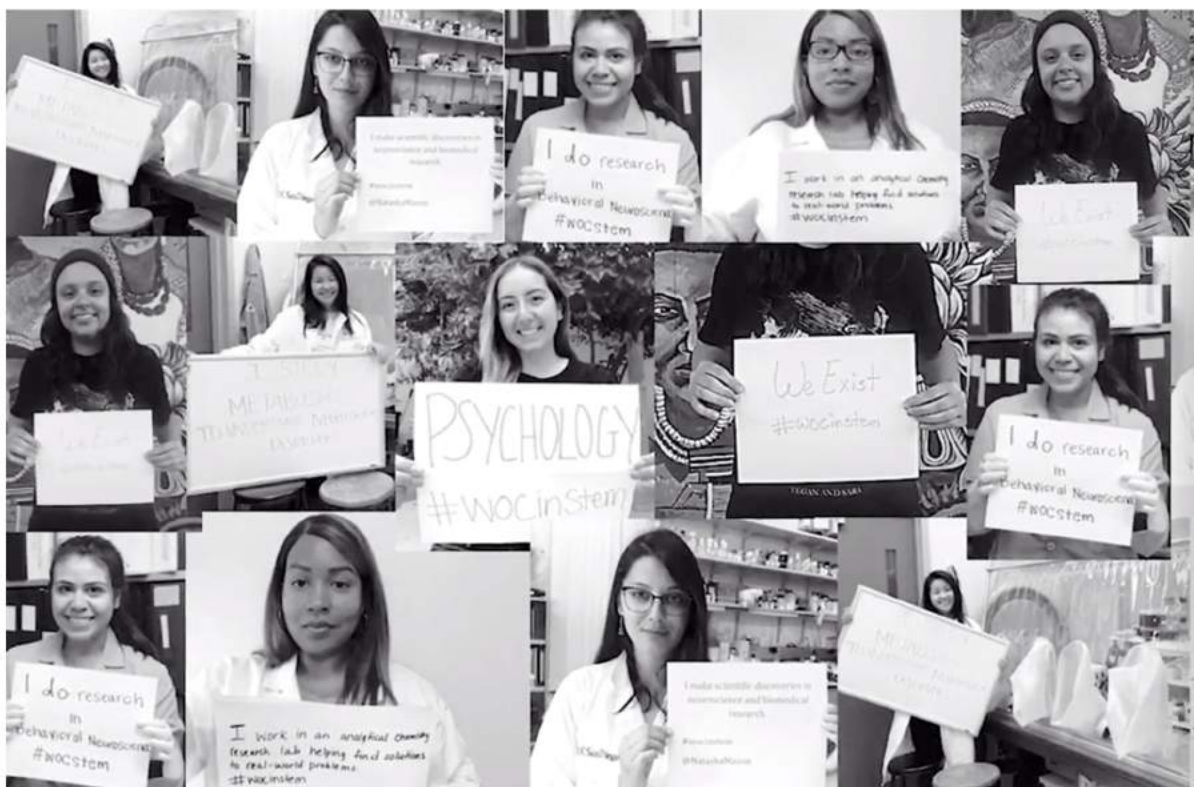


## ***Improve hiring, retention, and promotion pathways, create intentionally inclusive cultures:***

- Recruit women and promote women throughout their STEM careers

## **Promote welcoming work environments including;**

- Pay equity
- Family and medical leave policies
- Anti-bias training
- Ally-ship opportunities
- Strong anti-discrimination and anti-harassment policies



Source:

<https://www.aauw.org/resources/research/the-stem-gap/>



# THE COST OF URBANIZATION

LEEAH HAN

Throughout history, population growth and, consequently, land development, have been relevant issues that have not only affected people, but the environment around them. More specifically, urbanization, the development of rural populations into urban areas (which scholars believe began in the Mesopotamia region of 4300-3100 BCE), has become a modern issue that impacts societies, economies, and landscapes. The issue of urbanization was most pervasive during late 19th-early 20th century America, as millions of immigrants entered the country seeking opportunities for themselves and their families; this increase in population created a need for further urban development in the United States. From the end of the 19th century to the beginning of the 20th century, American cities grew by about 15 million people. Although the process of global urbanization was originally initiated to support employment opportunities and

industrial growth, the benefits of this practice have begun to deteriorate, and its negative effects are as prevalent as ever.

The consequences of urbanization are vast and significant, some of which include: deforestation, higher consumption rates, reduction of biodiversity, air pollution, interference with biogeochemical cycles, and shifts in weather patterns. To make matters worse, the dangerous impacts of climate change intersect with (and are heightened by) urbanization. On this topic, an article written in the United Nations Chronicle states that "...in the coming decades, climate change may render hundreds of millions of urban residents increasingly vulnerable to floods, landslides, extreme weather and other natural disasters." These potentially devastating events are only being made worse with the unsustainable urban growth that is



occurring around the world. Additionally, most of the world's largest cities and urban populations are located near bodies of water, resulting in the vulnerability of such communities during natural disasters. According to the previously mentioned UN report, over half of the world's population lives in urban areas, a statistic which makes this situation all the more urgent. Although urban areas bring economic growth and potential for business, they are also depleting our natural resources and destroying our planet. Therefore, it is essential that society focuses on developing "greener" and more sustainable cities/towns.



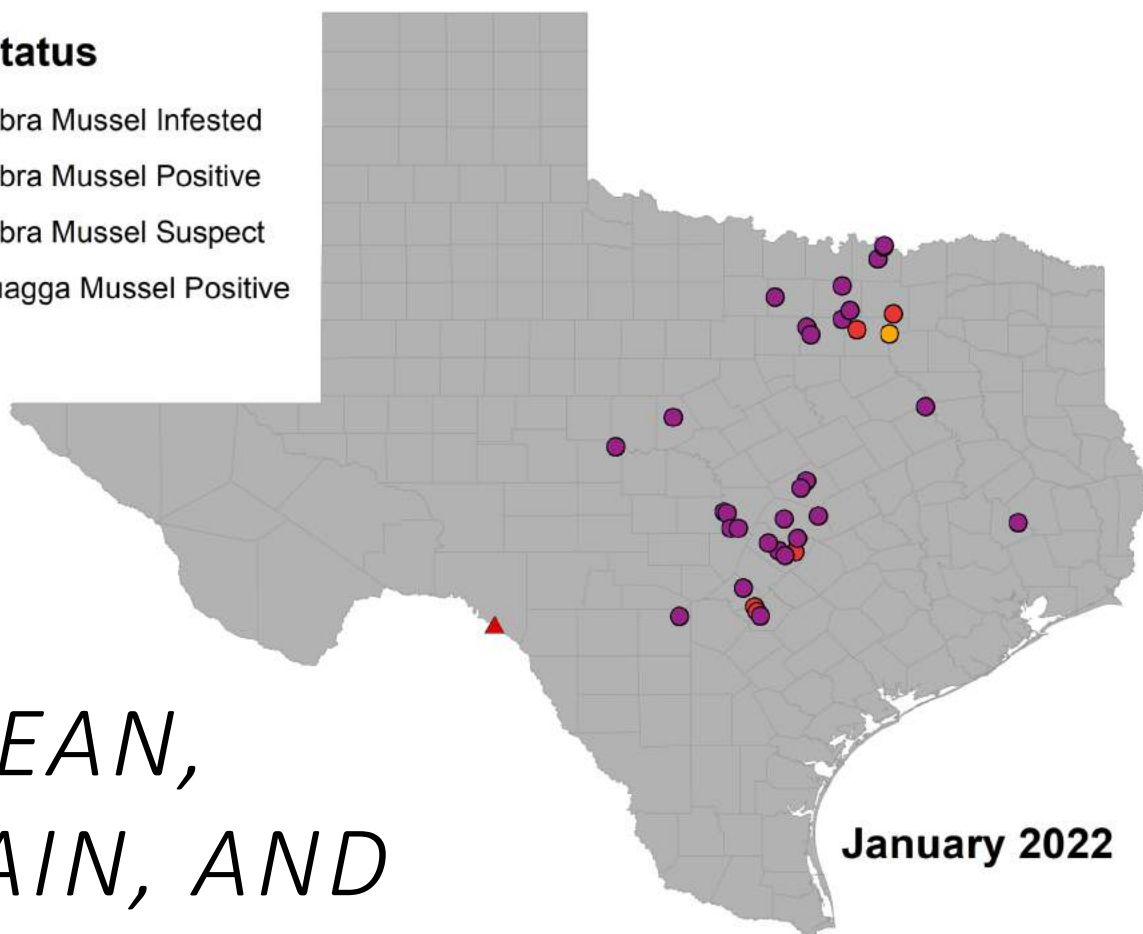
There are many solutions to the negative consequences of urbanization. For instance, the implementation of more environmentally friendly structures within urban areas is crucial and should be prioritized. This can be done through a myriad of ways, such as: promoting urban agriculture, implementing accessible public transportation services, reducing and managing food waste, or protecting "green" spaces (e.g. parks or

other areas reserved for public access to nature). Additionally, convenient access to contraceptive care is important in order to maintain a balanced population growth rate; overpopulation has become yet another threat that is only serving to increase the need for compact housing in urban areas. Such solutions need to be acted upon, for, if current trends continue, 68% of our world's population will be living in cities by 2050, a year in which threats such as drought, wildfires, increased flooding and extreme weather will likely be prevalent around the world.



## Lake Status

- Zebra Mussel Infested
- Zebra Mussel Positive
- Zebra Mussel Suspect
- ▲ Quagga Mussel Positive



*"CLEAN,  
DRAIN, AND  
DRY."*

January 2022

PAGE PENISTON

"Clean, drain, and dry." That has been the Texas Parks and Wildlife's plea to boaters for the past thirteen years after discovering the first adult zebra mussel in Texas waters. Since then, this invasive species has spread rapidly; currently infesting 28 lakes and six river basins across the state and identified in several more. As a result, state regulations require boaters to drain all water before leaving or approaching freshwaters at the risk of a 500 dollar fine, increasing up to 2000 dollars and 180 days of jail time for repeat offenses.

But why are these minuscule creatures such a big deal?

Simply put, they are stubborn and highly destructive to the local ecosystems, critical infrastructure, watercraft, and recreational lake access.

Zebra mussels are ecologically disruptive on many levels that lead to the decline of crucial native wildlife, including fish, birds, and mussels.

The most significant disruption zebra mussels cause is primarily due to the scale on which they operate. They multiply extremely quickly, taking over vast areas despite their small size. Sustaining this large population leads to the excessive removal of phytoplankton,



such as green algae, clarifying lakes. Deprived of their algae shields, lakes no longer have protection from the sun's harsh rays, leading to an increase in water temperatures and Secchi depths\*. These same feeding habits are also associated with a similar decline in zooplankton.

Unsurprisingly, Zebra Mussels' most dramatic detriment has been upon their local cousins. Texas mussels, already facing other struggles, stand little chance against this invader who, in competition for nutrition and space, quite literally grows over them. As a result, many have been added to the endangered species list, with several others not far behind.

Zebra mussels are also a vicious adversary of locals who rely on the lakes and rivers for water and outdoor activity. Their microscopic larvae are invisible to the eye and nearly impossible to separate from water, often taking up their permanent residence in pipes supplying water to residents. As they grow, they obstruct water flow, forcing shutdowns for challenging and expensive removal processes and costly prevention measures, including chemical injections.

Besides wreaking havoc upon water systems, they also negatively impact water recreation. Zebra mussels have caused extensive damage to boats, overtaken trailers and water toys, and even sunk buoys. Additionally, the shells of deceased mussels litter beaches, ladders, and ramps, and people run the risk of slicing their hands and feet on



their exceptionally sharp edges.

Unfortunately for many Texas lakes, it is too late to reverse many of these impacts. Monica McGarrity, a senior scientist with Texas Parks & Wildlife, spoke with a reporter with TexasMonthly about the growing crisis. When asked about removing the invasive mussels, she responded, "Unfortunately, once zebra mussels get into a water body, there is currently nothing that can be done to manage them... Prevention is the only weapon we have."

"Protect the Lakes You Love." Take these invasive creatures seriously because who knows where they could take over next.

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# DENMARK

## THE POLICIES THAT MADE IT THE MOST ENVIRONMENTALLY FRIENDLY COUNTRY IN THE WORLD

HELEN SHARP

It should be the goal for all nations to decrease their environmental footprint, which can be achieved by implementing laws that focus on environmental policy. There is a quantitative way to see how countries are measuring up to each other in these initiatives, called the Environmental Performance Index (EPI). It measures countries on 24 indicators that judge their policies, ranging from air quality to fisheries. It then gives each country a score out of 100. In 2021, Denmark had the highest EPI score of 82.5. For comparison, the United States' EPI score was 69.3, which put it 24th in the international rankings. To see how other countries' EPI scores can be raised, it can be useful to look at the policies that helped Denmark rise to the top of the chart.

One of the largest policies that Denmark has implemented to benefit the environment is the Industrial Emissions Initiative (IED). Numerous laws and regulations have been passed under this initiative, all of which focus on

supervising combustion plants. They also launch investigations on factories effects' on soil and groundwater. Due to how factories account for 29.4% of the United States emissions, implementing policies like these would be a monumental step towards making the US a greener country.

Another policy that Denmark has implemented to become a more environmentally friendly country is requiring strict environmental permits in the following industries: metal manufacturing, processing of raw materials, chemical and biological manufacturing, production of heat and power, airfields, the care and breeding of animals, and disposal of waste. All of these industries can undo environmental repercussions if left unchecked, so making sure that they can perform their important tasks without harming the environment is imperative. There are also penalties like fines or possible removal of the permit if the company holding it damages the environment, whether that is from negligence or blatant disregard.



Arguably the most important initiative that Denmark has taken to become greener is their pledge that their entire energy supply will be renewable by 2050. They are making great strides to reach this goal, as of right now 67% of their electricity is from renewable sources. This is mostly done using power from windmills, but they also use biofuels and solar energy. In stark comparison, only 19.8% of the United States' electricity is gleaned from renewable sources.

There are countless other legislations that Denmark has implemented to become a more environmentally friendly place. In looking at these legislations, it can be seen that they are not out of reach for other countries. Although the legislation would take longer to both put in place and see the effects of in a large complex country such as the United States, this is no excuse not to implement policies such as these that have proven to greatly benefit the environment. Denmark should serve as an example to the rest of the world on what to do to help end the burgeoning climate crisis.



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# PLASTIC DECOMPOSITION

ANQI SHI

The pandemic has increased single-use plastic with extra packaging, disposable masks, and gloves made of plastic fibers, polypropylene. A single mask that ends up in the ocean could release 173,000 microplastics per day. (Parker 2021)



## Plastic Recycling Myths Debunked

Plastic recycling myths #1: Most plastic will be recycled

Fact: Less than 10 percent of the total plastic produced is recycled because using plastic produced from oil is cheaper than the cost of the recycling process.

Plastic recycling myths #2: Plastic bottles are recycled into new plastic bottles

Fact: The plastic quality degrades each time recycled because polymer chains are broken when melted, decreasing its durability, making it only suitable for products with less plastic quality such as carpets, cloth, etc. This means plastic bottles can't be recycled into new plastic bottles, they could only be recycled into other products that can't be recycled again and eventually will end up in a landfill.

Plastic recycling myths #3: Plastic could be recycled infinitely

Fact: A piece of plastic could only be recycled up to 2-3 times, which means, the best way to stop plastic pollution is simple, to not use any plastic products at all.

## Recent Discoveries Raise Question: Could Organisms That Consume Plastic Be The Hero To The Plastic Pollution Crisis?

Scientists have found over 50 species of 'plastivores', mainly bacteria, and fungus that can digest plastic. Most notably, a





a bacteria in the gut of waxworm larvae, which naturally feed on honeycombs, could turn common plastic, polyethylene, into ethylene glycol. Mainly used in antifreeze and ballpoint pens solvent, ethylene glycol is biodegradable and not toxic to the environment. Waxworms were accidentally discovered by a biologist, Federica Bertocchini, at the University of Cantabrian when she took out some wax worms from the beehive she was raising into a plastic bag and discovered that those worms chewed their way out to escape. But, it would take 100 worms a month to eat only a 5g plastic bag.

Another bacteria, *Ideonella Sakaiensis*, discovered in landfills by Japanese scientists in landfills, are able to break down and use the most common plastic, PET, which is used in making plastic water bottles, as its energy source. The bacteria make enzymes, which are proteins that catalyze biochemical reactions to break down plastic. Specifically, the enzyme PETase is able to break the ester bond, usually found in lipids, to hydrolyze PET. In other words, hydrolysis is a process where water is

added to break larger polymers into monomers. The product of which is broken down by another enzyme and left with biodegradable end products, terephthalic acid, and ethylene glycol. Terephthalic acid could be used to make plastic bottles.

However, the use of organisms to degrade plastic is still not widely applied in real life and needs more research, such as genetic engineering, to improve efficiency and reduce cost.

## What's Next?

There are many complexities to the plastic problem. One being, if all plastic is easily biodegradable, would it mean the need to develop a more sturdy material that would replace plastic?

What's the impact of having microplastic on the human body? Would microplastic lead to more cancer mutations?

There are social and political aspects to this environmental problem as well because most plastics are produced in developed countries but would end up in developing countries.

## Further readings:

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# THE TRANSITION TO RENEWABLE ENERGY

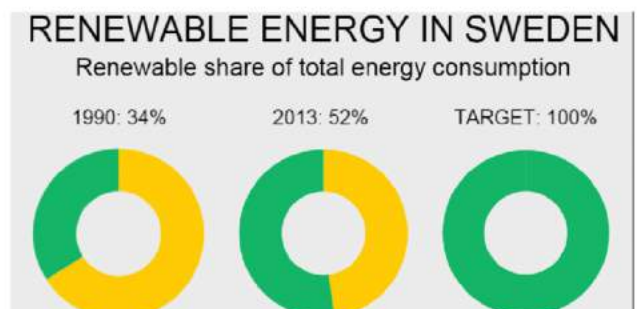
EMMA ANDREWS

Fossil fuels are one of the main causes of climate change today. The world relies heavily on fossil fuels as they are the leading source of energy, providing 80% of all energy on the planet. Through mining and drilling, humans extract oil, coal, and natural gas, to be used for transportation, producing electricity, and heat. Apprehension towards fossil fuels began in 1968 when the Stanford research institute claimed that, “the release of carbon dioxide from burning fossil fuels could carry an array of harmful consequences for the planet”. Fossil fuels are responsible for over 40% of global energy-related carbon dioxide emissions, with the total being about 33 billion tonnes of carbon dioxide released each year.



Leading this transition to clean energy is Sweden, which aims to completely eliminate the use of fossil fuels by 2040. In 2012, 50% of the energy used in Sweden was renewable, and that number has continued to rise in recent years. Sweden uses its natural resources, such as moving water and biomass, for heating and electricity production. Citizens of Sweden are satisfied with these new changes, noticing the improvements and less expensive bills. Sweden has challenged the rest of the world to beat them to their goal, encouraging other countries to make the transition.

As climate concerns escalate, countries around the world are becoming increasingly interested in renewable energy sources. Not only do they reduce greenhouse gas emissions and air pollutants, but renewable energy also has economic advantages, such as reducing costs and creating new jobs. There are several different types of renewable energy, most commonly, bioenergy, hydropower, geothermal, solar, and wind. The renewable energy industry is anticipated to grow rapidly in the next few decades; many countries are beginning to shift their focus





Using clean energy is one of the most crucial things that society needs to reduce its impact on the environment. Clean energy reduces greenhouse gases, toxic materials in our air and water, and overall will help with climate change mitigation. The transition from fossil fuels to renewable energy might be difficult, and it's important that renewable sources are being built in the right places, but it's a necessary change.



“FOSSIL FUELS ARE RESPONSIBLE FOR OVER 40% OF GLOBAL ENERGY-RELATED CARBON DIOXIDE EMISSIONS, WITH THE TOTAL BEING ABOUT 33 BILLION TONNES OF CARBON DIOXIDE RELEASED EACH YEAR.”

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Renewable energy explained - types and usage -



# WHAT DOES THE FUTURE LOOK LIKE?

## A story of planet Earth

ELIZABETH AKOMOLAFE

What will the planet look like in 10 years? 20? 50? In the wake of a new year, it may be a good idea to examine the impact climate change may have in the next few decades. Everyone has heard about the generalized effects of climate like melting glaciers, rising sea levels, and increased temperatures, but how will that shape the landscape in the coming years?



It was Churchill who said that “those who fail to learn from history are doomed to repeat it”. In order to be better scholars on the climate crisis it is important to take a brief dive into history. While climate change encompasses the natural changes in temperature and precipitation of the earth, climate change history—as it relates to humans—really begins in the 1800s. In 1820 physicist Joseph Fourier, proposed the idea of the ‘natural greenhouse effect’ where a thin layer of gas ‘traps’ heat and Energy that keeps the Earth warm. 40 years later, In 1861 Irish physicist John Tyndall found that coal gas (CO<sub>2</sub>, methane, and volatile hydrocarbons) alongside water vapor were highly effective at absorbing heat. Opposing the sentiments of today, the potential of global warming was thought to be a good thing in the 1800s; Swedish chemist Svante Arrhenius came to the conclusion that the industrial-age would enhance the greenhouse effect

suggesting it might be beneficial for future generations. He demonstrated that the temperature of the planet would increase and decrease based on CO<sub>2</sub> levels and even all that time ago his results weren’t far off modern calculations.

More recently, in 1938 British engineer Guy Callendar, used records from 147 weather stations worldwide to show that global temperatures had risen over the last century and CO<sub>2</sub> concentrations had increased over the same period. Sadly for earth’s inhabitants, in 1957 US oceanographer Roger Revelle and chemist Hans Suess discovered that seawater will not absorb all the additional CO<sub>2</sub> in the atmosphere, and it is widely known as a coral killer in today’s world.

As the world became more aware of the issue of global warming the Kyoto Protocol was agreed on in 1997, with the nations included pledged to reduce carbon emissions by an average of 5%. Many nations, including the US did not follow through on that commitment and in 2006 carbon emissions from burning fossil fuels were at eight billion tonnes per year. Just 3 years later in 2009 China overtook the US as the world's largest greenhouse gas emitter and has been leading ever since. Last on the list of significant events is the United Nations Climate Change Conference (COP26) that took place in Scotland from October 31st to November 12th, just last year, in 2021, putting together yet another agreement to lower carbon emissions.



A quick look into the future can show that simply by not cutting carbon emissions, the world could be facing an increase in average temperature of about 3 degrees by 2100. The future isn't pretty, and plays to the tune of extreme weather events in increased frequency, intense heat, Disease, dangerous income inequality, and mass migration. Many places will become uninhabitable, food production will become more difficult and water more scarce. Air will be the first concern, it will end up being hot and heavy, clogged with particulate pollution. This will leave people with watery eyes, terrible coughs, and masks that will never go away. By this point the ice caps will be gone, no longer able to reflect the sun's rays. The permafrost will be melting and exposing humans to unfamiliar microbes, ticks and mosquitos running rampant, flourishing in the new climate, with widespread disease and

infection wherever you look. Natural disasters will most likely delay food and basic relief supplies, alongside the molecular difference in the air, leading to an increase in malnutrition, cholera, general infections, and respiratory illnesses. There will be few forests that were not consumed by wildfire or logging and the oceans, plants, and soil can no longer keep the effects the CO<sub>2</sub> at bay. Hurricanes and intense tropical storms are a given, wiping out coastal cities, 'killing many thousands and displacing millions' (Figueres and Rivett-Carnac, 2020). In addition, the fishing industry will be essentially non-existent, with the ocean becoming an acidic-hostile environment for marine life because of the absorbed carbon dioxide.



On the other side of that, droughts and heat waves are turning vast regions into dry infertile land or deserts. In the hottest parts of the world, there are days with temperatures of 60°C (140°F), a point where after six hours the body loses the ability to cool itself down. Food and water become scarce hot commodities with people migrating to find it, and countries shutting their borders to protect it. Travel for anything other than permanent migration, is a thing of the past. Global trade has essentially come to a halt, and wars still rage blocking off trade routes. This is all accompanied by refugee problems and civil unrest, and further death. Even areas that are safe from wars and wouldn't be majorly affected by eroding coastlines, they will suffer flash floods, wildfires, mudslides, and blizzards or at the very least the fear of those things.

Clearly, the future has the potential to be a terrifying place if the general trend of things is to be believed. Natural disasters, extreme temperatures, disease and starvation make things look quite grim, and with climate change becoming an increasingly politically polarizing issue, it is so important to have discussions and raise awareness about it. Exploring it by traveling from the facts of the past to the potential future is just another way to continue the conversation. Scientists use climate models to predict what will happen but what was shown here is only one very dystopian outcome. Humans are a big unknown within the equation and as important as the past is, what's more important is what happens next. Armed with this knowledge, What will you do next?

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# INTRODUCTION TO GENETICALLY MODIFIED ORGANISMS

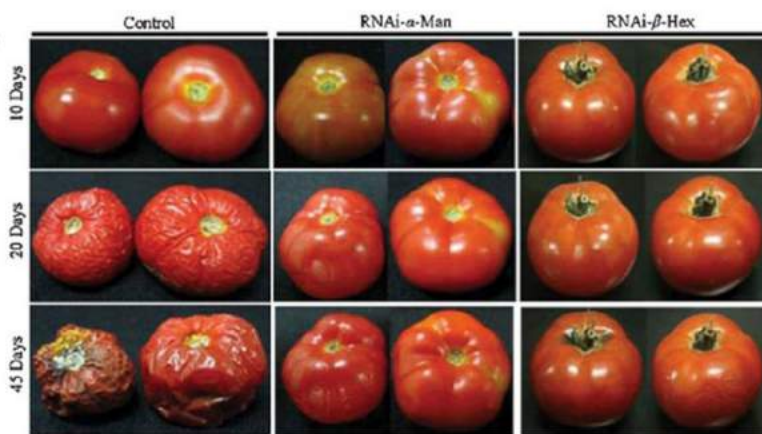
KINLEY SIMMONS AND JUNE LIU

GMOs have remained a homogeneous aspect of commercial agriculture in recent years. However, GMOs have become a topic of much controversy among both scientists and civilians. GMOs or genetically modified organisms are dubious as some see the benefit in using science to create the ideal crop, while others are uneasy about essentially eating one's science project. Nonetheless, it's important to know the history and facts surrounding GMOs before making opinions about them.

The origin of genetic engineering can be traced back to Circa 8000 BCE when humans discovered that they could take two crops with different positive qualities and breed them to create the most ideal version of a crop. This process is known as selective breeding and has become a staple in the scientific world today. Despite the significant scientific advancements made with this discovery of selective breeding, little was known about the science behind it. This all

changed due to Australian monk and botanist Gregor Mendel's discovery of dominant and recessive genes or Mendelian Inheritance. Through experimentation with seven different characteristics of pea plants, he discovered certain traits were dominant or recessive. By crossing plants with the ideal dominant trait, the offspring would be inheriting the dominant trait. This shaped genetics as we see it today. Mendel published his work in 1866 but was not recognized until his work was verified in 1900 by Hugo de Vries and Carl Correns. As a result of this genetic discovery, in 1922 the first hybrid corn was produced and sold commercially. This corn was double-crossed and produced using a parent made from two Burr White inbreds, and the other from two Leaming inbreds. In 1973 genetic engineering was developed by Biochemists Herbert Boyer and Stanley Cohen, nine years later the FDA approved the first consumer GMO produced using

Boyer's and Cohen's discoveries. Between 1986 and 1992 legislation was passed to regulate the safety and requirements of GMOs. In 2015 an application for genetic modification in animals eaten by humans was approved, and in 2016 a law was passed requiring food GMOs to be labeled using the term "bioengineered". Finally, from 2017 to present-day GMOs have become common among commercially sold foods.



Although GMOs are so widely conversed, few actually know how they are produced. First, scientists find a desired trait in specific plants, then identify an organism that contains that trait within its genes. Next, scientists copy the found gene with the desired trait. After that scientists insert the gene into a strand of DNA into the nucleus of a single stem cell from the crop they wish to modify. After the single cell has been modified, the scientist allows the cell to grow in naturally occurring plant hormones. The resulting cells will then begin to separate and form a whole plant that contains both the added trait and the traits that the plant naturally

possesses. Scientists don't only have to insert genes into the DNA of an organism, they can also edit the existing DNA in an organism. Scientists can genetically engineer an organism to overexpress a certain trait, for example, the height of a plant, or reduce the expression of a certain trait. GMOs then undergo reviews and tests before being sold to farmers. The four most conventionally modified crops are corn, cotton, soybeans, and canola. Majority of agriculture in the United States is already using many GMO crops. In 2015, India planted 250,000 acres of genetically modified cotton. The specific genetic modification made is to be insect resistant, called Bt cotton. GMOs are not only in regards to food but also in medicine and vaccines. Two examples of vaccines that used genetically modified organisms are one against cholera and the other against Hepatitis B.

While GMOs are relatively new, there has been a lot of controversy surrounding them. People debate whether or not there will be health defects caused by genetic modifications, or potential environmental issues. A Harvard study published in 2015 by Megan L. Norris investigated the different controversies surrounding GMOs. There are many people in support of and against genetic modifications in organisms. On one side, there are many people that believe that GMOs can cause health and environmental issues. The Institute of Responsible Technology (IRT), an anti-GMO advocacy group founded in

2003, set up an investigation regarding feeding rats a diet containing a genetically modified potato. The IRT had stated that the rats had every organ system adversely affected after ten days of feeding and that the toxicity was a result of genetic modification and not just a specific case for that potato. In some research, scientists have speculated that genetically modified plants may leak harmful chemical compounds into the soil through their root systems, potentially affecting communities of microorganisms.



While there are many studies against GMOs, there are also many studies showing that GMOs do not exhibit toxicity in one generation or across many. The National Institute of Toxicological Research in Seoul investigated something similar to IRT regarding genetically modified potatoes. They had fed rats GMO potatoes and non-GMO potatoes. The results seemed to contradict the claim that the IRT had made. A thorough histopathological (pertaining to the study of changes in tissues



caused by disease) examination showed that there were no differences between the different organ systems of rats that ate the GMO potatoes and those that did not. Another factor to consider however is that the consequences of consuming GMOs might not appear for generations. To address the issue of toxicity buildup, a group from South Dakota State University studied many generations of rats consuming GMOs. Their results showed that there was no change or defects in the rats for four generations. There is still worry regarding whether GMOs can change DNA, so a group of scientists from the National Laboratory of Protein Engineering and Plant Genetic Engineering in Beijing applied the Ames test (a method able to track increased rates of mutations in a living thing) to GMO tomatoes and GMO corn. The GMO tomatoes and corn were modified to be resistant to the cucumber mosaic virus (CMV), the most broadly infectious virus of any known plant virus. The results show that there is no relationship



between mutations and the GMO corn and tomatoes. The group repeated their analysis multiple times and still had the same results. Researchers have concluded that there is no evidence for gene transfer between the GMO and the consumer, nor are there relationships between GMOs and mutations.

This begs the question, why is there so much controversy around GMOs? As rather insightfully said by Morgan Chamberlin in her paper regarding the effect of genetically modified crops. In her paper, she had studied that there were net increases in the use of herbicide in some places after using GMOs that were meant to counter herbicide, but this was mainly due to mishandling. "In many cases, these effects are due to human error in the application of this technology, not the technology itself." GMOs themselves are not as harmful as some people think, but misuse can have negative effects on the environment and health. It is important to understand the history behind GMOs, how they were developed, and their implications or lack thereof in the health of humans. In a world riddled with blind controversy, the debate surrounding GMOs encourages one to search for the full picture of this topic as relayed in this article, and make a personal decision regarding their chosen lifestyle.



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Our next issue will be in **Spring 2022**

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write for the next issue of Hypatia,

please email:

[eakomolafe23@missporters.org](mailto:eakomolafe23@missporters.org)

[sli23@missporters.org](mailto:sli23@missporters.org)

[ashi24@missporters.org](mailto:ashi24@missporters.org)