

ISSUE 36 Spring 2018

# NU SCI

NEU Marine  
Science Center

Harvard Museum of Natural History

3D Printing at  
Harvard University



MIT

Science Writing  
@Kendall Square

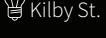
Museum of  
Science

ACIR @ Sidney St.

Partners in Health  
@ Boylston St.

ReGame VR Lab at NEU

Brigham and  
Women's Hospital



Seaport



# LOCAL

Codeman Square

Revision Urban Farms

Sharon

Duxbury

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# Letter from the President



PHOTO BY RACHEL GIANATASIO

Over the past five years, I have contributed to 21 issues of NU Sci – first as a writer and editor, then as editor-in-chief, and now in the past two semesters as president. During that time, I've watched and participated as the magazine continually evolved and changed. We've covered everything from Food (Issue 21) to Climate (Issue 27) to Space (Issue 32). We've shortened our name from "NUScience" to the more concise "NU Sci." We've changed our logo more than once, and have debated the utility of certain forms of social media. We've gone through a constantly fluctuating but unceasingly dedicated team of leaders and contributors.

I have enjoyed every minute of it.

It's fitting that the last issue that I will contribute to before graduating in May 2018 is focused on a theme that is close to home. In Issue 36, "Local," you'll find many Northeastern-based stories – a feature on the NU chapter of the College Diabetes Network, a look into the Rehabilitation Games and Virtual Reality Lab, a visual portrait of the research happening at the Marine Science Center in Nahant – as well as articles that took our writers outside campus for research and reporting. Turn to page 12 to read about how Harvard researchers are studying how to improve heart valve replacement or look to page 30 for a peek into the future of the MBTA. On page 23, you'll find a firsthand account of what it's like to work at the Best Bees Company. The varied content of Issue 36 shows just how much exciting science is happening at Northeastern and throughout Boston every day.

Throughout my college career, I've spent time finding my niche in both the Northeastern and the broader Boston communities. From the very first time I met Jessica Melanson and Claudia Geib, then editor-in-chief and staff writer, respectively, at the Student Involvement Fair in September of 2013, NU Sci has been a key part of that process. It's been a chance to build my writing and editing skills and to get better at communicating science at a time when that skill is increasingly vital. In addition, I've met and worked with an amazing group of researchers and writers. But this experience has also helped me to grow in ways that have nothing to do with writing. I've learned to stop being afraid of asking stupid questions, to be assertive and clear in my online communication, and to work collaboratively on a team containing diverse skill sets and opinions.

Every time I table at the Student Involvement Fair or talk to a new writer, I think about when I was just starting out at NU Sci. Then, being part of the magazine helped me feel more confident at a time when it was easy to feel lost. Now, it's a passion project that I share with nine other e-board members and more than 50 other contributors. As the team continues to evolve over the following years – headed by Editor-in-Chief Sage Wesenberg and future President Jackson Griffiths – I know that it will always be a resource for people who are inspired by science, passionate about effective communication, and just the right amount of geeky.

Gwendolyn Schanker  
President



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# Boston's Getting Hot & Bothered by GMOs

BY HUGH SHIRLEY, BIOCHEMISTRY, 2019

DESIGN BY JULIE MURMANN, BEHAVIORAL NEUROSCIENCE, 2021

**Genetically modified organisms** (GMOs) are reshaping the agricultural industry. GMOs are defined by the U.S. Food and Drug Administration (FDA) as any animal or plant that has been created specifically through genetic engineering. GMOs do not include animals or plants injected with hormones, subjected to selective breeding, or animals that are fed GMO crops. GMOs are poised to shake up the production of food and pharmaceuticals through the innovative scientific techniques that allow researchers to specifically design organisms capable of withstanding disease, extreme temperature, pests, and other environmental stressors that a non-GMO organism would not survive. GMOs provide amazing new ways to reduce the use of potentially harmful pesticides and chemicals, or to feed more people by increasing a plant's resilience, but debate surrounding the harm that this new technology could cause keeps GMOs from being fully accepted into the mainstream.

In Massachusetts, the question of GMOs and their relevance to the market and the end consumer is still under deliberation. Many questions surrounding the ethics and safety of GMOs muddy the waters of what could be a revolutionary technological advancement. Policy makers in Boston are faced with deciding whether GMOs should be labeled as such or if they should be allowed in stores at all. The science surrounding the safety of GMOs for consumption is still up for debate. Thousands of studies published over the past few decades have reached wildly different conclusions about the toxicity of GMOs to humans. Many researchers and governments believe GMOs "need to be assessed on a case-by-case basis" and a blanket statement about their safety could end up harming the consumer and the environment.

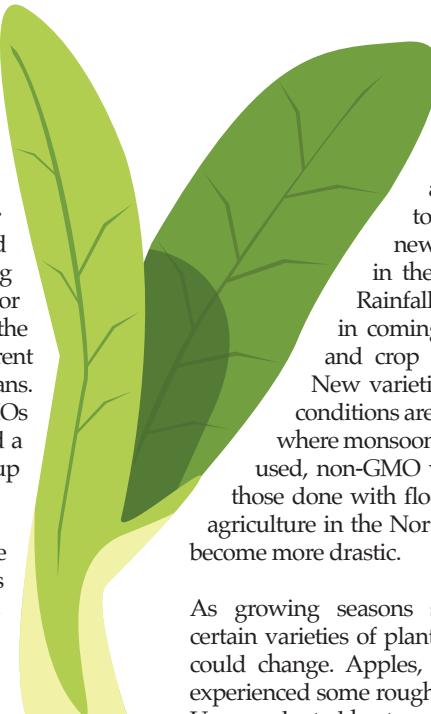
The GMO picture gets even blurrier when the ethical concerns are considered. The do's and don'ts of toying with DNA are difficult, if not impossible, to categorize objectively. Should a scientist in a lab be allowed to modify an organism's size? Its color? Shape? When does that organism become something else entirely? Questions ranging from the small and seemingly insignificant all the way to whether humanity is playing god, and if that is okay, by editing genomes at will have to be dealt with in a public way if GMOs are ever going to enter the mainstream.

Since a lot of public uncertainty and even pushback against GMOs remains, many farms in Massachusetts advertise non-GMO products to entice consumers and distributors. Produce labeled as organic cannot be GMO or given GMO feed for livestock, according to FDA regulations. So, while Massachusetts does not require GMOs to be specifically labeled, produce not labeled as organic has probably been genetically modified or exposed to a GMO during its production.

On the other side of the debate, the benefits of GMOs are hard to overshadow. Genetic engineers can design crops to produce specific proteins that can supplement diets and provide better nutrition for communities

that have limited access to calorically and nutritionally dense foods. Produce that can synthesize its own pesticides can reduce the use of artificial chemicals and pesticide sprays and provide more targeted defenses for plants vulnerable to specific pests. Communities lacking access to commercial pesticides can benefit enormously from GMOs.

Climate change has impacted agriculture around the world in significant ways. Extreme rainfall and drought in some parts of the world have pushed crops to their natural limits. GMOs offer a dynamic solution to that problem. Crops designed to survive long dry spells, high temperatures and humidity, flooding, and other environmental hazards that have caused widespread food shortages in the past can help feed a growing human population during a time of dramatic environmental instability.



The U.S. Northeast has experienced warming temperatures, shorter winters, and more dramatic precipitation in recent decades associated with climate change. As the environment changes, its impact on agriculture in Massachusetts and access to produce in Boston has posed difficult new questions and challenges for farmers in the area. An answer could lie in GMOs.

Rainfall is expected to increase in frequency in coming decades which could cause flooding and crop damage if not handled appropriately. New varieties of GMO rice that can survive flood conditions are already used in some parts of the world where monsoon conditions would damage traditionally used, non-GMO varieties. Innovative modifications, like those done with flood resistant rice, could be the future of agriculture in the Northeast as the impacts of climate change become more drastic.

As growing seasons shift and the environment changes, certain varieties of plant life that have been constant in Boston could change. Apples, a quintessential Northeast crop, have experienced some rough growing seasons in the past few years. Unprecedented heatwaves in the winter caused apples to begin growing much earlier than normal, but subsequent freezes killed off a lot of those fruits, causing widespread shortages in 2013. Farmers have been creating new apple varieties by cross pollinating parent trees as a part of agricultural progress and innovation. With more extreme changes and more requirements an apple needs to thrive, that job might leave the orchards and go to the labs.

What does that mean for those of us used to apple picking in the fall? Or those who frequent farmers markets around Boston? Without GMOs, climate change will probably have a dramatic impact on the foods that reach our plates. With GMOs, more resilient strains of common crops could keep those varieties around much longer. The question of whether Bostonians, Massachusettsans, and New Englanders as a whole want anything to do with GMOs needs to be answered soon. Climate change does not look to be slowing down, and with GMOs offering a promising solution to a looming problem, maybe they should be considered more seriously.

# Urban Farming in Boston

BY ARIEL ZWEIG, UNDECLARED, 2021

**On what once was an abandoned lot in Dorchester**, a half-acre of dirt waits to be covered in seedlings and tilled for the spring season. This is ReVision Urban Farm, a plot started in 1990 and run by the umbrella nonprofit organization Victory Programs. Across the street is ReVision Family Home, a shelter for homeless families. Each year, two of its residents work on the farm to learn valuable skills as part of a job-training program.

The term “urban agriculture” encompasses many things, from growing food in abandoned lots to rooftop farms to hydroponics with purple grow lights. Many of its practitioners in Boston, like ReVision, are community-focused and supported. The Food Project is a nonprofit that operates two plots in Dudley neighborhood and a greenhouse in Roxbury, donating a portion of the produce grown to hunger relief organizations. Boston-based company Green City Growers helps clients install farms on rooftops and other unused spaces. Among many others, they’ve helped bring rooftop farms to B.Good, a Whole Foods in Lynnfield, Mass., and, in 2015, Fenway Park.

On another end of the spectrum, some startups in greater Boston are focused on indoor urban agriculture. Freight Farms, whose CEO Brad McNamara is a Northeastern alumnus, sells shipping containers in which greens can be grown using hydroponics that can be placed in essentially any climate. There’s no need for pesticides, and it uses significantly less water than conventional agriculture. However, it comes at a steep price – \$85,000 per shipping container, to be exact.

Urban agriculture has become somewhat of a buzzword in cities across the U.S., and it’s not hard to see why. By bringing the source of food closer to its consumers, the transportation and thus, carbon emissions, required to get food to the table is minimized. Then there is its potential to increase disadvantaged communities’ access to healthy produce – like ReVision aims to do in Dorchester. Finally, there’s an educational aspect to the farms; in connecting people to how their food is grown, they are made more conscious about where their food comes from. Yet a large hope for urban farming lies in the possibility that it could reduce the need for produce to be grown traditionally, which requires huge inputs of water, energy, and fertilizers and plunders the land.

I spoke to Dr. Christopher Bosso, a professor of public policy at Northeastern, to gauge just how realistic these hopes for urban farming are. He teaches a class on food systems, and recently edited the book *Feeding Cities: Improving Local Food Access, Sustainability, and Resilience*.

Bosso emphasized that while it can have many benefits, there simply isn’t enough space for urban farming to replace

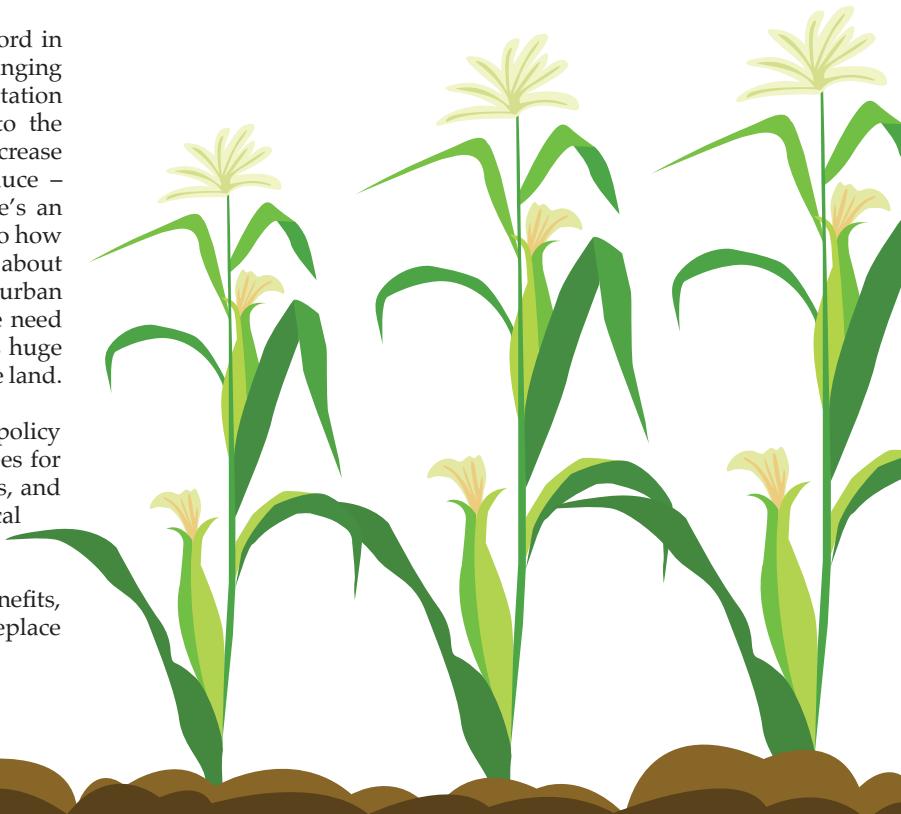
DESIGN BY JULIE MURMANN, BEHAVIORAL NEUROSCIENCE, 2021

conventional methods, especially in Boston where there is little available uncontested land. “Let’s say you took every open space in Boston and planted it with crops,” he said. “It still wouldn’t be enough, capacity-wise, to put more than a little dent in the dominant food system.”

Bosso also noted that urban ag doesn’t make much sense economically, especially when local greens can be costlier than those shipped from California – it’s all about economies of scale. That doesn’t mean that urban ag, especially community-supported ones like ReVision and The Food Project, doesn’t have a purpose. When it is approached as a way to build community through nonprofits rather than upend the entire food system, it can have real benefits.

“There’s a couple of hopes for urban agriculture I think are justified,” he said. “Connecting people to how their food is produced, getting them involved in growing food can be educational, it can provide some jobs for people, it can enable some local residents to have access to healthier food during the growing season.”

Meanwhile, Bosso has been spearheading a movement to install a garden on the rooftop of the Behrakis Health Sciences Center. He’s working with the Husky Environmental Action Team (HEAT) and Terra Society to build up support and action to get the farm implemented. Though it seems to have student support, Bosso maintains that it’s going to need a big push from the student body to get the ball rolling. If it can muster up the manpower, who knows – perhaps we’ll have an urban farm of our very own here at Northeastern.



# The Science of Running a Brewery, as Told by the Head Brewer at Down the Road Beer Co.

BY GWENDOLYN SCHANKER, JOURNALISM AND BIOLOGY, 2018

DESIGN BY ANNIE LEE, DESIGN, 2019

**One of the best things** about living in Massachusetts is the opportunity to drink great beer. From Jack's Abby brewery and beer hall in Framingham, to the Trillium indoor beer garden at the Roslindale substation, to the many Boston bars that include local brews in their tap rotation, Boston is a haven for beer drinkers. It's also a great place for beer makers, including Donovan Bailey, founder and head brewer at Down the Road Beer Co. in Everett, Massachusetts.

Bailey founded Down the Road in 2015 after spending years as a home brewer. He has a degree in microbiology from the University of Massachusetts Boston, and spent time in the construction and electricity industries before finding his place on the Boston beer scene. The taproom in Everett opened late 2017.

Bailey originally expected Down the Road to be a smaller operation, which is why the brew house is packed with equipment and activity. On a typical weekday afternoon, staff members can be found cleaning the equipment, wiping down the floors, and of course brewing and canning the beer.

**“Craft brewers all over Massachusetts make waves with their experiments.”**

The process of brewing beer is by nature experimental. It's also rife with terminology. The first essential ingredient is a raw grain – usually barley, but sometimes wheat, oat, or rye – which is malted (dried and crushed), usually somewhere other than the brewery, to form a product called grist. Often, multiple grains are used to create a single beer. This grist is combined with water in a large metal vessel known as a mash tun, which is heated to allow the enzymes in the grain to break down its starches into sugars.

The mash material is transferred to a lauter tun, which helps further extract the sugars, resulting in a sugary liquid known as wort. The wort is condensed and sterilized through boiling in another metal container, the kettle. This is where hops are added.

Hops are conical flowers harvested from the vine plant *Humulus lupulus*, and are used to balance the sweetness of the beer with bitterness and to add aroma and flavor. Different types of hops are used for different varieties of beer. For example, at Down the Road, Cascade hops – known for their floral and spicy flavors – are used to make the sour Feyborn Berliner Weisse, while a variety of bitter hops are used to create the Undine double India Pale Ale (IPA). The longer the hops are boiled, the more they will isomerize, and the more bitter the beer will ultimately be.

Next, the wort is separated from leftover grain and hop particles in a whirlpool. Often, aromatic hops are added at this stage rather than the boiling stage to improve flavor. Yeast is then added for fermentation. This is when the sugary wort actually becomes beer – microbes in the yeast break down the sugars to carbon dioxide and alcohol. Like hops, different strains of yeast are used to brew different types of beer. Down the Road makes frequent use of Chico yeast, which is widely used across the U.S.

Finally, the beer is matured, filtered, and conditioned in “bright tanks,” often for a couple of weeks, sometimes undergoing additional fermentation or other treatment, before being packaged for distribution. At Down the Road, beer is packaged in cans, which are more easily recyclable than glass bottles.



Bailey says that one of the goals of Down the Road is to create beer that works for everyone. They aren't focused on a particular taste or style.

“A lot of innovation is being pushed here [in Boston] by brewers brewing interesting stuff,” Bailey said. “We're just trying to keep up.”

Craft brewers all over Massachusetts make waves with their experiments. Jack's Abby pushes the boundaries of what it means to brew lager. Trillium Brewing Company periodically releases a new beer in their Permutation Series, which includes everything from wild ales to imperial stouts. And Samuel Adams recently did their tenth annual release of Utopias, a barrel-aged beer made with three different malts and three different hops, which clocks in at 28 percent alcohol by volume (ABV).

Down the Road is equally adventurous. Their latest brew, the Deepdweller, is a chocolate stout that contains cranberry concentrate from a local farm. The taste is a unique combination of sour and rich, which can be hard to pull off. For Bailey, the experimental part of brewing is both frustrating and exciting.

“Sometimes you know what you're gonna get. Sometimes it will surprise you,” Bailey said. “It's a noble experiment.”

# Think Before You Shop

## THE CASE FOR BUYING LOCAL

BY LUCAS PRINCIPE, ENVIRONMENTAL SCIENCE AND PHILOSOPHY, 2020

DESIGN BY ANNIE LEE, DESIGN, 2019

**Buying local** means something different everywhere. What is local to us here in Boston means something completely different to someone in a small town like Atchinson, Kansas. This is mainly because "local" is a combination of both the geographic proximity to products as well as the relationship between producer and consumer. More importantly, buying local doesn't have to apply solely to food. Any kind of product which can be made and sold within a community or its surrounding area constitutes a local product. However, what all local goods have in common across state lines is their proximity to the consumer and the human interactions that represent the transaction. These aspects result in a surge in the local economy and an incredibly sustainable and healthy way of living.

One important aspect of buying local is the economic effect on the community. Picture this: you buy a pair of shoes from a large retailer. While a portion of the money you spend on the shoes goes to the employees of the store in the form of a wage, another significant portion of these profits goes to the company itself, headquartered elsewhere, which means the money is taken out of the local economy. However, if you were to buy that same pair of shoes at a local shoe maker's store, the profits would be going solely to the individual that made those shoes, who would then keep much of that money in circulation in the local economy.

As the local trend has grown over the past few decades, multiple studies have confirmed this economic effect. For instance, a 2011 study conducted by researchers at the Maine Center for Economic Policy (MECEP) concluded that every \$100 spent at locally owned businesses in Portland generates \$58 in local impact. In comparison, when that same \$100 was spent at a representative national chain store, only \$33 was generated in local impact. In short, MECEP found that shopping at local businesses as opposed to national chains generates up to a 76% greater return for the local economy.

Additionally, local start-ups stimulate net job growth. According to a 2015 study done by researchers at the

Kauffman Foundation, "new businesses account for nearly all new net job creation and almost 20 percent of gross job creation," a huge boost to the economy. Moreover, over the past three decades start-ups less than one year old have generated an average of 1.5 million new jobs per year.

Buying local can also have many dietary benefits. Local produce is typically preservative-free, at peak ripeness, and is less likely to be contaminated due to the limited number of "hands" touching it from farm to table.

Furthermore, if you are the type of consumer who likes to know where your food is coming from and how it is being harvested, all you have to do is ask the vendor at the farmers market where you shop. There is no massive, impersonal middleman, and typically these people are quite proud of their methods and are willing to share them with you.

However, the single biggest impact of buying local produce is the reduced carbon cost associated with transportation. Whenever you buy a non-local, in-season product, that product had to travel a certain distance to reach you. This transportation cost may not always be reflected in terms of the price of the product, but it will cost you and everyone else in the amount of carbon released into the atmosphere. According to research done by the Worldwatch Institute in 2002, food typically travels between 2,500 and 4,000 kilometers from farm to plate. By buying in-season, local produce, you can reduce your food footprint by 7-11%.

Buying local can help keep money and create jobs in the local economy, ensure that food is at its peak freshness with a low chance of contamination, and reduce the amount of carbon released into the atmosphere from transportation. So, the next time you think about doing some shopping, think about where your products are coming from. Buy local and you'll be contributing in the push towards a more sustainable society.



# How Far Did Your Chicken Have to Fly?

## *Big Chicken*: A book review

BY ADANYA LUSTIG, LINGUISTICS, 2018

DESIGN BY SILVIA DIAZ, DESIGN, 2021

*Big Chicken*, Maryn McKenna's 2017 bestseller, details the chicken industry's roaring start and slow turnaround. A book that professes to tell the story of "how antibiotics created modern agriculture and changed the way the world eats" sounds like it's going to be a downer, but McKenna manages to give a hopeful view of the future of the industry, and not just in that last-chapter-here's-what-you-can-do kind of way.

McKenna starts by telling her readers how it all started: how did chicken go from a once-a-week luxury to America's most-eaten meat? Antibiotics. Not just antibiotics to keep the birds from getting sick, but antibiotics to create birds that grow faster and bigger. The antibiotic scientific breakthrough, coupled with radical shifts in the industry (e.g. the invention of the chicken nugget and the sale of chicken parts) meant that chickens were finally on Americans' tables every night – and they were literally coated in antibiotics, which led to antibiotic-resistant strains of bacteria. Then there was mass consolidation of chicken farms; in 1950 there were 1.6 million poultry farms in America. Today there are 25 thousand farms, most of them under contract with one of 35 firms that run the chicken business.

McKenna's prose is largely without an ick factor – the issues she's describing are grotesque, but she's not trying to make her readers cry thinking about the poor chickens in factory farms. She doesn't make the modern chickens of today sound terribly appetizing, either: "A fast-growth broiler has the teetering instability of an olive propped up on two toothpicks. Broilers can develop areas of dead or hardened muscle in their breasts and fluid in their abdomens, both signs their circulatory systems cannot keep up with bringing oxygen to their muscles and carrying metabolic waste away."

She shows a better way to raise chickens, though. Of course, that's in France. There, the 'Label Rouge' chickens run wild, eat well, and apparently taste delicious. They are pricier than American chickens, but they sell well in France

– making up three-fifths of the market. In the United States, along with the regulation of antibiotic use in chickens, there has also been a shift towards free-range chickens that are bred more like the chickens of the past. They are physically capable of running, and stores like Whole Foods sell them. They're expensive.

The cost of these chickens would be prohibitive for many Americans, and a book that starts with McKenna describing how she spends "some time" in a tiny apartment in Paris each year could come off as a pretentious look at our food system.

However, McKenna avoids that failure by describing the ways that the better chickens she describes could become commonplace. In a local farm that produces multiple kinds of meat and produce, healthy chickens play a vital role. McKenna visited White Oak Pastures, a farm that sells the best kinds of chickens she found in the United States, along with other animals. "By adding the sheep and then the chickens, Harris was embarking on rotational grazing, a historic practice, lost after industrialization, that uses each species on a farm to augment or

remedy the effect of whichever animal came through the fields before," said McKenna.

McKenna saves her most rapturous description for a man's farm, where he preserves breeds of chickens that the chicken world forgot about--the breeds that live for a long time, and are very hardy, or maybe just rare. "To get to Marquette requires intention, and to get to Good Shepherd Poultry Ranch, which lies just outside of it, requires daylight and a paper map and the trust of a child in a fairy tale: beyond the edges of the cities, beyond the forests, beyond the hills, lies a treasure," wrote McKenna.

McKenna's prose, straightforward storytelling, and passion for the subject make *Big Chicken* a delight to read.

“ McKenna's prose, straightforward storytelling, and passion for the subject make *Big Chicken* a delight to read.”

# Recreating Drug Administration

BY JULIA WALL, BIOLOGY, 2021

DESIGN BY SILVIA DIAZ, DESIGN, 2021

**Researchers at Brigham and Women's Hospital** and the Massachusetts Institute of Technology have been collaborating to create new methods of administering medication. Their work is targeting to advance and overcome the complexities of dispensing drugs. Drugs that must be administered into tissue, such as insulin for diabetics, are hindered by the standard subcutaneous injection method. Insulin administered through a syringe has a substantially slower absorption rate in the body than endogenous insulin produced by the pancreas. The pancreas is located in the hub of digestion activity, while injected insulin has a long way to travel before reaching the bloodstream. Researchers formulated a solution to this time delay dilemma: a capsule with microneedles that injects medication straight into the stomach lining. This invention would allow for oral administration of drugs that require higher absorption rates and faster effectiveness.

Two critical points were considered while formulating this device. First, the drug needed to be administered just as well or better than standard injections. Second, and most importantly, the device needed to be safe. Researchers tested the capabilities of the capsule by inserting insulin into the device and conducting oral administration of the capsule to a group of pigs. To compare this method with the current method of injections, the scientists ran a trial in which insulin was administered to the pigs by subcutaneous injection. The differences in results were staggering. Insulin administered through the skin only lowered the pigs' blood sugar by 20 percent, whereas the insulin administered via the capsule reduced blood sugar by 55 percent. These findings indicated how powerful this tool could be for people facing chronic conditions like diabetes.

The idea of swallowing needles is counterintuitive, and for good reason. In order to test the potential damage these needles could inflict on a gastrointestinal (GI) tract, researchers had animals host the capsules for either 7, 19, or 56 days. Afterwards, the GI tracts of each animal were examined, and the results guaranteed the harmlessness of the capsule; GI tracts were always found to be macroscopically normal. The researchers also emphasized that the GI tract does not have pain receptors. Discomfort, a characteristic that strays people away from standard needle injections, would not be felt with this new treatment.



The Brigham and MIT collaborators are also investigating the key relationship between dosing regimens and viral resistance. The timing of administration is crucial for many drugs, similar to the timely manner of taking birth control pills. If taken at an incorrect time, but in the correct dose, a virus can rapidly become resistant to

a drug. Creating a capsule that would administer drugs for a week or longer would greatly reduce the errors that allow viruses to grow. The Institute for Disease Modeling in Bellevue, Washington found that transitioning from a daily dose to a weekly dose would "improve the efficacy of HIV preventative treatment by approximately 20 percent."

The problem – creating a capsule with a battery to administer drugs throughout a week – is complex, but the solution is straightforward. The galvanic cell, an invention used by electrical engineers for centuries, proved to have all of the components needed for a battery to fuel a self-dosing pill. The cell is modeled after the simple battery made of a lemon and two electrodes. The two electrodes, one copper and one zinc, are placed on opposite ends of a lemon. The acidity of the lemon combined with the electrodes initiates a chemical reaction that creates electricity. The capsule would replace the acidity of the lemon with the acidity of the gastric juices inside of the GI tract. This fueling method would eliminate common issues that many self-dosing capsule inventors come across, such as the toxicity of batteries and the limitations of battery-life.

By questioning the current methods that drive medicine, scientists are able to create devices that could revolutionize how individuals live their lives. As the intersection between medicine and technology strengthens, medical innovation continues to reach new heights. Any person suffering from a chronic illness knows how time-consuming the administration of drugs can be. With these brilliant innovations, that unwanted commitment would be lifted from their shoulders.

This research, happening just steps away from Northeastern, has the potential to transform how doctors administer drugs and how patients are affected by those drugs, thus changing the entire field of medicine.



# Massachusetts Inventions That Changed the World

BY HEATHER OFFERMANN, BEHAVIORAL NEUROSCIENCE, 2019

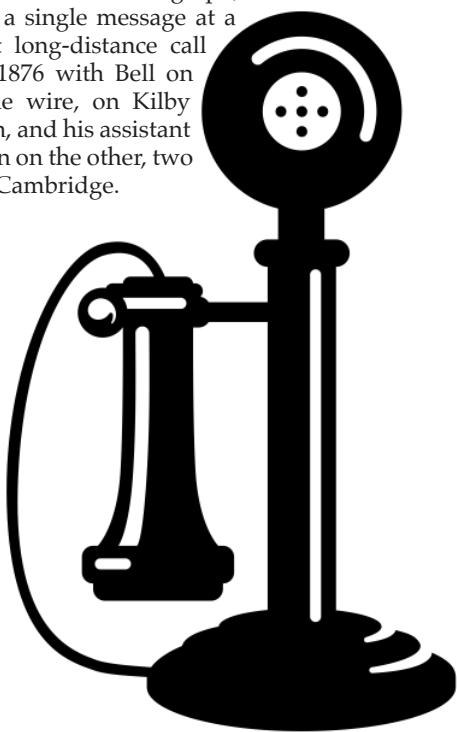
DESIGN BY SILVIA DIAZ, DESIGN, 2021

**From comfort classics to office essentials,** Massachusetts has provided the world with much more than just baked beans, pies, and passionate sports fans. Check out these inventions that most people today can't live without; you may be surprised to learn they are rooted in this New England state.

## TELEPHONE

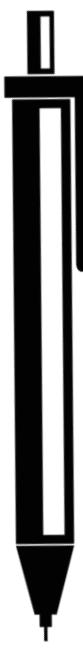
1876

Although the definitive origin of the telephone is unknown, it is agreed that Alexander Graham Bell was awarded the first official U.S. patent for the world-changing device. Bell, a native of Scotland, moved to Boston in 1872 to establish a school for the deaf where he researched the transmission of messages over a wire and recorded sound waves. The idea of a telephone had always appealed to Bell, so he worked on modifying the acoustic telegraph, which was limited to receiving only a single message at a time. The first long-distance call was made in 1876 with Bell on one end of the wire, on Kilby Street in Boston, and his assistant Thomas Watson on the other, two miles away in Cambridge.



## BALLPOINT PEN

1888

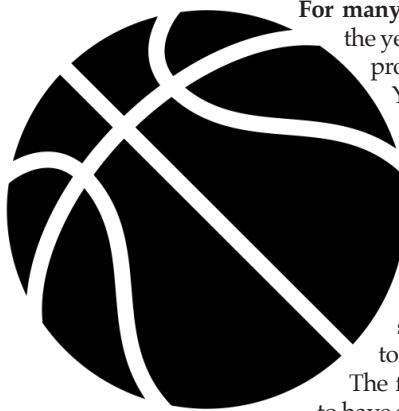


The true origin of this fundamental writing utensil is under-credited as the modern ballpoint pen was claimed to be invented in 1938 by a newspaper editor in Hungary. John Loud, a banker from Weymouth, Massachusetts, first patented this revolutionary pen in 1888. Loud was frustrated with the way typical fountain pens or quills would skip as he tried to write on rough surfaces such as leather. He created a pen that had a reservoir chamber to dispense ink and a rotating steel ball held in by a socket at the tip. This design allowed for ink to flow spherically in all directions. Unfortunately, the idea was phased out due to problems with ink consistency and leakage, but with a few adjustments, the modern ballpoint pen was eventually redesigned and commercialized in the mid-1900s.

## BASKETBALL

1891

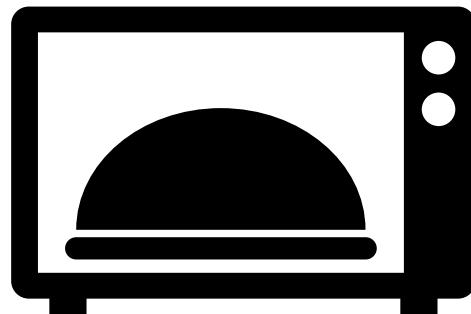
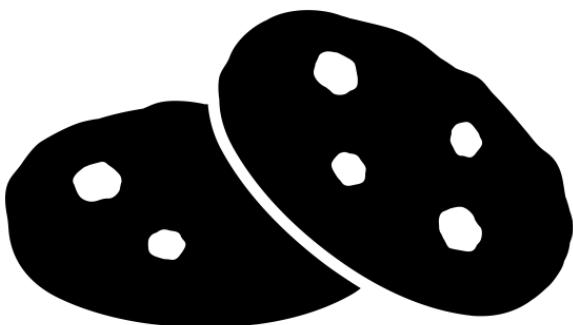
**For many people**, boredom often sparks creativity. In the year 1891, in Springfield, Massachusetts, college professor James Naismith was sitting around a YMCA gymnasium, now known as Springfield College, with a group of his students. They were faced with boredom and restlessness for the lack of indoor activities during the winter season. Naismith loved studying physical education and the psychology of play and he urged his students to join him in creating a new game. After consulting the school janitor, Naismith nailed a peach basket to the balconies at both ends of the gymnasium. The first thirteen rules were sophisticated enough to have an established game, and "basket ball" quickly evolved to be an official winter sport in 1905.



## CHOCOLATE CHIP COOKIES

1930

This **happy accident** led to a renowned comfort classic. In 1930, Ruth Wakefield ran the Toll House Inn in Whitman, MA. Wakefield was known for preparing all the food provided to the inn guests, and her Chocolate Butter Drop Do cookies were a Toll House specialty. One day, after realizing she was out of her usual baker's chocolate, Ruth made a substitution by chopping a block of Nestle semi-sweet chocolate and throwing it into the dough, assuming the chocolate would melt and disperse to make her typical chocolate cookies. To her surprise, and everyone's benefit, the chocolate pieces maintained their shapes, revealing a cookie spotted with melted chocolate. The recipe grew in popularity, and eventually a deal was made between Nestle and Ruth. Thus, the Toll House Cookie. The rest is ooey, gooey history.



## MICROWAVE

1946

We are all too familiar with this college essential. When you are craving that Easy Mac at 1 a.m., thank Percy Spencer for accidentally inventing this convenient appliance. In 1946, Spencer worked at Raytheon's radiation laboratory at the Massachusetts Institute of Technology (MIT) producing magnetrons for radar sets. During a lunch break, Spencer noticed that the peanut candy bar in his pocket had melted after he stood in front of the magnetron. After he quickly tested the cooking potential of an egg and some popcorn kernels, the basic microwave was born. The "Radarange" was released just a year after its discovery, and the microwave became a household essential for quickly nuking frozen meals in the early 1970s.

# Fixing a Broken Heart:

## *Treatment of cardiac valve disease*

BY YAEL LISSACK, BIOENGINEERING AND ETHICS, 2021

DESIGN BY ANNA LI, BEHAVIORAL NEUROSCIENCE, 2018

**Bovine and porcine heart valves**, which do not contain living tissue, can often replace human ones, but have to be replaced around every 15 years. It can take a very long time to get onto the transplant list, and the death of any patient waiting to get a valve is tragic. Mechanical valves are also used, but require a lifelong commitment to coagulant drugs, which help blood clot, but have negative side effects like infertility. Common treatments for these diseases can be invasive, expensive, and unsustainable for younger patients.

Fortunately, researchers at Harvard's School of Engineering and Applied Sciences and the University of Zurich are contributing to research that aims to dramatically reduce the exclusivity and production time of heart valve replacements. Kevin Kit Parker, the leader of the Harvard team, and his group are using 3D printers to create an alternative solution for patients. Their product, called JetValve, is specifically targeted towards patients who would traditionally have to go under the knife every 10 years to replace a pig, cow, or horse heart valve.

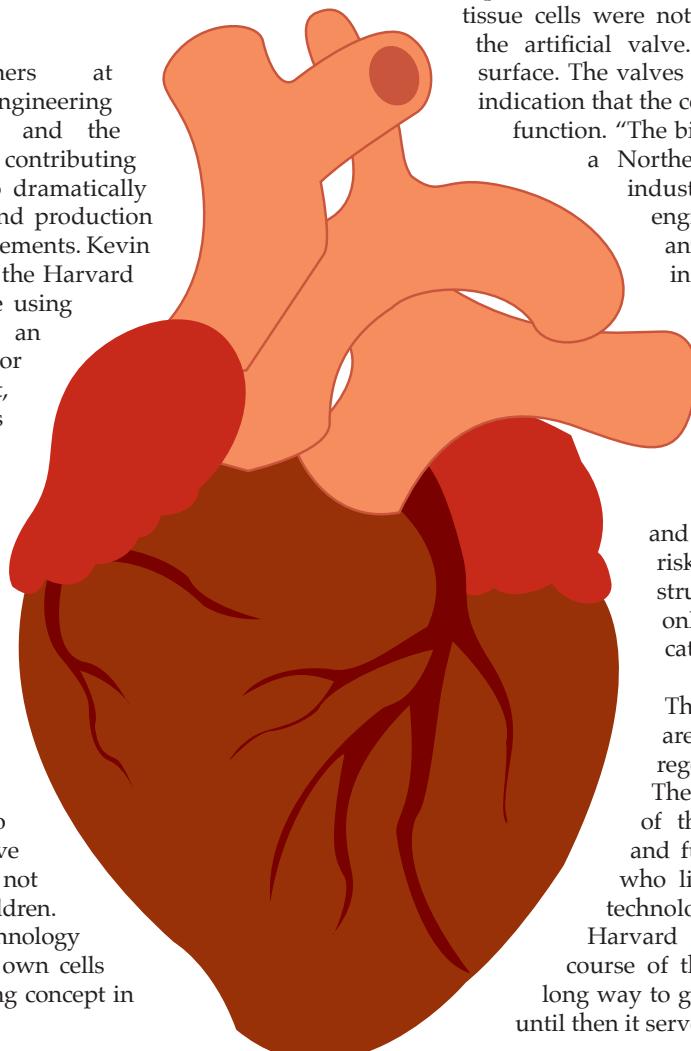
In addition to its low durability, an animal heart valve replacement is expensive, non-degradable, and requires the patient to take immunosuppressive drugs. These drugs are not ideal, especially for children. The goal of JetValve technology is to allow the patient's own cells to regenerate, an emerging concept in tissue engineering.

It is important to note that this technology is not an artificial heart valve that serves the same function as a bovine or porcine heart valve replacement. Rather, it uses a combination of extracellular matrix (ECM) proteins and synthetic polymers to create a framework for new cells to overtake the JetValve. This product "mimics

physiological conditions of the native valve" with a scaffold comprised of nanofibers made of blends of gelatin and other polymers called "biohybrids." They are fabricated like cotton candy, each layer delicately accumulating until the entire structure is formed. The JetValve behaves like the structural beams and foundation that the rest of a house is built around.

The product was tested on sheep but their endogenous tissue cells were not able to penetrate deeply within the artificial valve. Instead, they just covered the surface. The valves were functional, but there was no indication that the cells actually assumed the intended function. "The big question," says Michael Jaeggli, a Northeastern professor with years of industry experience in heart tissue engineering, "is what happens to an animal when you let the product sit in it for a long time. What is the body going to do with it?" Though this technology is promising Dr. Jaeggli believes, "they have a lot of work to do in getting the cells to actually penetrate the scaffold." The appeal of JetValve is that it can easily scale to fit a patient and never has to be maintained with risky surgeries. The insertion of these structures is also minimally invasive, only requiring an implantation catheter.

The results of this innovative study are a steppingstone to completely regenerative heart valve treatment. The next phase in the development of this technology is animal testing and further clinical research. For some who literally have a broken heart, the technology being explored like that at Harvard has the capacity to change the course of their lives. This technology has a long way to go before it reaches the shelves but until then it serves as a promising solution.



*Biomaterials* (2017). DOI: 10.1016/j.biomaterials.2017.04.033

# (EN)TANGLED: ESCAPE FROM LOCALITY

BY JAMESON O'REILLY, PHYSICS AND MATHEMATICS, 2019

DESIGN BY ANNA LI, BEHAVIORAL NEUROSCIENCE, 2018

**When Rapunzel** was stuck in her tower, she felt limited because she could only interact with and affect the state of what was in her immediate vicinity. Ultimately, she, like everyone else, was limited by the principle of locality, which states that an object is only influenced by its immediate surroundings. The main difference was that her limited motion meant she could not get close enough to as many people or things.

Even if Rapunzel had a phone, she would still be limited by locality. Although she could communicate with Flynn from a distance, this is only because her phone generates an electromagnetic disturbance that could propagate to Flynn's. There would be no direct, local interaction between the phones but rather a chain of local interactions that would ultimately connect them. An important consequence of this limitation is that their communication cannot be instantaneous. The signal needs time to move from one phone to another because it travels at a finite speed.

This speed is the speed of light, which is the fastest that anything in our universe can travel. This fundamental limitation on how quickly two different points in space can communicate is a key tenet of special relativity and famously led Einstein to suggest that quantum mechanics is "an incomplete theory." He objected to the disregard that quantum entanglement holds for his all-important principle.

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“Generally, chameleons are too large and needy to behave quantum mechanically, but a similar protocol can be used by physicists to entangle much smaller things, like photons or atoms.”

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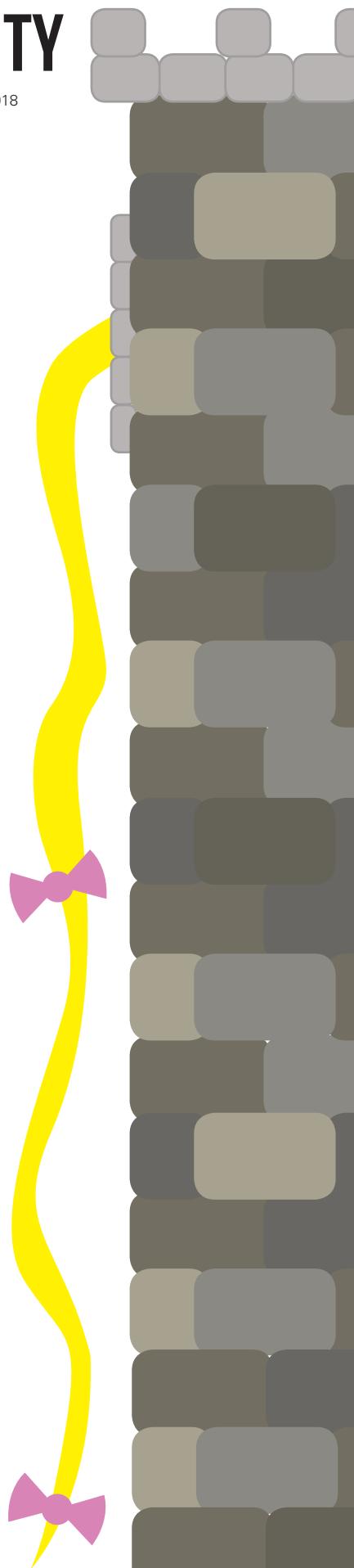
Suppose that Rapunzel had a box containing two chameleons, one of which is alive. These chameleons are identical, so much so that they are impossible to tell apart. If the original box is split into two boxes, each containing one chameleon, in such a way that it is impossible to know which box contains the living and which contains the dead, then the two chameleons will be entangled. Based on the original knowledge of only one living chameleon and the law of preservation of chameleon lives, checking the health of the resident of one of the boxes will also inform the measurer of the other chameleon's status.

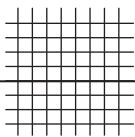
The key difference between the classical and quantum worldview is that in the former, this occurs because the chameleon in the opened box was always dead or alive and therefore so was the other chameleon. Nothing physical changed, just the observer's knowledge. In the latter view, each was in a quantum superposition of being dead and being alive.

When Rapunzel opens the box, this superposition collapses, meaning that there was a real, meaningful change in the state of the first chameleon. Therefore, the state of the second, unobserved chameleon must also collapse from a superposition to the state opposite to what the first chameleon was observed as. Even if the two chameleons were brought millions of light years apart, the second one's superposition would collapse instantaneously when the first box was opened.

The fact that measuring the first also affected the state of the second is the definition of entanglement. Generally, chameleons are too large and needy to behave quantum mechanically, but a similar protocol can be used by physicists to entangle much smaller things, like photons or atoms. This is a violation of locality, just like Einstein said, but it has also been verified experimentally many times in the decades since he issued his original objection.

This all makes it very tempting to suggest that all Rapunzel really needed was a pair of quantum Pascals to overcome the limitations of her tower. The first problem with this thinking is that living things are too large, too boisterous, and too energy-dispersing to actually be in quantum mechanical superpositions, which is why weird quantum phenomena stay in the realm of atoms and molecules and do not intrude on our daily, macroscopic lives. Secondly, she would have no control over which state her chameleon, and therefore the other chameleon, would collapse into, so she could not send a definite message. Both would just get a random string of living and dead chameleons if they repeated the experiment over and over again. Rapunzel could use entanglement to escape locality, but even that has very definite limits.

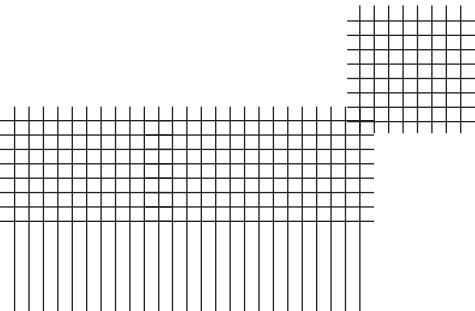
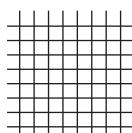
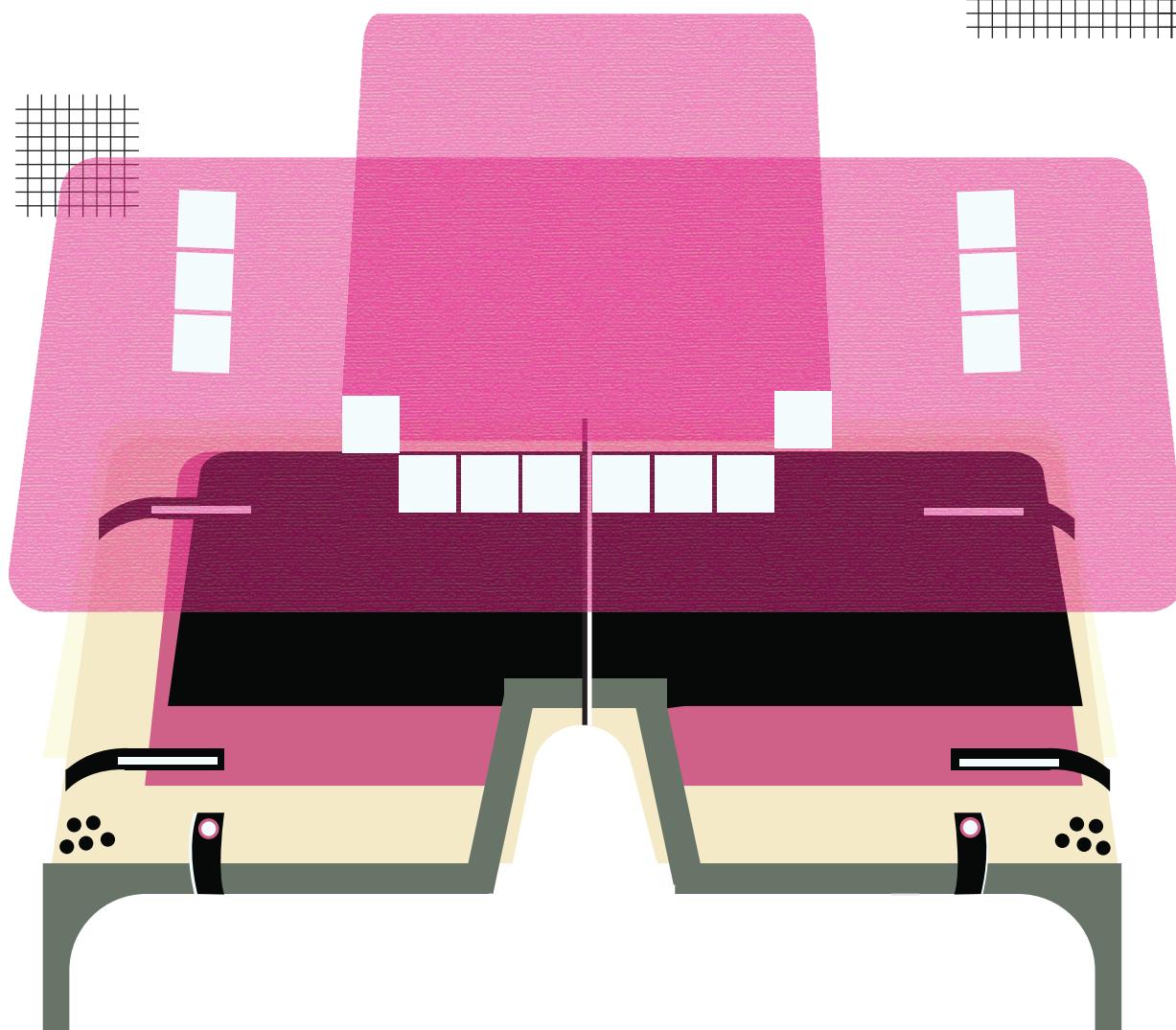
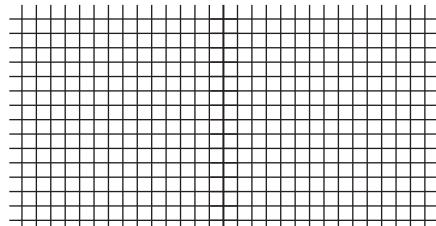




# VIRTUAL REALITY THERAPY:

## A Look into the ReGame-VR Lab

BY VINCE CASAMBRE, COMPUTER SCIENCE AND COGNITIVE PSYCHOLOGY, 2022  
DESIGN BY LILLIE HOFFART, ENVIRONMENTAL SCIENCE, 2022



When you think of "virtual reality," you may think of some visual experience where your body and mind is taken to a different place. Or you may think of some clunky, face-hugger type headset contraption (at least you can't see yourself). While both options might be true, the general consensus today is that virtual environments are used mainly for entertainment. But, one lab at Northeastern University is using the technology to go against this trend.

The Rehabilitation Games and Virtual Reality Lab (ReGame-VR) explores how virtual games can be used to rehabilitate children with motor dysfunctions -- namely, cerebral palsy. This congenital condition (occurring from birth) results in poor development of the motor cortex at the early stages of life. The condition's symptoms include stiffness, poor balance, and lack of muscle coordination. Because cerebral palsy affects roughly one in 300 children, it is a primary area of research at the lab.

VR rehabilitation is different than traditional methods in a combination of ways. "Because of the engaging nature of the games, the feedback, the audiovisual graphics -- we find that we can get the kids to be present in an environment so that they're a bit distracted from some of the limitations that might otherwise be holding them back from doing the movement successfully, or from doing it as often as we need," said Dr. Danielle Levac, who founded the ReGame-VR when she came to Northeastern in 2015.

While traditional physical therapy can be very boring, especially for kids, virtual environments are a way for kids to stay motivated as they do repetitive motions. In addition, virtual rehabilitation allows physical therapists to "receive accurate data about how often and how well the user does the given task." The lab's VR therapy incorporates a variety of devices, including: an HTC Vive Headset hanging from the ceiling, two cameras on opposite sides of the room to track spatial motion, a pair of gloves from a company called Manus VR that give haptic feedback and virtual object interaction, and a vest that also tracks movement.

According to Levac, measurements of improvement can be simple -- like counting the percentage of times a patient can do a task -- or they can be fine tuned, such as measuring the error in centimeters that someone misses a certain target, or the angular change of particular joints over time. So far, the lab has shown that among healthy kids, learning a task within a virtual environment can be done, but they can't replicate that same skill in the real world. This was done through a postural-reaching task where kids would reach for objects held above them,

while trying to remain balanced. The next steps for the lab are to evaluate learning of this task for children with cerebral palsy.

"There's something specific about the virtual environment that isn't getting transferred back into trying to do that same skill in real life. And so that's what we're exploring now with our next study," Levac explained. "If we're going to have kids practice in a virtual environment, whether it's a head-mounted display, or just looking at a projection screen, how can we design those environments better so that they will transfer to real life?"

Trying to find the most optimal virtual environments to induce learning is one of the lab's main goals. For example, while the environments are fantasy, narrative, and story-based, the lab doesn't try to incorporate characters into their worlds that fit gender stereotypes -- they want their environments to be fun for all children. They also want to explore what exactly keeps children motivated. When asked what the children's primary reactions are to being put in the virtual environment, Dr. Levac said,

"That's something I've always thought about. Is it solely the novelty that is what we're mistaking for being 'motivated' and 'engaged?' It's this new cool thing at first, but after a couple of times it's not cool anymore. So how can we sustain that novelty and that motivation to engage in that environment and be present in it?"

**"If we're going to have kids practice in a virtual environment ... how can we design those environments better so that they will transfer to real life?"**

*– Dr. Danielle Levac*

Levac also mentioned a variety of additional uses for virtual reality in therapy, such as a safe means of exposure therapy for people who have experienced trauma coming back from combat or people with dementia whose experience with a familiar virtual environment, such as a childhood home, could bring them a sense of comfort and security.

However, one of the major challenges in virtual reality research is how slowly research goes compared to how quickly the technology moves.

"For research, it takes a year or two to write the grant and then get the grant and then do everything, and in that time we have a changing field where things are so different than what they were a year ago and what they were two years ago," Levac said. "And maybe in 2 years, VR might be less of a thing and it might be augmented reality."

While the development of the technology might lead us to unpredictable places, the reality we create is ultimately up to us.

# Ahead of the Pack



## Terracea

Brian Kurland and Eric Hui

Northeastern undergrads in music industry, business, received MBAs from Northeastern

**Bonding over their mutual love of snowboarding and the outdoors,** Eric Hui and Brian Kurland met in the D'Amore-McKim School of Business MBA program. While discussing industry ideas, they conceptualized a jacket that allowed the wearer to swap out layers for a custom look and usage. This idea would form their company, Terracea.

They first compiled a list of jacket features and gathered information from surveys and reviews of other popular outerwear brands. Then, they contacted technical outerwear designers, who helped create design files and measurement charts.

To choose materials, Hui and Kurland evaluated thousands of fabric and material swatches. They eventually chose durable double- and triple-layer fabrics from Toyota and recycled polyester insulation to reduce Terracea's carbon footprint; they also learned synthetic fabrics perform on-level with non-synthetic ones. Once the materials were chosen, they had to be tested.

"We felt the best way was to wear the jackets and use them how we ultimately intended them to be used by our customers, but in a magnified sense," Kurland said. That meant they went snowboarding and hiking in extreme temperatures and dragged the jackets across ice and snow. Though Kurland says the process hasn't been easy, it's worth it.

"If you start a business, then you have to love it," Kurland said. "The only way it can survive is if you care enough to work through the most challenging stretches. Your business will keep you up at night, whether it's figuring out how to navigate a new issue or the excitement you're feeling from a decision that worked out perfectly."



## ArchAngels Insoles

Dr. Richard J. Manolian

Biology pre-med major at Northeastern

**Arch pain, heel pain, toe gait, and growth plate issues** are all podiatric conditions which affect children ages 13 and under. Research shows the need for early intervention with these types of conditions, but Dr. Richard J. Manolian, a board-certified foot surgeon, didn't find any insoles on the market for children. That's when he and a few other people founded ArchAngels Insoles.

They first started the design process with a scaled-down clay mold of an adult orthopedic implant to compose the model. The team put together a "stepwise approach" to the model in order to apply for a patent later. Once they were satisfied with its shape, they used CAD/CAM imaging to make the 3D version of the design. Now, the company has received a design and utility patent and has sold over 150,000 units worldwide.

Manolian said the experience he gained through co-op helped him with the progression of his company and gave advice to future entrepreneurs.

"As you get the idea or impulse for a product or project, write it down, and at a minimum each week catalog any progression of ideas or information," Manolian said. "Spend as much time as you can gathering data points from as many experts in the field that you can."

Alumni entrepreneurs share how they began their businesses

ARTICLE AND DESIGN BY LILLIE HOFFART,  
ENVIRONMENTAL SCIENCE, 2022



## ARISE

Kristen Gold

Music industry and business majors at Northeastern, graduates of the D'Amore McKim MBA program

In December 2016, Kristen Gold sent her first self-care box to support a friend who had lost a parent. Having also experienced loss and a near-burnout at work, Gold wanted to package up the self-care remedies that had worked for herself, starting her business, ARISE. These packages include a scented candle, bath scrubs, yoga flows, and an encouraging message.

Part of the healing process is remembering to take care of oneself, according to the American Psychological Association, and Gold's self-care box encourages recipients to do just that. Rather than sending flowers as a "thinking of you" gift, Gold's boxes also offers people ways to support themselves.

"Self-care is doing the things that bring you joy, fill you up and make you feel vibrant," Gold said. "This looks different for everyone – maybe it's lunch with friends or having a night in by yourself and going to bed early. It could be having your favorite tea or moving your body in a way that feels good for you. In times of heaviness and darkness, it's good to balance that out with lightness and ease."

The reminder to take care of oneself can support people as they navigate the healing process.

"Grieving is a journey and will be with you for the rest of your life," Gold said. "Self-care is one of the ways that can help people process their grief and are tools someone can use at every stage of their journey."

# Science Friday and the stories that should be told

BY JENNIFER GARLAND, APPLIED PHYSICS, 2021  
DESIGN BY KRISTI BUI, COMPUTER SCIENCE, 2021

New podcasts seem to pop up every day, but Science Friday has been around for 25 years, airing for two hours every Friday on public radio. More than 2 million people tune in weekly, not to mention podcast downloads. Hosted by Ira Flatow, Science Friday is “your trusted source for news and entertaining stories about science.”

Aleszu Bajak is the graduate programs manager at Northeastern University’s School of Journalism and worked as a radio producer and blogger for Science Friday. NU Sci met with Bajak to talk about the radio show and his work in science journalism.

## You started in science, how did you get into journalism?

I thought I was going to be a biologist ever since I visited the Galapagos when I was thirteen. Graduating from college, I got a job at Weill Cornell Medical College where I did gene therapy. But after three years of a lot of working with mice and working with viruses, I wanted to change it up...and it seemed a natural thing to start thinking about different ways I could talk about science [and] connect with people on issues that I cared about.

I was a news writer for [Biotechniques] for about four months...and I applied for...a dream job. It was an opening at Science Friday. The allure of producing something for an audience of 2-3 million plus podcast downloads was enticing. I could pitch a story on something I was passionate about or something that was coming out as a piece of science news that people weren’t paying attention to. And the challenge of trying to produce that for a live talk show was invigorating.

## What are some of your strategies for making really technical subjects interesting to the public?

One strategy is finding the right person – a character through which to tell the story. So obviously, the scientist. Because you can see across different continents, the image of the scientist is something that’s sometimes very far removed. They’re very faceless people.

## Do you talk to the actual scientists who have done the research? And how much do you have to learn about the subject?

It varies, but what I always felt was so invigorating about Science Friday was, on a week-by-week basis, you were learning, sometimes from scratch, about an entire area of science. That involved talking to the study authors for sure – that was first step. Second step was trying to find other people in that network that knew of the research... to understand the surrounding conversation, and then get ready for your primetime interview.

## How would you say podcasts have an advantage over other types of media?

The reason I think people are selling [podcasts] or are interested in it is because of the intimate nature of stories being piped into your ears. In terms of it versus other formats, I think that done well and written well, they can be equally emotive, they can be equally interesting... I think that the

“ One strategy is finding the right person - a character through which to tell the story.”

story should stand on its own, I think that the reporting, that the rigor with which you do the reporting should stand on its own, and the platform is just the vehicle.

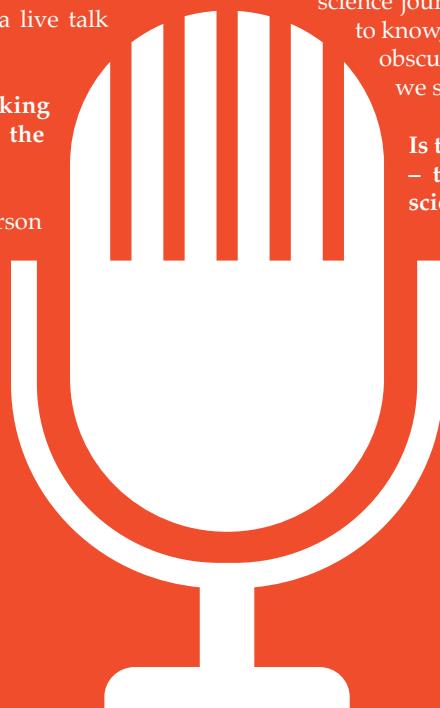
## At NU Sci, we were talking about how it's way more common to go from science to journalism than the other way around. What do you think about that?

I don't think it's necessary to have a science background. Sometimes it can hinder a story, can hinder your judgment of folks in that area or your ability to distance yourself, which is part of journalism ethics – writing those stories and thinking of questions that may be uncomfortable within the field of research that you're in.

Having a truly objective and removed way is the best way for the readers ultimately...if you think about the role of science journalism and what stories the public needs to know, number one is the truth. So, what is being obscured, what is out in the open, and how do we show all of that?

## Is that your motivation for being in the field – that you want to educate people about science?

I think it's spotlighting stories that should be told. Spotlighting stories or shedding light on stories that people might not necessarily think of when they think of an area, a person, a country, a gadget. I think science is a great vehicle to explain the world. In the end, it's showing a little bit of the wondrous aspects of science.



**Students search for biodiversity on a rocky shoreline in Winter Harbor, Maine.**



# Helmuth Lab at Marine Science Center Works Toward Science Communication

BY HANNAH BERNSTEIN, JOURNALISM AND ENVIRONMENTAL SCIENCE, 2021

DESIGN BY KRISTI BUI, COMPUTER SCIENCE, 2021

**Lynn, Massachusetts** is a 15-minute drive from Wonderland, the northern end of the Blue Line. The 439 bus crosses a thin piece of land and ends in Nahant, a small peninsula town of almost 3,500. Here, Northeastern's marine and environmental science research thrives at the Marine Science Center, an ex-World War II bunker turned massive laboratory.

Today, the center is a space for solving the world's toughest problems in climate change, evolutionary ecology, biomimetics, coastal ecology, ecological modeling, and more. Behind one door in their low, quiet building on Nahant's East Point is Brian Helmuth's marine ecological forecasting and ecophysiology lab. Helmuth, a Northeastern professor of marine and environmental science, has been teaching at Northeastern since 2013.

Helmuth and his team are working on multiple projects aimed at predicting the impacts climate change will have on coastal ecosystems, also known as ecological forecasting: using existing knowledge of processes and organisms to try and see the future.

Ecological forecasting is particularly important in the merging of science and policy. Without a clear idea of what the Nahant coastline will look like in 10 years, for example,

local policymakers can't take effective measures against coastline erosion. As much as the lab's research is about science, it's also about communication.

Here's a look at three of the initiatives in the Helmuth Lab.

## Robomussels

Jessica Torossian, one of three doctoral candidates, has worked in the Helmuth lab for five years on a project Helmuth himself began while completing his Ph.D. at the University of Washington in 1997. They are researching the way stress levels affect mussels and barnacles in coastal environments, especially in the Northeast, where mussel populations have declined precipitously in recent years.

Unlike humans, mussels are ectotherms, meaning they can't regulate their own body temperature and instead rely on the environment. Traditional temperature and condition sensors have limited accuracy simply because they don't mimic the color and biological materials of live mussels.

"The way we experience the environment is not the way an animal is going to experience the environment," Torossian

said. "Most of the temperature loggers that come off the shelf ... they're a certain size, they're a certain weight, and they're a lot different than the marine organisms that we're measuring."

To fix that problem, Helmuth developed robomussels, which are temperature sensors masquerading as mussels. They can be seamlessly placed in mussel beds to record data as if they were the organisms themselves.

"[Robomussels] get us much closer to what the mussels are experiencing in the environment, versus if you just were to measure air temperature on a given day," Torossian said. "[Normal temperature loggers] can be up to 17 degrees Celsius off from what a mussel experiences."

Mussels are known as ecological engineers and are foundational to providing habitats for the marine organisms living around them. They are also more resistant than other marine species to temperature and pollution. If they're disappearing, Torossian said, something is wrong.

"They can deal with a lot of different, wide ranges of temperature and a lot of pollution," Torossian said. "They can deal with a lot of stress. If they're dying off, it's a pretty good indicator that something is going on."

## Turning Gray Into Green

Ashley Cryan is the second of three doctoral candidates working in the lab. Cryan attended Northeastern as an undergrad and spent some time working at an environmental nonprofit in San Francisco before returning to Massachusetts.

Her work in the lab is also focused on the intersection of science and policy, trying to develop strategies to make urban coastal infrastructure more supportive of functional ecosystems. She identified two ways for cities attempting to solve these problems: soft and hard approaches.

The soft approach focuses on restoring natural vegetation near shoreline structures, such as planting mangrove trees alongside bulkheads. The hard approach involves changing the physical nature of the structures themselves through different materials or textures.

Cryan plans to conduct experiments to determine which types of substrates, or materials, allow marine organisms to remain in their habitats despite urban building. She said she will look at materials such as cobble composite, corrugated steel, wood, and granite.

**“Today, the center is a space for solving the world’s toughest problems in climate change, evolutionary ecology, biomimetics, coastal ecology, ecological modeling, and more.”**

Eventually, Cryan hopes to use her results to provide ways for coastal cities to contribute to climate change solutions that bring more ecosystem services — natural ecological processes that benefit humans, such as storm protection or water quality — back to the human and animal populations in the area.

"It's a really interesting blend of a lot of fields that are starting to discover the same things at the same time," Cryan said. "Cities are sort of poised to invest in coastal infrastructure."

Figuring out a way to design it so that it supports local, functional ecosystems and feeds back to us a lot of ecosystem benefits — it's just a fascinating challenge."

## Beach Sisters

Seven years ago, the Marine Science Center began a partnership with the nearby Lynn chapter of Girls Incorporated, a national organization focused on empowerment for young girls. The group, called Beach Sisters, allows high school girls to work directly with Northeastern scientists on marine and environmental science projects. The girls conduct experiments and go on excursions with

Marine Science Center researchers.

"For us, it was a gift, because we really are about promoting STEM with our girls," said Lena Crowley, the program director of middle and high school programs for Girls Inc. in Lynn. "It's a really attractive area for the girls because they live on the coast, they go to the beach, they care about the animals in the ocean and on the land. For us, it was a great way to keep the girls engaged."

Torossian said she loves the program because it empowers the girls to teach others about science.

"We brought the older girls out to a nearby marsh [or] harbor space, and they went out and did their own experiments," Torossian said. "They decided what photos they wanted to upload, they decided what data they wanted to include, and they used that to teach the younger girls about the space."

Right now, the girls are collecting signatures and meeting with local city leaders in Lynn over a plastic bag ban. Crowley believes teaching the girls about the connection between science and social change will be a lesson that sticks with them forever.

"It's empowering them," Crowley said. "They're definitely learning how they can make actual change in their community, so I think that's a pretty powerful lesson that they'll be able to use the rest of their lives."

**Though the natural world seems resilient**, it is only truly robust when its visitors are mindful of where and how they tread through and around it. Indeed, this is increasingly true of the ocean, with its beautiful and fragile kingdoms of coral that beckon millions of divers across the globe. Still, these communities are edging closer to some dismal, all-too-conceivable, but feasibly preventable end.

The guardians of these aquatic paradises are those who believe in the necessity of their preservation and enact change by conducting research to protect them, actively modulating their choices in a manner conducive to such preservation, and promoting these practices to a broader audience. One such guardian is Northeastern University's own Jodi Robertson, CIS'20, who recently received the Millennium Oceans Prize – awarded by a Boston-based non-profit called Millennium Campus Network – for her efforts in developing a set of principles that underlie environmentally-conscious diving practices.

For Robertson, the drive to spread awareness of these practices is rooted in deeply personal experiences. Her journey began at her high school in New Mexico, where she participated in a wilderness program that exposed her to Leave No Trace, the rule-based code of ethics that has weaved its way into the very DNA of backpacking culture. During a gap year, Robertson lived in a coastal town in Colombia, where she became a PADI-certified Divemaster and went on to work as such in a high-altitude lake in Guatemala nestled within a volcanic caldera.

For Robertson, adventures in this new and striking underwater world were breathtaking. "I just fell in love with it," she said. With this passion came another: introducing others to these same experiences. Robertson noticed that as new divers settled into their surroundings, profound changes in their respective outlooks took place. "I think they're able to connect with the world once they've relaxed into it," noted Robertson. Still, she was troubled by the insufficiency of the diving curricula to educate participants about taking care of the marine environment through which they swam. The ethics code of Leave No Trace, it seemed, had no parallel in diving. For Robertson, the tendency of other divers to touch corals or smack their fins against them was due to an overarching lack of conservation-based education in dive training that should warn divers of the potential harm that they might bring to aquatic communities.

When she came to Northeastern, Robertson set out to change this. Through a Summer Scholars Independent Research Fellowship under the guidance of Assistant Professor Steven Scyphers at Northeastern's Marine Science Center in Nahant, Robertson scoured the scientific literature for insight into how recreational and non-recreational diving activity shapes marine environments - in her words, the "social ecological outcomes of scuba diving." She is currently preparing a literature review manuscript that synthesizes her findings.

Out of this traditional research-to-publication pipeline came Robertson's campaign Raising Fins, funded in part by the Millennium Oceans Prize. In the spirit of Leave No Trace, Raising Fins is Robertson's way of providing the broader diving community with a set of finite principles to guide divers towards sustainable diving practices and behavior. Her goal is to have these principles implemented in the classrooms of widely-recognized dive organizations.

"I'll be approaching dive certifying agencies [like] PADI, SSI, and SEAMass," said Robertson, "and basically asking to work with them to develop the principles and potentially add them to their curricula." If successful, Raising Fins would reach countless prospective and seasoned divers, and ultimately bring the diving community closer to realizing a safer, more environmentally-conscious culture.

As recreational diving becomes more popular globally, the need to establish standardized ethical guidelines for sustainable diving practices is ever more critical. Robertson stresses that coral are vital components of marine ecosystems that are particularly vulnerable to contact with reckless visitors. She acknowledges that coral are indispensable contributors to marine biodiversity as well as defenders of ecosystem integrity that function as buffers against wave action for exposed shorelines.

Above all else, Robertson underscores a need to respect the marine environment and work towards spreading this sense of respect. "The environment is not there for our entertainment," she said. "We are the intruders – it's not ours to manipulate."

For Robertson, it comes down to "really just doing our best to understand what the ocean is telling us – what scientists are telling us that the ocean is telling us, and trying to fight for it."

# HANDS OFF, FINS UP: JODI ROBERTSON WANTS DIVERS TO TREAD RESPONSIBLY

BY LUCAS COHEN, BIOLOGY, 2018  
DESIGN BY YECHAN YANG, PSYCHOLOGY AND CHEMISTRY, 2022

# A LOOK INTO THE DEVELOPMENTAL NEUROPSYCHOBIOLOGY LAB

BY ALEXANDRA JACULLO, BEHAVIORAL NEUROSCIENCE, 2021

**On the third floor of Nightingale Hall**, part of the infamous maze of buildings on Forsyth Street, is the Brenhouse Developmental Neuropsychobiology Lab. It is in this lab that Dr. Jennifer Honeycutt conducts her post-doctoral research and was generous enough to give some insight into the significant work being done in the lab, as well as a glimpse into what it's like to be in her position as a post-doctoral researcher.

Even though she now holds a PhD in Psychology specializing in Behavioral Neuroscience, it wasn't until her undergraduate years of college that Honeycutt knew she wanted to pursue neuroscience research as a career. Through an interesting and unexpected turn of events, Honeycutt, originally a major in fine arts, began cleaning rat cages in a new faculty member's neuroscience lab as a job, only to end up conducting research there as well. It was only toward the end of her junior year did she decide to go on to graduate school to study psychology and neuroscience. She noted, "I'm the only person in my family to go to college so that in and of itself was already more than I was expecting to do; going on to graduate school had never been on my radar."

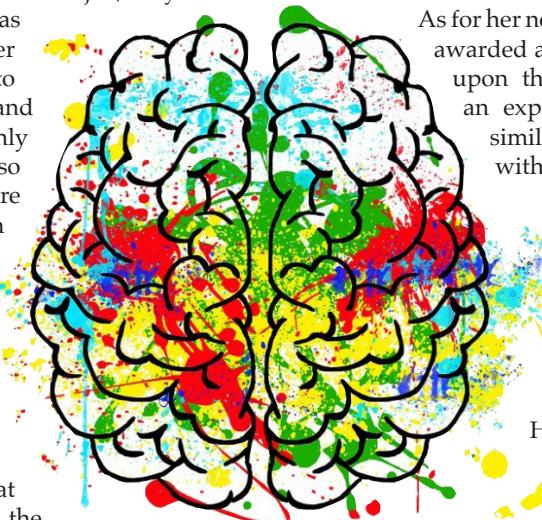
After shifting her focus away from developmental research during graduate school, Honeycutt joined the Brenhouse Lab for her post-doctoral research because of the connection of the lab's work to what initially sparked her interest in the field. The research being conducted by the members of the Brenhouse Lab primarily focuses on exploring how different experiences during the formative years of development can influence the way in which the brain itself develops, and how these structural and functional alterations subsequently serve to affect behavior and the manifestation of neuropsychological disorders later in life. Their efforts to better understand this complex brain-behavior interaction is a crucial step toward what they hope will ultimately culminate in the ability to prevent or mitigate these adverse effects.

The work being done in the Brenhouse Lab occupies a significant niche in the context of other research endeavors in the field. Currently, researchers are finding evidence in humans indicating that exposure to situations of early life stress correlates with noteworthy changes in the functional relationship that exists between the amygdala, which is the brain's center of emotion and the prefrontal cortex, the area

DESIGN BY VICTORIA PAJAK, BEHAVIORAL NEUROSCIENCE, 2021

primarily responsible for higher order cognition including reasoning, judgment, and decision making. Specifically, institutionalized children show a connection between these two brain regions which resembles that of older children, suggesting that this neural maturation process is occurring earlier in development than is typical.

According to Honeycutt, the Brenhouse Lab may very well have the insight to potentially explain this phenomenon. As she put it, "We're seeing a sex effect in animals that is perhaps driving this finding in humans which could be caused by the actual connectivity developing too early from the amygdala into the prefrontal cortex... we're showing that there might be a very real anatomical etiology for that behavioral change and that activity change."



As for her next step, Honeycutt has recently been awarded a grant that will allow her to expand upon these initial findings by developing an experimental task for rodents that is similar to what is studied in research with humans. This will essentially facilitate further investigation to determine if there are indeed identical elements involved in the functional changes observed in both rats and humans.

Looking ahead to her promising future in the neuroscience field, Honeycutt has several ideas she plans to explore with her own eventual research, including a focus on the pathology of schizophrenia.

Additionally, a goal of hers is to work toward developing highly transitional methods and techniques that will better answer the questions she and countless other researchers have.

When asked what advice she would impart to undergraduate students interested in research careers, Honeycutt emphasized the value of being flexible and escaping your comfort zone.

"I think it's important to be open to different things. I thought I was going to be an art therapist and then things aligned in such a way that I became a behavioral neuroscientist," she said. "Also important, of course, is flexibility because things never go the way you think they are going to go. That's just a life fact as opposed to a science fact, but it translates well to the sciences too."

# The College Diabetes Network: Support, Advocacy, and Legacy

BY ADRIANNA GRAZIANO, BIOLOGY, 2019

DESIGN BY FIONA GRIDLEY, COMPUTER SCIENCE AND DESIGN, 2021

**College is a time of transition** for many students as they relocate to a new city, find a new friend group, and adjust to a fast-paced educational environment. Though exciting, entering this new space can be daunting as students learn to manage their independence for the first time. For some, transitioning to college comes with an additional responsibility: managing type 1 diabetes (T1D). From changing doctors and solidifying medication supplies to tracking sugar levels, students with T1D have more to balance than the average college freshman. Importantly, the College Diabetes Network exists as a resource across the United States for university students living with and affected by T1D.

**“Northeastern’s CDN chapter is the beginning of creating a safer, healthier, and more educated student body.”**

The College Diabetes Network (CDN) is a nonprofit that started in 2009 to connect students that are affected by T1D. With headquarters in Boston, the CDN helps college students across the country form and lead their own chapters to create support systems and resources for their fellow students. As stated on their website, they are “focused on providing young adults with T1D the peer connections they value, and expert resources they need, to successfully manage the challenging transition to independence at college and beyond.” Not only is this an important resource for incoming freshman, but also for anyone that is diagnosed during their college years, affected by the disease, or interested in learning more about it. For many, forming a CDN chapter on their campus is an outlet to provide others with resources, advocate for each other, and educate fellow students on their campus about T1D. The change is also long-lasting, with CDN program coordinator Dan Browne stating that, “the most important

and most commonly seen difference is simply that students with diabetes feel safe, supported, and healthy.” And luckily for Northeastern students and those in the surrounding area, a CDN chapter has been recently established on our campus.

After a year of spearheading this initiative, Northeastern students Alex Peterson (COS ’18) and Maggie Gallagher (DMSB ’20) have successfully brought the CDN and its resources to Northeastern’s campus. They’re assisted by advisor Dori Woods, a dedicated lecturer and researcher on campus who has a personal connection to the disease. As a group, they’re currently working on a pilot program to connect counseling services, health services (collectively, UHCS), and the disability resource center (DRC) to streamline accommodations for students with T1D and other disabilities. In addition to creating a support system for students, they’re also aiming to educate the community about what it means to have diabetes and work to destroy harmful stereotypes about the disease. During an interview with Vice President Alex Peterson, a graduating senior, she stressed that her main goal is to “build up CDN to create a legacy for other students.” For her and many other student leaders who formed their own chapters, having this as a resource their freshman year would have been an important support system for their transition to college.

Northeastern’s CDN chapter is the beginning of creating a safer, healthier, and more educated student body. Though predominantly advertised as a support system for students with T1D, the chapter welcomes all students who are interested in learning more about the disease, working alongside their peers to advocate for policy change on campus, and teaching the surrounding community what diabetes is and also what it is not. Though a life-altering and chronic disease, CDN is just one example of the resilience of people with T1D and their ability to empower and enact change at a campus level and beyond.



Find more information at:  
Facebook - @cdnneu  
College Diabetes Network - [bit.ly/2G5WP81](http://bit.ly/2G5WP81)

# The Best Bees Around: Northeastern's Beekeeping Co-op

BY HEATHER OFFERMANN, BEHAVIORAL NEUROSCIENCE, 2019



DESIGN BY FIONA GRIDLEY, COMPUTER SCIENCE AND DESIGN, 2021

**The Best Bees Company** (BBC) is a Boston based, full-service beekeeping operation. Since opening in 2010, it has expanded to cities across the country. I met with Beth Ventura, an undergraduate student studying environmental science at Northeastern, to talk about her co-op experience at this company.

## What is Best Bees all about?

BBC is a beekeeping service that conducts research on improving bee health. They install and manage honeybee hives at homes and business locations. Each hive is a source of data for their research, so after each visit the beekeeper records the status of the hive. Once the honey is harvested from a hive, the client gets their own honey back. If they desire, the clients can harvest their own honey.

## What's a typical day at your job, and how will that change in the spring?

The work at this job is broken up into cycles, which follow the activities of the bees. Since I started in January when the bees were clustered to keep warm, a majority of my work has been in the shop building new hive parts and refurbishing old ones, preparing winter feed, and going through samples of bees to check for diseases. The diseases I've come across are the Varroa mite, which can be seen on a bee's body, and the microscopic Nosema parasite inside their gut. On warmer days, we have the opportunity to check on hives and make sure they have enough honey to get through the rest of winter. Having many warm winter days like we've seen this year can be bad for the bees, as the colony will go through honey faster when the bees are more able to break out of their cluster without freezing.

Each beekeeping cycle begins with a meeting about that cycle's tasks. We go out into the field with general expectations based on bee activities during that time of year, but we also need to be prepared for the unexpected as well. The co-ops and interns work closely with the full-time beekeeping team, so we have support through all of this. This makes for a great learning experience.

## What research is being conducted?

The research topics include optimizing beekeeping practices and managing diseases. There is also a non-profit that branched off from BBC called The Urban Beekeeping Laboratory & Bee Sanctuary, which investigates a range of scientific topics from where bees thrive, to how bees help humans. Something fun the company is able to do is sequence the DNA within honey to determine which flowers the nectar was taken from to make that honey. This is a great way to determine the types of flowers people should plant in order to help the bees.

## What are the future goals of Best Bees?

They are trying to grow their roots at current locations and establish themselves rather than expanding. They also have plans to develop their workspace to accommodate more lab space and equipment on site.

## Has there been any specific moment at work that helped you realize the importance of your job?

The first time I went out on a route to check the bees on a warm winter day there was a client whose hive had died. They were saying that if their hives keep dying they won't continue. This interaction highlighted to me that the important point of doing this work is to help the bees. After all, human activities such as habitat destruction and the use of pesticides are the reasons that bees are struggling in the first place. It is our responsibility to help the populations regain their health and provide habitats in which we can coexist with these important pollinators. By having a hive with BBC, clients are providing important data points for our research.

## Is there anything cool I didn't ask about that I should know?

National Geographic recently published an article about the BBC, titled "A Dollop of Sweet Science." It talks about how BBC is able to sequence the genetic material in honey, and features infographics on the common plants for honeybees in each of major cities.



# A Spotlight of Spotlights

A day in the life of a science writing co-op

BY BRYNN VESSEY, BEHAVIORAL NEUROSCIENCE, 2019

DESIGN BY LILLIE HOFFART, ENVIRONMENTAL SCIENCE, 2022

**Cancer immunotherapy has become something of a prodigal child** in the last few years. Techniques and ideas such as checkpoint blockades, which aim to modify some aspect of the cancer immunity cycle such as anti-PD-1 and anti-CTLA4 therapy, vaccines, adoptive T cell transfer, and CAR T cell therapy are rising to the forefront with papers and studies conducted at an advanced rate. With so much new knowledge aiding in the fight against cancer, it seems almost impossible to know where to begin to get acquainted with the field. That's where Advancing Cancer Immunotherapy Research, or ACIR, comes in.

ACIR is a nonprofit company started through the Fritsch Foundation that seeks to make papers and studies public knowledge. Founded by Edward Fritsch and Ute Burkhardt, the

Fritsch Foundation looks to provide researchers and readers alike with the latest and most significant research in the field of cancer immunotherapy, and I am lucky enough to currently be in the midst of a co-op at the company!

Each week at ACIR, six to ten articles are summarized and one article is featured. In spotlights, six concise lines detail important aspects of the paper and provide a jumping off point for other researchers intrigued by the work. Spotlights are picked from a variety of sources and can take anywhere from a few hours to a few days for us to teach ourselves and then explain to others through our summaries. Published weekly on the website, these spotlights are shorter versions of important papers that offer researchers a glance at what's new in immunotherapy for the week. Featured articles, on the other hand, are the major players of the week in immunotherapy. I recently wrote my first feature, on LXR agonism - a concept that relates to activating a certain receptor on a microscopic level to cause macroscopic change - and its impacts on a population of immune cells known as myeloid derived suppressor cells (MDSCs). While this paper may have taken my coworkers a day or two to understand, as both

have been with the company from the beginning and are considered experts at decoding scientific language, the initial drafting took me the better part of a week. Once I figured out what exactly MDSCs are, I set to work writing my first published article on ACIR.org, titled "LXR agonism promotes macroscopic change in the tumor microenvironment."

Co-oping with ACIR has provided me the chance to do real work and contribute in a tangible way to an advanced field that takes years to understand. I spent the first month of my co-op with my nose in textbooks detailing everything from innate immunity to neoantigen vaccines and now get to be part of a group of brilliant women that work every day to make science more accessible.

**“**Co-oping with ACIR has provided me with the chance to do real work and contribute in a tangible way to an advanced field that takes years to understand.”

The Fritsch Foundation is looking to expand its reach in immunotherapy with a second site called UCIR, or Understanding Cancer Immunotherapy Research. A portal for patients, affected others, loved ones, or people without a hard science background who want to understand immunotherapy, the main

mission of both ACIR and UCIR is to make cancer immunotherapy less of an unknown.

Working alongside NU Sci alumna and science writer Lauren Hitchings and science writer Anna Scherer, I am able to write about topics that matter every day. Gaelle Llambi, our Communications and Outreach Coordinator, takes our writings and makes a brand for our words, designing logos and swag, contacting authors, and using her social media savvy to draw attention to ACIR in the digital world.

Coffee and tea may be the main ingredients of our diet at ACIR, with a few treats from Flour Bakery thrown in, but our appetite for science and bringing information to the forefront never ceases.



## How Science Writing Opens Minds and Opens Doors

BY SAGE WESENBERG, BIOLOGY AND JOURNALISM, 2019

**“For me, a lot of times it comes down to not only the science, but also the importance for the planet and how it’s impacting people’s lives. That’s why I love what I do now,”** said science writer Angela Herring Page.

After completing her undergraduate career at Bennington College in chemistry and literature, Page started out as a research technician. While she was fascinated by the work and considered going back to school to get her PhD so she could explore other questions in chemistry, she worried that she would feel stuck if she chose one area to focus on for the rest of her life.

“Science writing was a perfect foil for that, because I could learn about anything I wanted,” said Page.

She began a blog publishing articles based on scientific press releases, which she used to pitch her work to local research institutions. This gave her the opportunity to write articles for places like the Harvard Stem Cell Institute and the Broad Institute, a biomedical and genomic research center in Cambridge, Mass. In 2012, Page found a job at Northeastern University as a science writer.

“There was a big push on research when I started,” Page said. “They needed someone to tell all of those stories.”

Page describes her time at Northeastern as a “once in a lifetime treasure of an opportunity.” Her writing took her through many fields of research, interviewing professors all over the university.

“I would find myself one day getting a one-on-one personal science lesson in particle physics, and one day writing about marine biology research,” she said. “I loved learning about marine biology. I met such great people with deep personal missions to study the impacts of climate change and sustainability. They used their gifts as scientists to try to tackle those really pressing global problems, and I loved that.”

Now, Page writes in a different capacity. As the Communications Lead for the Global Alliance for Genomics and Health (GA4GH), Page plays an important role in helping to advance the mission of this international consortium which is working to create standards and frameworks for international genomic data sharing.

DESIGN BY IRINA PYATAEVA, BIOENGINEERING, 2020

Genome sequencing has become more affordable and feasible around the world. “Five years ago, they were talking about tens of thousands of genomes for research studies,” said Page. “Now, they’re talking about millions of genomes being used all across health care systems.”

In order for this genomic data to be used to advance precision medicine, Page explains, it needs to be compared to other genomes across nations and ethnicities. The GA4GH works to create standards that institutions around the world can use so all genomic data is being collected, stored, and analyzed in the same manner.

As the communications lead, Page has launched a new website where she tries to write one story per week on the importance of data sharing. She also helped produce and launch the organization’s five-year strategic plan, which was released in October 2017. For that project, she coordinated leaders from all over the world expressing their confidence in and goals for GA4GH. Page said this type of collaboration is one of the best parts of her job.

“My favorite thing about science writing in general is working so closely with brilliant people,” Page said. “To learn from them but also to have a voice in how their work is communicated - it’s a very empowering experience.”

Her work at GA4GH involves a lot of moving parts, but the end result is always worthwhile.

“My role makes it possible for the organization to function and succeed,” she said. “I feel like I’m contributing to the world for a good purpose, and people’s lives will be made better because of my work.”

She said that science writing is a career that has the ability to give access to endless other careers in science, and Page advises young science writers to remain open to every opportunity.

“Don’t necessarily decide right now what you’re going to be when you grow up,” she said. “You never know which connection will be the unexpected thing that could change your life.”

# Becoming a Part of the Museum of Science: A symbiotic relationship at the living laboratory

BY KAELEN ENCARNACION, BIOLOGY AND ENGLISH, 2021

DESIGN BY KYLA VIGDOR, DESIGN, 2021

**One major issue the scientific community faces** today is the great lack of communication between its researchers and the general public. The Museum of Science strives to bridge this gap with a special program that takes place in their Hall of Human Life. As the name implies, this interactive exhibit is dedicated to teaching visitors about human biology and everything that falls under it, including physiology, neuroscience, anatomy, and health. Within this wing, the Museum of Science has created a program called the Living Laboratory, where researchers from local universities are invited to conduct experiments and present their work to visitors. By doing so, the general population is encouraged to participate and contribute to research, while also learning about the work that goes on in each researcher's lab, creating an enriching experience for both researchers and visitors alike.

Dr. Peter Bex, a professor in the Department of Psychology at Northeastern University, is one such researcher. His Translational Vision Lab focuses on visual perception and how the brain processes images, particularly in relation to how these mechanisms are affected in blinding eye diseases such as amblyopia, glaucoma, and age-related macular degeneration. In the Living Laboratory, his lab's work involves the use of eye-trackers in order to provide some insight on a person's cognitive abilities and behavior.

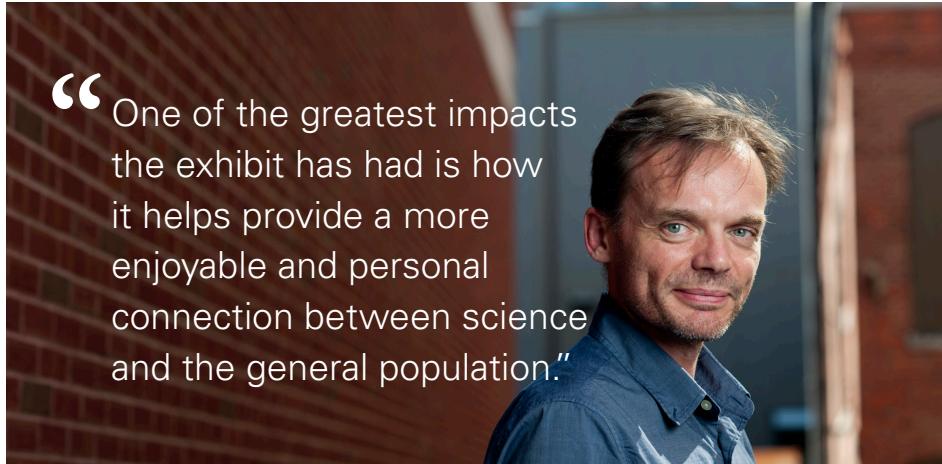
For example, when someone is watching a movie, they can track their eye movements to see where their attention is and what information their brain is deciding to process. In an individual who is cognitively healthy or has good vision, you could see through their eye movements that they are following the sequence of the plot normally, by doing things like switching between two people in a dialogue or looking at information-rich locations. In an individual with cognitive deficits or poor vision, these abilities may be negatively impacted. Therefore, the purpose of Bex's research at the Museum of Science is to track and monitor visual and cognitive health in ways that have not been very accessible or even possible in the past.

Bex first started conducting his research at the Museum of Science because he saw a great opportunity that researchers typically do not get: the program allows for the diversification of participants, which helps to make their data set more representative of the real world. Because Boston is a big college city, volunteers for experiments typically consist of healthy undergraduate students between the ages of 18 and

22, so it often proves to be very difficult to find participants outside of this demographic. Because visitors of the museum come from all backgrounds and age groups, this results in richer and more diverse data for the researchers to work with as well as a wider audience with which to share their findings.

Like with many scientific pursuits however, researchers often find it difficult to communicate their work to the public, especially when people have backgrounds as broad and diverse as imaginable. Bex acknowledges this issue in his own field, "Professors really want to engage undergraduate students and high school students because they're our future. And I'm not sure that we as scientists have done a great job of making it clear to the future generations of scientists that we really welcome their involvement in our

**“** One of the greatest impacts the exhibit has had is how it helps provide a more enjoyable and personal connection between science and the general population.”



work. We're not trying to separate ourselves from them... We want to get more and more people into our field because it's important, and I certainly recognize that the only way this field can move forward is if we bring young people in."

Thus, one of the greatest impacts the exhibit has had is how it has helped provide a more enjoyable and personal connection between the general population and scientific research. Here, researchers are able to share what they're working on and expose visitors to new and interesting concepts about the human body. People can not only learn from the program, but they can also become a part of it and contribute to something greater: "The more of this kind of thing that we can do as scientists, the better. And not simply for the communication purpose, but also to stimulate interest in showing people paths to contribute in an area that they might not realize was possible."

PHOTO COURTESY OF PETER BEX

# I ❤️ Science at the Harvard Museum of Natural History

BY ISABEL KAIN, PHYSICS, 2021

DESIGN BY KYLA VIGDOR, DESIGN, 2021

**Boston has a long and vibrant history** of scientific achievement, a legacy celebrated by the Harvard Museum of Natural History's semi-annual *I Heart Science* event. On February 10, science enthusiasts of all ages and backgrounds wove between stations scattered across the museum. Kids built Lego habitats for Madagascar hissing cockroaches; adults perused scientist profiles lining the hallways. Visitors of all ages tested model aircraft in a wind tunnel to learn about the flight morphology of animals. The one common element between all these different displays was excitement.

While having fun is important, outreach events like *I Heart Science* serve a greater purpose: to demystify science and make it approachable for everyone. "I want them to see science as a human thing, I want them to see, 'Oh, these are human people doing it and asking questions,'" says Brianna Weir, a graduate student volunteering at the event. "I like making it seem accessible."

Wendy Derjue-Holzer, Educational Director for the museum, wants to clarify the purpose of the museum's outreach efforts: "Unlike some other people I'm not looking to make every kid turn out to be a scientist but I want them to be comfortable with science and feel like it's something they can understand." Instead, she emphasizes the importance of

science literacy. "The same way I believe everyone should be able to read, write, do math, I think people should be able to do science. I think it impacts the way people are citizens."

Outreach efforts are primarily targeted towards the public, but are also valuable for the scientists. "It's really important for the grad students to be able to talk about their science in a way that the public understands," says Derjue-Holzer. A big part of graduate students' training is learning to communicate their work concisely and effectively, to scientists and non-scientists alike. Communicating their work to peers is imperative for supporting it through collaboration and grant-writing. Without that skill, they would struggle to support their own research.

The same goes for a non-scientific audience: if your work has no justification beyond the tight confines of your discipline, then why are you inspired to pursue your work? "[Outreach] makes me care about what I'm doing," explains Weir.

Such vibrant engagement with science cannot be found just anywhere. "I think we're lucky to live in Boston, which is a really intellectually rich town," says Derjue-Holzer. "It's a place that has a lot of people doing a lot of interesting work, so it's important to think about the spaces where we connect what we're doing with the public."

## Partners In Health: A Boston-Grown Nonprofit

A look into one of Boston's nonprofits with a mission to make healthcare accessible to all

BY PAULA HORNSTEIN, BIOLOGY, 2020

DESIGN BY KYLA VIGDOR, DESIGN, 2021



**Boston-based and Boston-grown,** Partners In Health is a nonprofit organization with a mission to bring modern medical advancements to low-income areas. Its founders include Ophelia Dahl, recipient of the 2011 Bostonian of the Year award, Dr.

Paul Farmer, a professor at Harvard Medical School and the subject of Tracy Kidder's *Mountains Beyond Mountains*, and Dr. Jim Yong Kim, current President of the World Bank, as well as Todd McCormack, senior VP of IMG Media, and Tom White, one of Boston's most historically generous philanthropists. The organization has links to Harvard Medical School as well as the Brigham and Women's Hospital, and is headquartered in the Prudential Tower. Northeastern has a chapter of PIH Engage, the grassroots level of PIH, as do Harvard, Boston College, Boston University, and Tufts. However, the organization reaches far beyond the greater Boston area.

PIH's motto—"We go. We make house calls. We build health systems. We stay."—is true for each country that the nonprofit has a base in. These nations include Haiti, Liberia, Sierra Leone, Peru, Mexico, Lesotho, Rwanda, Malawi, Kazakhstan, the Tomsk Oblast region in central Russia, and Navajo Nation in Arizona, Utah, and New Mexico. In these countries, the organization strives to create a "preferential option for the poor in health care." This includes, but is certainly not limited to, health care that is free and readily available. PIH prides itself on its sense of solidarity, as opposed to charity, with the communities in which it works.

They achieve this by hiring doctors from the community and training community health workers, who already have strong relationships with the patients, to implement strong health care resources permanently in the area. It is through these teams of health professionals within a community that Partners In Health is able to apply some modern medical and academic wonders to nations in need of them.

For all chapters of PIH Engage, this spring's goal is to raise money that will go towards improving maternal health care resources in Lesotho, a country enclaved by South Africa in which about 40 percent of the population lives below the international poverty line, or the equivalent of 1.25 USD per day. The money raised will be applied to building clinics and lying-in centers for pregnant women, training community health workers in how to best care for expecting mothers, and treating children with diseases such as tuberculosis and HIV. Sarah Yates, the Advocacy Lead of Northeastern's chapter of PIH Engage, had this to share about the current mission to improve maternal health conditions in Lesotho: "I care about Partners In Health because I believe that suffering is universal, that local problems are also global, and that there should be preferential treatment for all."

For more information on PIH, visit [www.pihi.org](http://www.pihi.org) or reach out to the PIH Engage members on campus.

# SHOULD SCIENTISTS PARTAKE IN SOCIAL ACTIVISM AND MARCH FOR SCIENCE?

BY KATIE MCCREEDY, HEALTH SCIENCE, 2021  
DESIGN BY YEECHAN YANG, PSYCHOLOGY AND CHEMISTRY, 2022

**Thousands of protesters and scientists** flooded the streets in hundreds of U.S. cities on Earth Day last year in part to protest the then newly sworn-in President Trump's plans to cut research agency funding. His original plan, which was not approved this year, included a \$5.6 billion budget cut to the National Institutes of Health. The March for Science, as it was called, will take place again this year including in Boston this April. Because the Boston march promotes research-based policy decision making, there has been backlash and many feel conflicted about the role of scientists in politics. Should scientists be involved in social activism, is there a point where the scientific community must fight for science?

We asked three Northeastern University professors for their opinion on the role of activism in science.

Diomedes Logothetis, a professor of pharmaceutical science, feels that researchers' investment into their work can lend itself to social activism. "If you work on climate change, then that's what you're intimately involved in," Logothetis said in reference to the many climate change researchers who are involved with the march. He also said that this activism can be useful in informing the public. "[It] gets the public to realize that the scientists are behind their issues that they study," Logothetis said.

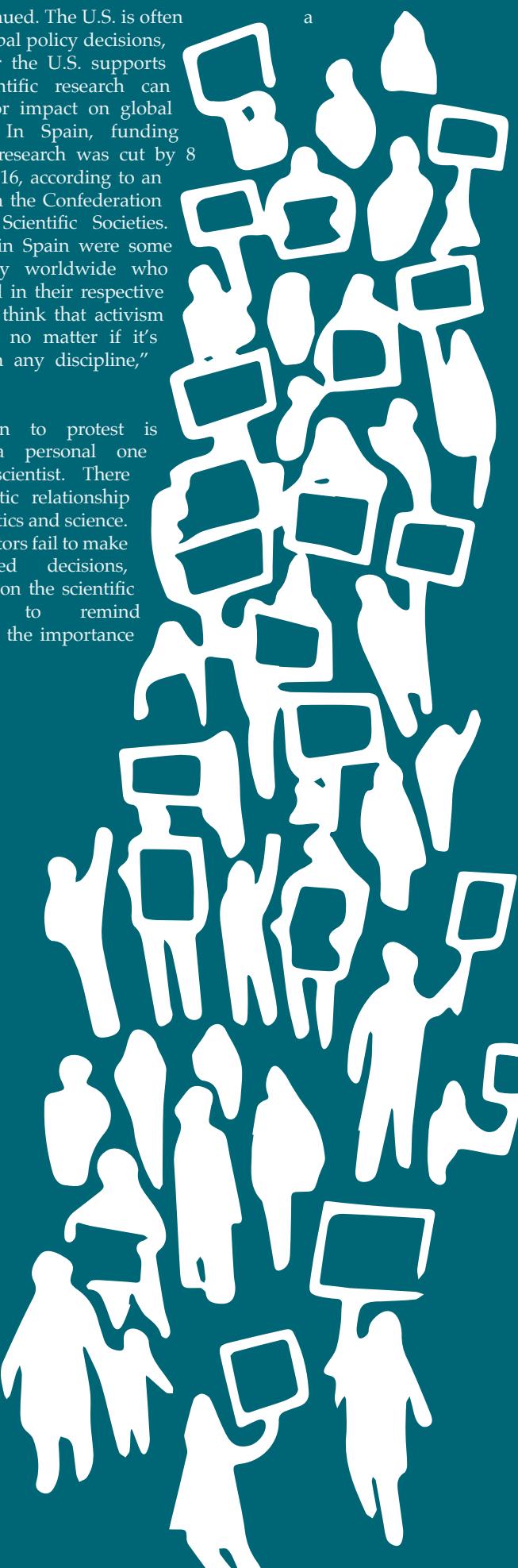
**“**I think that activism is important no matter if it's science or in any discipline.”

Deniz Erdogmus, a professor of electrical and computer engineering, weighed in on the march's potential justification for science activism. "When we write a proposal to NSF, they ask us how we will disseminate, the typical answers are papers and seminars but why not also do public speeches about it," Erdogmus said. This is analogous to the euphemism that if a tree falls in a forest and no one is around to hear it, does it make a sound? If a researcher does not actively advocate on behalf of their research, did they even do the research?

Pau Closas is an assistant professor of electrical and computer engineering originally from Barcelona. "It's more of a social thing," he said of his home country. "Everyone is active in general, so there is scientific activism as a consequence."

Closas continued. The U.S. is often leader in global policy decisions, and whether the U.S. supports certain scientific research can have a major impact on global researchers. In Spain, funding for general research was cut by 8 percent in 2016, according to an analysis from the Confederation of Spanish Scientific Societies. Researchers in Spain were some of the many worldwide who also marched in their respective countries. "I think that activism is important no matter if it's science or in any discipline," Closas said.

The decision to protest is ultimately a personal one for every scientist. There is a symbiotic relationship between politics and science. When legislators fail to make evidence-based decisions, it often falls on the scientific community to remind politicians of the importance of research.



# A Look at University Research Funding

BY ERICA YEE, COMPUTER SCIENCE, 2021

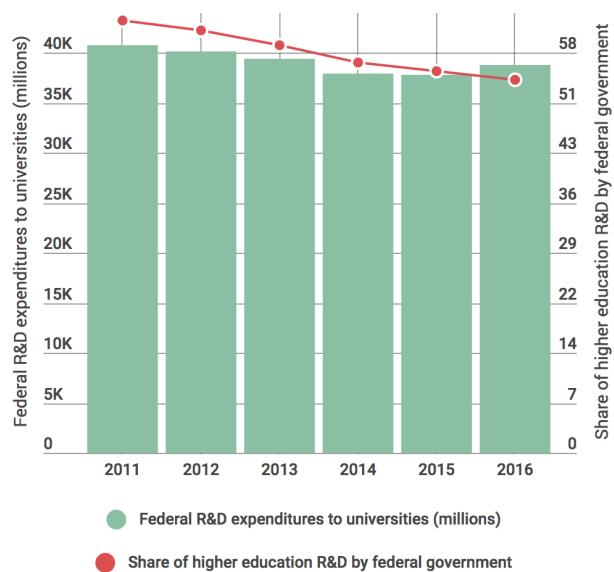
DESIGN BY ANNIE LEE, DESIGN, 2019

The federal government has long been a major funder of research and development (R&D) at institutions of higher education, pouring billions of dollars each year into projects from a wide variety of fields. Here is an overview of where this money goes and a local look at federally-funded research at Northeastern University.

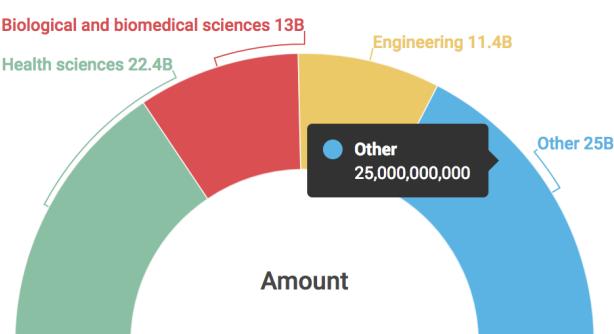
## National

All national data are from the Higher Education Research and Development (HERD) Survey by the National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation (NSF), published on Nov. 30, 2017.

Federal R&D funding to universities increased for the first time in five years for FY16, but the share of funding by the federal government continued to decline. Universities may also receive funding from state and local governments, institution funds, businesses, and nonprofit organizations.



The bulk of university research spending from all sources is in three fields, which accounted for 65.2% of the total spent in FY16.

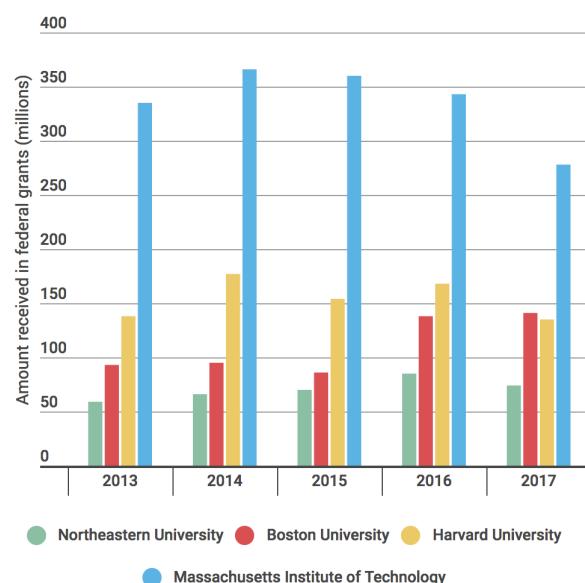


These are the higher education institutions that spent the most on R&D from all sources in 2016. The highest ranking Boston-area institution was Harvard, in eighth overall.

## Local

All local data are from USA Spending.gov, which categorizes federal awards as grants, sub-awards, contracts, or loans. The school data below only refers to grants, which are defined as awards of financial assistance from a federal agency to a recipient to carry out a public project or service authorized by a law of the United States.

Out of several major Boston-area private research universities, MIT received the most in federal grants in FY17.



These are the three largest federal research project grants to Northeastern in FY17.

- 1 \$4,000,000**  
Department of Defense  
Interdisciplinary expeditionary cyber research
- 2 \$3,500,000**  
Department of Homeland Security  
Awareness & Localization of Explosive Related Threats (ALERT)
- 3 \$2,407,714**  
Department of Health and Human Services  
Puerto Rico Testsite for Exploring Contamination Threats (PROTECT)

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# The Future of the MBTA: What's in the Cards?

BY RAFI RAZZAQUE, ENVIRONMENTAL SCIENCE, 2019

DESIGN BY IRINA PYATAEVA, BIOENGINEERING, 2020



**With a daily ridership near 1.2 million**, the Massachusetts Bay Transit Authority (MBTA), the fifth largest transit agency in the country is the lifeline of the Massachusetts Bay area. As a useful and affordable alternative to other forms of transportation, the MBTA is set for numerous commuter, subway, tram, and bus route extension projects to better serve its community. Planned rolling stock improvements, fare payment advances and pilot late-night services in Mattapan and Chelsea headline the MBTA's improvements in ridership quality.

Nonetheless, the MBTA has its share of issues to address going forward. The MBTA is five billion dollars in debt and routinely plagued by tardy service. Service is expensive and potential cuts to those services are imminent. In addition, the MBTA's success has actually managed to gentrify the very neighborhoods they service.

So what can we expect from the MBTA in the future?

The MBTA will ascertain their 2018 fiscal budget in April. To fund future projects, the MBTA is expected to increase its revenue by \$33 million over 2015 levels by increased advertising revenue and real estate sales. With regards to the former, a ban on alcohol advertising has been overturned, potentially worth two to four million dollars in annual revenue. As for real estate sales, as the MBTA is one of Massachusetts' largest landowners. Selling off MBTA land for development and increasing tenant rates is another way to increase revenue. Additionally, raising fares and service cuts are likely, including privatization of certain maintenance positions.

The MBTA also plans on overhauling fare collection. The actual fares are set to increase, following cost cap guidelines that limits increases to seven percent every two years. A new fare collection system will replace the existing CharlieCard circa-2020, estimated to save about \$5 million a year. Additionally, it will reduce fare evasion and speed up the boarding process. The expectation is that a phone-based system similar to those used in Japan will replace all cash transactions on the MBTA; commuter rail customers will tapping in and out of the train to pay fares based on distance traveled. For cash wielding customers, fare tickets can still be purchased at MBTA stations.

An overhaul in reliability is another way the MBTA can potentially improve its ridership. By providing clean, new trains that run reliably and frequently, they can improve ridership and service quality. The Orange and Red Lines will replace aged equipment with 152 Orange Line and 252 Red Line units replacing decades old rolling stock, starting in 2019. The MBTA envisions a three minute wait for trains during peak service hours following the implementation of new cars.

Although the prospect of obtaining new equipment is exciting, the MBTA commuter rail can have quirks and issues. Improper shipping of materials and turbocharger issues sidelined 13 of the 40 new commuter rail diesel engines that were delivered between 2013 and 2014.

Finally, the MBTA hopes to expand into new territories to increase ridership. A Somerville and Medford Expansion on the current Green Line past the Lechmere stop would extend the D line, and a Union Square stop would extend the E line. The extension is expected to cost \$2.3 billion and will be completed in 2021. The Silver Line is expected to service Chelsea from South Station in 2018, with five new busses purchased via federal grants. Finally, MBTA commuter service to New Bedford, Fall River and Taunton is expected to be completed in 2022 at a cost of \$3.4 billion.

The MBTA also has several expansion plans still in proposal and planning stages. Notably, a North Station and South Station link, as there is no direct connection between the two. Solutions involve a Central Station serviced by the Blue Line (which does not connect to North or South Station), or a set of connecting freight tunnels for the commuter rail and freight. A project awaits a feasibility study to determine the best plan of action.

Through new line expansions, the MBTA increases its customer base and, potentially, revenue. Their current efforts at expanding existing services by replacing aging and unreliable rolling stock can increase the MBTA's capability and image, as more and more people depend on the MBTA services. Will the MBTA get it together and address its reliability issues, budget shortcomings and cost issues? That has yet to be seen, but Boston is faring up for a brighter transit-oriented future.



# THANK YOU

BY SAGE WESENBERG, BIOLOGY AND JOURNALISM, 2019  
DESIGN BY KRISTI BUI, COMPUTER SCIENCE, 2021

To our graduating seniors this year, all of us at NU Sci wish you the best of luck. Our magazine would not be where it is now without all of your hard work. We can't wait to see where you'll go!

PHOTO BY RACHEL GIANATASIO



## Gwendolyn Schanker

Journalism and Biology major Gwen has been a writer, editor, editor-in-chief, and president of NU Sci over the course of her five years at Northeastern. Her favorite articles include "Reactions and Roleplay: Telling the Story of Organic Chemistry" from Issue 30, interviews with Professor Toyoko Orikomo for Issues 16 and 26, and "Sticking the Landing: Strategies for Working through Fear in Gymnastics" for Issue 25. After graduation, she will be staying local - working as an associate at Ten Bridge Communications and continuing to pursue her dream of communicating science across a variety of audiences and disciplines.



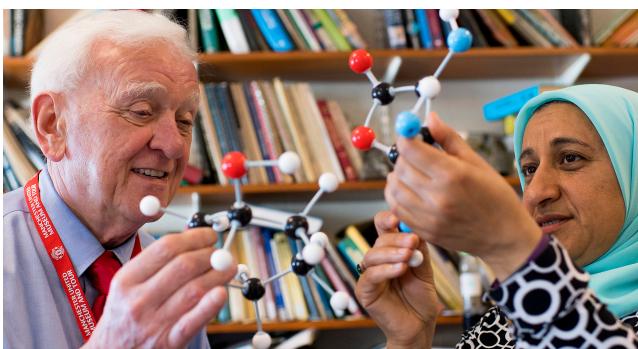
## Adanya Lustig

Linguistics major Adanya has been writing for NU Sci since her freshman year in 2014 and editing since 2016. Her favorite articles were on lethal injections, deep-sea bacteria, and many of Northeastern's professors. She loves to help writers develop their stories and find their voices. After graduation, she will continue pursuing a career in journalism, but she's still looking for a job!

We would also like to spotlight our past faculty advisor of NU Sci, Professor Geoff Davies, and Lori Lennon, who is our new advisor this semester. Thank you for constantly supporting us, signing our forms, and helping us grow!

## Geoffrey Davies, Distinguished University Professor

PHOTO BY MATTHEW MODOONO



*Geoffrey Davies and Elham Ghabbour, Principal Research Scientist, Department of Chemistry & Chemical Biology.*

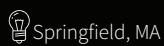
Chemistry Professor Geoff Davies has been with NU Sci as our faculty advisor since the beginning. As many of our members have taken general chemistry courses with him, Professor Davies has always been a friendly and supportive face for NU Sci. We are incredibly grateful for the work that he has done in helping us spread the word about NU Sci, being interviewed on his own work, and being an avid reader of our magazine. We will miss having him as our advisor, and are so appreciative of all of the help he has

given NU Sci over the years. Luckily, we have the amazing Lori Lennon as our new advisor, starting Spring 2018. Lori is the Director of Communications for the College of Science and has been an avid reader of NU Sci since she started here in 2011. She looks forward giving us a hand through future issues and helping the community of science writers grow throughout our Northeastern community. As a former journalist, she understands the importance of spreading the impact of science, and we are so excited to have her join our team.

**Lori Lennon, Director of Communications, College of Science**



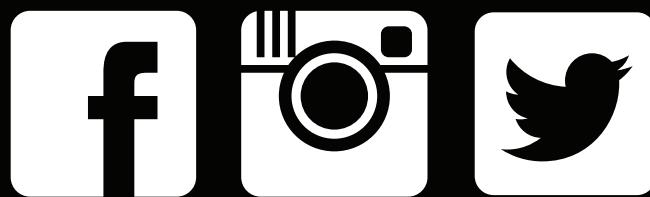
PHOTO BY SRI THUMATI OF THUMATIPICS



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Best Bees Company

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