FUELING DISCOVERY

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College of Letters & Science
UNIVERSITY OF WISCONSIN–MADISON

COLLEGE OF LETTERS & SCIENCE

Curiosity-driven research fuels life-changing discovery at L&S

ERIC M. WILCOTS

UW-Madison is known as an "R1" research university. But what does this mean? There are 146 institutions in the U.S. classified as "R1," which stands for "very high research activity." It means this campus is humming with discovery, much of it unfolding in the College of Letters & Science.

This "Fueling Discovery" supplement to the Wisconsin State Journal is a celebration of research, the act of "uncovering, or bringing to light," that happens every day in the College of Letters & Science. We asked faculty from across the College to write about their own research in their own words, not for the professional peers with whom we are so used to discussing our work, but in the spirit of the Wisconsin Idea.

The College of Letters & Science has 37 academic departments and schools and 66 interdisciplinary research centers and institutes that span the Arts & Humanities, Social Sciences, Biological, Physical, and Mathematical Sciences and, Computer, Data & Information Sciences. You will find the breadth of research and scholarship in L&S reflected in these essays. It is our mission, and that of the University as a whole, to address and tackle the most challenging and important questions of our time.

It is also our mission to provide a transformative experience for our students. While our graduate students are often on the frontline of discovery, participation in research has a lasting impact on our undergraduate students as well. Being able to work with faculty as an undergraduate shaped my own career, and we want our students to have that same experience.

In this edition of *Fueling Discovery*, you will find an essay by one our amazing Undergraduate Research Scholars (URS), Corina Robinson. We also have a new initiative in place to welcome and support outstanding students in science, technology and math. We're calling it our STEM Scholars program, and it will connect underrepresented students to research opportunities, mentors, internships and job options in the STEM sector. It's critical that we build this program because the STEM fields, especially in the private sector, need these students. This is how we grow the pipeline of talented, diverse STEM scholars. In this edition, you'll read about the research experiences of some of our STEM Scholars, in their own words.

We believe deeply in the importance of curiosity-driven research. My colleagues in L&S are driven by questions of how and why. We seek to understand the natural world we inhabit, be it the complex functions of Earth's atmosphere and climate, freshwater ecosystems or the universe as a whole. We are driven to understand how we as humans interact with one another as individuals and as societies, and how these interactions have changed over the course of human history. L&S research is also inspired by thinking about our political systems, our histories and our cultures and the sometimes-difficult truths that that thinking reveals. As technology, including the availability of massive amounts of data, has changed our world, we see not only curiosity-driven research, but also research inspired by a need to understand our interactions in a world so tied to computing and data. Understanding the stories we tell and write and the art and music we create, inspires and leads to a greater understanding of who we are as human beings. Through the breadth of L&S we are drawn to the realization that research, innovation, and creativity are the engines that drive discovery. They are the engines that drive the "fearless sifting and winnowing by which alone the truth can be found."

The things we take for granted today—the knowledge, technology and understanding—had their origin in curiosity-driven research that led to discovery years, decades or even centuries ago. By fueling discovery today, we are investing in our future and that of our children and the world they will inherit.

About the dean

Eric M. Wilcots is the dean of the College of Letters & Science and the Mary C. Jacoby Professor of Astronomy in the Department of Astronomy, his home department since 1995.

Dean Wilcots is committed to creating an environment where all can succeed and thrive. In 2020, he launched the Dean's Initiative for Diversity, Equity and Inclusion and created the STEM Scholars program, which provides critical support for L&S students entering the university with an interest in science, technology, engineering or math.

During the largest enrollment expansion in the history of the university, Dean Wilcots has championed and stewarded new capital projects, including the opening of the new Chemistry Tower, a state-of-the art space designed to accommodate enormous demand. He is currently presiding over the design and construction of a new L&S academic building, Irving and Dorothy Levy Hall, as well as a new facility for the School of Computer, Data & Information Sciences.

Dean Wilcots is dedicated to promoting outreach and the Wisconsin Idea. He's the current co-chair of the statewide steering committee for the Wisconsin Science Festival and has led the Universe in the Park outreach program.

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DEPARTMENT OF GEOSCIENCE

ANDREA DUTTON

The fossil reef exposed in this cliff face from Western Australia has revealed new information about rates of sea level change during a past warm period that occurred ~125,000 years ago.

Tropical Tales of Polar Ice

ANDREA DUTTON

Where do I go to study how ice sheets will respond to future warming? The answer might surprise you. I carry out most of my research on tropical islands around the globe, studying fossil coral reefs to learn about the dynamics of ice sheets and sea-level change.

I am a geologist and I study the past to learn more about our future. Geologists have been studying the history of climate change on planet Earth for a long time, but our climate is now changing so quickly that we can witness the impacts of global warming within a single lifespan. We have already left behind the climate state of my childhood—Earth will not experience those temperatures again in my lifetime, based on the amount of warming that has already happened.

Many of the impacts we are already feeling because of global warming have to do with changes in the water cycle—where water is, and where it is not. A warmer atmosphere holds more moisture, so some places are getting more frequent and severe rainfall, leading to inland flooding, while dry places are getting drier as the atmosphere warms and increases evaporation. At the same time, the warmer atmosphere is causing sea level to rise due to the combined effect of warmer oceans that expand as they heat up and melting of land-based ice.

My research focuses on understanding the dynamics of ice sheets under warming climates by reconstructing past changes in sea level during warm periods and rapid warming events. I use fossil corals that grow near the sea surface to survive, as a means of reconstructing the past position of sea level through time.

To date the age of the coral, I use a radiometric technique that relies on trace amounts of uranium that has been incorporated into the coral from the seawater in which it grew. The University of Wisconsin-Madison is building a specialized chemistry "clean lab" so that my students will be able to extract these trace metal isotopes to date corals and other geologic materials.

The results of our fieldwork and lab-based chemistry experiments are combined with geophysical models of ice sheets and sea-level rise to calibrate ice sheet and climate models.

Our reconstructions of past warm periods suggest that polar ice sheets in Greenland and Antarctica are sensitive to small increases in temperature, relative to today, and that these ice sheets are currently catching up to the amount of warming that has already occurred since the industrial revolution. In other words, it is like we have taken two ice cubes into a warm room, and we are now sitting back and watching them melt and equilibrate to this new climate state.

The students in my research team are currently focused on understanding how quickly ice sheets retreat and the nature of that retreat—is it stepwise, gradual, or will it happen in one big collapse? These scenarios are very different from the perspective of coastal planners who need to know how coastal retreat will evolve in the coming decades. We are also undertaking novel approaches to fossil coral dating, so that we have a better sense of the timing between warming and the response of the ice sheets (and sea level).

At the same time, we are exploring new avenues of expanding our science communication to the public and diversifying the scientific community. All of my graduate students have independently pursued such endeavors—very much in the spirit of the Wisconsin Idea—including developing new programs in diversity and inclusion, creating a podcast about our connection to geology in the state of Wisconsin, and engaging with members of the public through the UW Geology Museum.

This model of studying our climate while also improving the climate within our scientific community, and between scientists and the public, is the foundation of my work and one that I hope you will engage in as well, as we head into the future together.

About the author

Andrea Dutton is a Professor in the Department of Geoscience. She reconstructs past changes in sea level to understand how ice sheets and sea level will respond to future warming and she has an enduring passion for engaging in science communication on climate change.

PHILANTHROPY

Fueling the next century of discovery in the College of Letters & Science

STEVE KEAN

L&S faculty and students are immersed in innovative research focused on solving humanity's greatest challenges. This groundbreaking work is made possible through the generosity of donors who recognize the urgency of these challenges and perplexing questions. Forward-thinking philanthropic vision from donors both large and small ensures that L&S will continue to inspire through instruction and research for decades to come.

This support for discovery in the classroom and laboratory has manifested itself in efforts to construct the first two new L&S instructional buildings in more than half a century. As campus facilities age, it is imperative that we provide the extraordinary minds of the college with physical spaces that can support and enhance their ability to advance knowledge.

A transformational gift from the Levy family, along with support from other donors and the State of Wisconsin, will allow for the construction of Irving and Dorothy Levy Hall. This transformative space will bring together eight departments from across the humanities and social sciences in a building that will inspire collaboration in both research and the classroom. This vibrant hub of community will be a jewel at UW-Madison's south edge, and one of the most heavily used academic facilities in the entire UW system.

L&S's School of Computer, Data & Information Sciences (CDIS) is helping students and faculty use computation and data to understand and improve our experiences in both the digital and analog worlds. Embedded in L&S, CDIS is in a unique position to collaborate closely with colleagues in the natural sciences, social sciences, and humanities to harness the power of data in propelling research in those disciplines. And thanks to the generosity of donors, especially John and Tashia Morgridge, CDIS will be housed in a cutting-edge facility in the heart of campus funded entirely by philanthropy.

BRYCE RICHTER

A W crest emblem on the side of the UW Field House is pictured among the colors of the fall leaves at the University of Wisconsin-Madison during autumn on November 8, 2021. (Photo by Bryce Richter / UW-Madison)

These new building projects and collaborative fields of study are as important as they are inspiring, and their true measure of success will be in the young minds they stimulate.

These new building projects and collaborative fields of study are as important as they are inspiring, and their true measure of success will be in the young minds they stimulate. L&S is committed to finding new ways to create inclusive learning environments where bright students can thrive regardless of background. The support of donors has enabled the College to expand access to high-impact practices like undergraduate STEM research and meaningful paid internships that allow students to explore and gain valuable experience and launch their careers and new generations of discovery.

These projects all expand upon the remarkable breadth and depth of learning that happens every day in the College of Letters & Science. And whether it is supporting a building project, a lab doing creative research, or students exploring their future, donors help make a great college even greater. It is this sort of philanthropy that will enable the College's great minds to tackle the challenges of the future and fuel the next century of discovery—and it is people like you that make it possible.

About the author

Steve Kean is associate vice president and managing director of development at the Wisconsin Foundation and Alumni Association, leading a team of 17 development professionals working on behalf of the College of Letters & Science.

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Making a Gift
Consider making a gift to the College of Letters and Science by visiting www.allwaysforward.org/schools-colleges/ls or contacting Steve Kean at steve.kean@supportuw.org or (608) 308-5513.

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ECONOMIC DEVELOPMENT

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DEPARTMENT OF INTEGRATIVE BIOLOGY

Warming lakes

HILARY DUGAN

As an undergraduate, I applied for a summer research job that changed my life. I spent the summer of 2007 camping in the Canadian High Arctic, helping to study the response of Arctic lakes to climate change. I quickly learned that I could meld my love of water and the outdoors with scientific pursuits. That summer was hot. As the permafrost deepened and I cut my pants into shorts, I witnessed an ice-free Northwest Passage for the first time in recorded history. Naively, I assumed that the heat wave would be a historic event.

Early in my career, I pursued polar research. I was eager to understand the importance of frozen landscapes. As climate change threatened to tip the precarious balance between frozen and unfrozen states, how would these delicate ecosystems respond? It turns out that these questions are not specific to the Earth's poles; they're relevant to Wisconsin as well.

As a limnologist, there are few better places to live and work than Wisconsin. With thousands of lakes and rivers transecting the state, everyone is intimately connected with water. And the same could be said for winter. Winter is a time for ice skates and ice shanties when solid lakes become public parks. Veiled beneath that frozen surface, lake ecosystems are very much alive and active.

One of my research efforts is investigating the outcome warmer winters will have on Wisconsin's lakes. Winter is the fastest warming season in Wisconsin. The Wisconsin Initiative on Climate Change Impacts (WICCI) shows that minimum winter air temperatures have risen 4-8°F across the state from 1950-2018. For lakes, this means later ice formation in the fall, earlier ice breakup in the spring and more mid-winter melt events. It is not known what cascading effects these surface changes will have on lake ecosystems.

Collaborators and I recently examined the outcome of increased winter light availability on lake ecosystems, by mimicking winters without snow. For two winters, a hearty team of students and scientists at UW's Trout Lake Station plowed snow off a Northwoods bog lake and carried out routine measurements. This work showed the lake got colder. Even though a lack of snow allows more solar radiation into the lake, snow is an incredible insulator (think igloos). Without snow, heat from the lake is lost to the atmosphere, leading to colder water temperatures and thicker ice. We also saw an increase in plankton biomass. Algae photosynthesize, like plants. Give them light and they will grow, even at low temperatures. Initially, more algae results in more oxygen (thanks to photosynthesis), but secondarily results in less oxygen as microbes and other plankton consume the new food source. Oxygen drawdown under lake ice can be devastating if concentrations get too low, as all animals living in lakes require oxygen to breathe.

What does this mean for the future? We know winters are becoming shorter and that lakes will be sealed off from the atmosphere for a shorter period of time, and thus oxygen deprivation may become less common. On the other hand, if under-ice algal blooms increase, oxygen and nutrient cycling will change. My focus now is understanding how under-ice processes and increasingly erratic winter weather may impact lake dynamics into the summer. The importance of research on ice-covered lakes in Wisconsin stretches far beyond the state. Data from Wisconsin lakes have been vital in understanding our planet's frozen freshwater. Millions of lakes freeze every year, and all are set to change as the planet warms.

This fall, undergraduates in our limnology courses will spend time on Lake Mendota, and at our field station in Northern Wisconsin, learning the nuts and bolts of limnology. Some will go on to be biologists, engineers, artists, or farmers. But regardless of their careers, I hope they all carry with them the value of Wisconsin's freshwater.

ADRIANNA GORSKY

Hilary Dugan augering a hole in the lake ice on South Sparkling Bog to retrieve water samples.

About the author

Hilary Dugan is an assistant professor at UW-Madison's Center for Limnology and in the Department of Integrative Biology. She studies how terrestrial and atmospheric changes, such as warming air temperatures or land use patterns, alter biogeochemical fluxes and aquatic processes in lakes. Her research sites span from Wisconsin to Antarctica.

UW graduate students Adrianna Gorsky (left) and Linnea Rock (right) survey the ice on Trout Lake.

HILARY DUGAN

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DEPARTMENT OF POLITICAL SCIENCE

Russian Studies Amidst the Russian War in Ukraine

YOSHIKO M. HERRERA

As a first-year undergraduate in the spring of 1989, I took a class on World Communism. It was the last time that class would be taught because by the end of the year, the Berlin Wall had fallen, and by spring of 1990, when I did a study-abroad trip, communism was in tatters across Eastern Europe and even the Soviet Union had begun the rumblings of its own collapse. By the time I graduated in 1992, the USSR was no more, replaced by 15 sovereign states and an Eastern Europe no longer beholden to Soviet power. I was motivated by these massive historical changes to study politics in the new states of the former Soviet Union. In my many trips to Russia in the 1990s, including living there for two and a half years doing field research, there were lots of challenges, but the one thing that no one worried about was political persecution. Instead, the early 1990s were largely a time of hope and academic freedom in the region, despite the reigning economic chaos.

But hope turned to disappointment fairly quickly. First, the nationalisms that led to the disintegration of the Soviet Union produced not just free and independent states such as Estonia, but also a divided Ukraine, civil war in Tajikistan, and a separatist war in Chechnya. Second, skyrocketing economic inequality and institutional corruption impeded economic reform. Third, hopes for democracy were dimmed by political maneuvering and power struggles that turned erstwhile democrats into authoritarians. In all three of these areas—nationalism, economic reform, and the failure of democratization—the former Soviet region has been a major site of social science research, including my own research on the economic basis of sovereignty movements, state institutional reform, and Russian nationalism and xenophobia.

AMBER ARNOLD, WISCONSIN STATE JOURNAL

UW-Madison students, including postdoctoral student Yulia Khalikova from Russia, at left, protest Russia's attack on Ukraine outside Bascom Hall Thursday, February 24, 2022.

In Russia, Vladimir Putin came to power in 2000, but his creeping authoritarianism, his use of violence against his enemies, and his brutal prosecution of wars in Chechnya were masked by high energy prices that brought economic growth to Russia, and also by the terrorist attack of 9/11 and its aftermath, which distracted the West. Meanwhile, Ukraine was struggling with the choice of moving closer to Europe, or toward Putin's increasingly authoritarian Russia. In 2014, for the second time in ten years, Ukrainians rose up to oust a Kremlin-backed president. Largely in response, Putin invaded Crimea and started the war in eastern Ukraine. Ukrainians got the message: Research shows that since 2014, Ukraine has successfully implemented reforms to strengthen the state and Ukrainians have united in strong support for an inclusive, democratic, sovereign nation.

The Russian invasion on February 24, 2022, was a turning point, not only for European security, but also for Russian and Eurasian studies. Some military experts predicted an invasion, but they also thought Ukraine would be quickly defeated. Many political scientists like me did not think Russia would invade. My reasoning was that Russia would lose, given Ukrainians' commitment to fight for their nation and state, and Russia would be devastated by the international response. Hardly anyone predicted the level of war crimes and brutality that we've seen in places like Bucha, although when we analyze how Putin carried out the second Chechen war, as I do in a recent paper, the atrocities in Ukraine are much less surprising.

Like many academics working on the region, I had to stop and ask: What am I doing? How did we get here? What can or should my research agenda be in this new reality? There is no going back. The region has changed, Eurasian regional studies have changed, and debates about how to "decolonize" or "de-Russify" Eurasian studies are under way. Russia can no longer be the center of academic research on the region, not only because of the inability to travel there, but also because Russian universities and other aspects of civil society are now firmly under political control. After the war began, I embarked on a series of public lectures and media appearances to help people understand the war and why it matters for the United States. In addition, I decided to teach a new class this fall on Russia's war in Ukraine, which has brought me back to thinking about my experiences as a first-year student. Just as in 1989, we are now at a historic turning point in world politics. No one knows what other big events might happen in the next four years, but I look forward to working through this moment with University of Wisconsin students.

About the author

Yoshiko M. Herrera is Professor of Political Science at UW-Madison. She is a past director of the Center for Russia, East Europe and Central Asia at UW, and prior coming to Madison, she was faculty at the Davis Center for Russian Studies and Government at Harvard University.

DEPARTMENT OF ATMOSPHERIC & OCEANIC SCIENCES

Taking Earth's Temperature

TRISTAN L'ECUYER

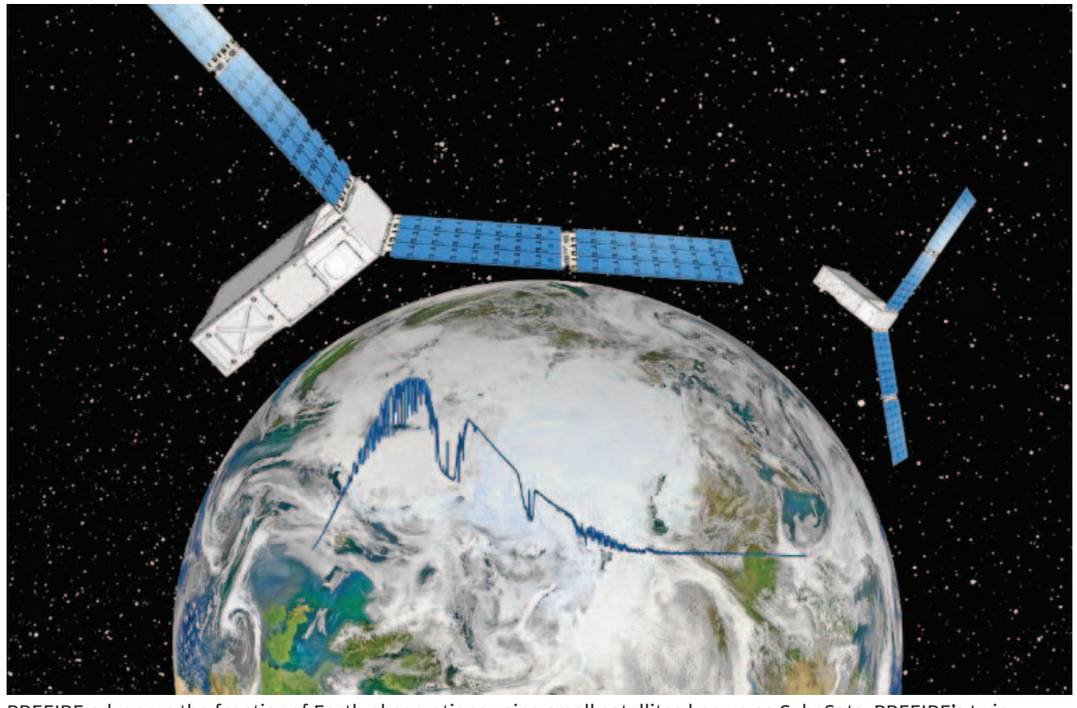
Growing up, I was fascinated by winter storms that brought a foot or more of snow and with them, the possibility of a snow day. Anticipating these spontaneous holidays made me wonder how meteorologists predicted how much snow would fall, and when. I still spend much of my time thinking about such questions but now for very different reasons—our winters are changing.

You've probably noticed that lakes are freezing later and thawing sooner, cross-country skiing and snowmobiling seasons are getting shorter, and flowers are blooming earlier than they did 20 years ago. Wisconsin's climate is changing, influencing everything from growing seasons to wildlife, and the Arctic is partly responsible.

The poles are Earth's thermostats. They regulate the planet's temperature by emitting more energy to space than they receive from the sun. This causes the cold, icy conditions that lower global temperatures by reflecting sunlight that would otherwise heat the surface.

More surprisingly, the poles influence weather around the world. If you've ever heated a pot on the stove, you know that heat flows from hot areas to colder ones. A similar transfer happens on Earth between the warm tropics and the cold poles. In the midlatitudes where we live, heat is carried poleward by weather systems that stir the atmosphere pushing warm tropical air north, where it mixes with colder air. This process offsets some of the polar cooling. So, the balance of sunlight and emitted energy that determines temperatures at the poles also affects our weather in Wisconsin.

But the Arctic is changing. Temperatures are increasing and ice is melting, dramatically altering this energy balance. Every continent is feeling the effects of these changes. To adapt, we need to accurately predict how temperature and sea ice changes will unfold in the future. All climate models predict that the Arctic will be much warmer in the coming decades, but exactly how warm is less clear.



PREFIRE advances the frontier of Earth observations using small satellites known as CubeSats. PREFIRE's twin satellites, each the size of a cereal box, will measure the complete emission spectra that contain the fingerprints of Arctic climate.

Until now, we've measured less than half of the Arctic fingerprint, leaving out important details about many phenomena responsible for the climate and weather we experience every day. PREFIRE will complete the picture.

We build climate models using measurements, but the harsh polar environment makes it difficult to install and operate instruments on the ground. Satellites have helped fill the void, but today's technology is unable to measure wavelengths longer than 15 micrometers, which is called the far infrared. Without measuring the complete spectrum, we are unable to construct the full fingerprints of the Arctic climate.

Four years ago, my research group started working with a team of engineers at NASA's Jet Propulsion Laboratory to fill this gap. We are developing a new satellite mission called the Polar Radiant Energy in the Far InfraRed Experiment, or PREFIRE. Thanks to innovations in small satellite technology, advances in miniaturizing instruments, and new detectors originally created to map minerals on the moon, we are building two small satellites, or CubeSats, to gather data. Each is the size of a cereal box, weighs less than 10 kilograms, and uses far less power than a standard lightbulb.

When our CubeSats launch next year, each will measure the full emission spectrum, opening a new frontier in Arctic research. These measurements will map temperature, moisture, clouds, heat exchanges, snow, and ice—and will stimulate exciting new discoveries across the Arctic and Antarctica. This information will help verify climate models and improve their ability to predict temperature, ice melt, and sea level rise.

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More than 60 years after the University of Wisconsin pioneered satellite meteorology in the late 1950s, we are revolutionizing Earth observations by demonstrating that we can study the climate with CubeSats. More than half of the PREFIRE team is composed of undergraduate and graduate students at the University of Wisconsin. This is allowing us to train the next generation of satellite scientists to continue gathering important environmental observations.

About the author

Tristan L'Ecuyer is a professor of atmospheric and oceanic sciences and director of the Cooperative Institute for Meteorological Satellite Studies. He applies global observations to improve climate projections. His group uses data collected by Earth-orbiting satellites to understand how the climate works and how it may change in the future.

ROBERT M. LA FOLLETTE SCHOOL OF PUBLIC AFFAIRS

How policy can save the planet

GREGORY NEMET

The problem of climate change has gotten worse, but the solutions have gotten much better. That's how I would summarize the most recent United Nations climate report by the Intergovernmental Panel on Climate Change (IPCC). That's also the core of my work at the La Follette School of Public Affairs, where I teach and do research on climate change policy.

Sea level records, the composition of the atmosphere, temperatures over the last 400,000 years and 150 years of ice cover data for perhaps the most studied lake in the world, Lake Mendota, all tell the same story: Climate is changing. The uncertainty is about when, where, and how bad the impacts will be. That depends, to some extent, on how sensitive the climate system is to further additions of greenhouse gases. It also depends on what we do about it.

My research group studies how policy can stimulate innovation in low carbon technologies. That includes research on what has made technologies improve in the past. It includes assessment of all stages of the innovation process, including scaling up and getting to widespread adoption. We also focus on how policies have played a role in past innovation, and how we might stimulate further invention, improvement and adoption of the technologies needed to address climate change, while also enabling access to energy services and inclusive well-being.

Five years ago, I received an Andrew Carnegie fellowship to study the improvement of solar energy technology, which has declined in cost by a factor of 10,000 and is now the least expensive way that humans have ever been able to produce electricity at scale. I'd been working on this using quantitative data since 2002, but the fellowship allowed me to take a qualitative perspective and interview people in 18 countries.

GREGORY NEMET

The widespread adoption of solar power provides a strong tool with which to address climate change. Photo taken by Gregory Nemet in Westby, WI.

Climate change is an extraordinarily difficult problem that will require new forms of governance, rapid adoption of technology, and changes in behavior. I am encouraged by students' interest in these issues; they seem concerned but also mobilized. That's probably my biggest source of optimism that we will make the energy transition we need.

Insights emerged from the qualitative data that had not emerged from engineering-based and econometric analysis of quantitative data. But those quantitative data were crucial for making sense of the interview responses I collected, as well as the archival research I did. Each approach informed the other and a more complete understanding emerged. For example, it became quite clear how international flows of knowledge enabled us to get where we are today. In sum, the U.S. created the technology, Germany created a market and China made it cheap.

My group's work on solar energy was timely in that it became important inputs for the IPCC's sixth assessment report in 2022. I was asked to work on five different chapters of the report, wrote part of the summary for policymakers and negotiated the sections I led with the UN member governments in a line-by-line approval process.

Much of my work at present involves how we can learn from previously successful technologies to scale up other technologies we might need for climate change. Post-doctoral student Cameron Roberts is working with me to study innovations such as ammonia synthesis, ethanol and other historically analogous technologies to inform the development and scale-up of carbon removal technologies. I'm working to understand how the solar supply chain could be more diverse, less dependent on other countries and add more domestic value, while also taking advantage of the global innovation system that has provided us with this tremendous asset: low-cost solar energy.

Climate change is an extraordinarily difficult problem that will require new forms of governance, rapid adoption of technology, and changes in behavior. I am encouraged by students' interest in these issues; they seem concerned but also mobilized. That's probably my biggest source of optimism that we will make the energy transition we need.

About the author

Gregory Nemet, professor of public affairs, teaches courses in energy systems, environmental governance, and policy analysis. His research focuses on how policy can stimulate innovation in environmental technologies. With his Andrew Carnegie Fellowship, he wrote: "How Solar Energy Became Cheap" (2019). He serves as a lead author for the UN IPCC Climate Report.

UW Energy Analysis and Policy (EAP) faculty Rob Anex, Greg Nemet, Paul Wilson & Jonathan Patz; EAP Engagement Coordinator Colleen Schmit; EAP students Sam Jurvich & Maitreyee Marathe, taken during the EAP bike ride to the O'Brien Solar Field in Fitchburg, WI.

DEPARTMENT OF HISTORY

Reckoning with the past

SIMON BALTO

Earlier this summer, I drove around the South Carolina Upcountry and Midlands researching one of the most heinous crimes in modern South Carolina history.

In October 1916, in the town of Abbeville, a mob of white men beat and tortured Anthony Crawford, a prosperous Black farmer, before hanging him and riddling his body with bullets. Crawford, a proud man who rejected the tenets of white supremacy to which Black people were expected to abide, had argued with a local shopkeeper over the price of cottonseed. The indiscretion cost Crawford his life; the white mob lynched him for refusing to be disrespected in what one of the local newspapers later called "a white man's country."

In the aftermath, then-Governor Richard Manning ordered an investigation—an unusual, controversial-for-its-time gambit when it came to white-on-Black violence. Manning's investigator, J.B. Ernst, interviewed dozens of witnesses, compiled his case, and drew up warrants. Abbeville's sheriff arrested the men the warrants named, although both Manning and Ernst doubted his commitment to the case. When called to testify, Ernst's witnesses conveniently forgot details of the crime. The outcome was preordained: everyone knew who'd done it, but no one was ever punished.

In short order, Crawford's family was scattered northward to Philadelphia and the greater Chicago area. Indeed, it was his great-great-granddaughter, my late friend Doria Dee Johnson, who earned her M.A. from UW-Madison in 2009 and was pursuing her Ph.D. here until her death in 2018, who first told me of what was done to her family.

SIMON BALTO

The front and back side of a historical marker located outside Abbeville County Courthouse in Abbeville, South Carolina.

The murder of Anthony Crawford was horrific and brutal. The seemingly mundane transaction records in the Deeds, Probate and Clerks offices, meanwhile, tell a story of unending cruelty and plunder in the years that followed.

Crawford's is one of many stories I'm writing about in my new book, which explores the long history of white mob violence against communities of color and how that history has shaped (and been shaped) by our collective social, economic, political, and legal contexts.

While I knew the outlines of the story thanks to Doria, further investigating the crime and its aftershocks meant traveling to the Library of Congress in Washington, D.C., to review records of the National Association for the Advancement of Colored People, which investigated the case. I also traveled to Columbia, South Carolina, where Richard Manning's papers, and the records of the investigation he ordered, are held. And I went to the literal scene of the crime—Abbeville, SC—to pore over century-old real estate records in the Register of Deeds office, estate records in the Probate Court's archives, and one heavy, dusty book of land records in a back alcove of the County Clerk's office that people working there said they didn't think existed.

The murder of Anthony Crawford was horrific and brutal. The seemingly mundane transaction records in the Deeds, Probate and Clerks offices, meanwhile, tell a story of unending cruelty and plunder in the years that followed. Over the protestations of his surviving family, two white men were charged with administering his estate. They proceeded to sell off Crawford's assets, pocketing much of the money themselves. Robbed of their patriarch and his agricultural acumen and assets, Crawford's family struggled to stay afloat financially. By 1923, with the family unable to pay a $2,300 debt, a local bank took their 427 acres of land, valued between $20,000 and $25,000. Local whites sold the land amongst themselves for decades before a realty company purchased it in 1957. Corporations have sold and re-sold it as valuable timber land ever since, often at handsome profits. It was most recently purchased in 2012 as part of a larger $4.1 million, 2,442-acre land buy; today, its majority owner is the Seattle-based hedge fund firm Silver Creek Capital Management.

The story of Anthony Crawford—what was done to him and his family; the failures of the criminal justice system to honestly seek, let alone deliver justice; how white men benefited from his murder and how corporations continue to do so—is part of the tapestry of American history.

We live in a time when the relevance of America's full, collective history is consistently under question and attack. Indeed, some people insist that injustices of the seemingly long-ago past aren't relevant to today.

But I would ask this: what is owed to Anthony Crawford's descendants? The question isn't abstract. Records show what happened, who the terrorists were and how the Crawfords were driven from their family farm. Records also show us the transactional history of the land they were robbed of and who owns it, harvests it and profits from it today.

This does not, to me, seem like a past too far distant to be worth discussing today.

About the author

Simon Balto is an assistant professor of history and College of Letters & Science Mary Herman Rubinstein Professor at the University of Wisconsin-Madison. He is the author of the multi-award-winning *Occupied Territory: Policing Black Chicago from Red Summer to Black Power* (University of North Carolina Press, 2019).

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DEPARTMENT OF ASTRONOMY

Studying 'baby pictures' of our universe

MICHAEL MASEDA

The story of galaxies is the story of the universe as we know it. Everything you can see in the night sky is either inside our Milky Way galaxy or is one of the trillions of other galaxies in the universe. Galaxies house essentially all of the stars and all of the planets that have ever existed and will ever exist. They are dynamic, evolving things: stars are constantly forming, dying, and rearranging themselves inside. They are also strongly influenced by their environment, and the universe has been constantly changing in the 14 billion years since the Big Bang. All of these changes take millions of years, far too long for us to observe directly, making it very difficult to fully understand how galaxies came to be the way that they are. We know what the Milky Way looks like as an adult today, but what did it look like as a baby 5 billion years ago when the solar system was formed? Were there a lot of other Sun-like stars being formed at the same time?

We can start by looking at the other galaxies around us, getting a cross-section of the population at different ages by separating old from young systems. But since the universe today is very different than it was in the past, galaxies were different then too. As astronomers, we have the luxury of being able to look back in time, so to speak. Since light travels at a fixed speed, the further away an object is from us, the longer it has taken for its light to reach us. That means that by looking at very distant galaxies, we are observing the universe as it was millions or billions of years ago.

So, not only do we observe the population of young and old galaxies today, but we also study different snapshots of the past by looking increasingly further away. Even though we can't see how any one particular galaxy changes over time, we can find its slightly younger analogue at a slightly greater distance, and then push back further and further. It's this piece-by-piece reconstruction of the galaxy population that has allowed us to begin to understand how the universe has evolved since the Big Bang.

It's a bit like paleontology: how do we know about the life cycle of dinosaurs when we only have access to fossils? Each fossil is a unique snapshot of a single dinosaur, captured at one specific instant, and by itself it doesn't tell us very much about how that species grew from youth to adult or how that species is related to other species from the past. You need a really large collection of fossils from different time periods in order to piece the whole picture together, seeing how species evolved into others and how the members of a single species changed over their lifetimes.

SPACE TELESCOPE SCIENCE INSTITUTE OFFICE OF PUBLIC OUTREACH

Images like this one, captured by the James Webb Space Telescope, help astronomers understand how galaxies are formed and how they change over time. This image covers an area the size of a grain of sand held up to the sky at arm's length, and yet it contains thousands of distant galaxies.

That's not to say we understand everything there is to know about galaxies from these kinds of studies. Far from it! Observing the most distant galaxies in the universe and hence the earliest cosmic times is very challenging! Galaxies that are further away appear smaller and, since younger galaxies have not had enough time to form a lot of stars, they are also intrinsically fainter. This makes them very tricky to find, which means we actually do not know very much about the very first stages of how galaxies are born.

Enter the James Webb Space Telescope, or JWST. Launched in December 2021, with science operations starting in July 2022, JWST was designed from the ground up to observe galaxies in the very early universe. From the very first public image alone (displayed here), astronomers have discovered some of the most distant galaxies we have ever seen. Over the next few years, astronomers will find and, more importantly, characterize these galaxies. We will understand how quickly they form new stars, what their chemical compositions are, and what kinds of galaxies they will grow up to be. These are the crucial pieces of the puzzle that will help us understand how galaxies like our Milky Way have grown over time. We like to say that JWST is the ultimate "time machine," allowing us to look back at the infant universe. I think of it as the ultimate machine for taking baby pictures of galaxies.

About the author

Michael Maseda is an assistant professor in the Department of Astronomy. His research focuses on the growth and evolution of galaxies, particularly at early cosmic times. He uses observational data from large telescopes to characterize the physical conditions inside galaxies, which will be pushed further with the advent of the James Webb Space Telescope.

We can start by looking at the other galaxies around us, getting a cross-section of the population at different ages by separating old from young systems. But since the universe today is very different than it was in the past, galaxies were different then too. As astronomers, we have the luxury of being able to look back in time, so to speak. Since light travels at a fixed speed, the further away an object is from us, the longer it has taken for its light to reach us. That means that by looking at very distant galaxies, we are observing the universe as it was millions or billions of years ago.

DEPARTMENT OF COMMUNICATION SCIENCES AND DISORDERS

Better Ears For Better Lives

RUTH LITOVSKY

I stood next to the mother of the four-year old girl who had only recently received a cochlear implant in her second ear. As the girl walked away to play, the mom called her name and the girl immediately turned around to find her mother's voice. The mom was astounded. Her child, who was born with congenital deafness, had received her first cochlear implant early enough to access spoken language, but with only one implant she had struggled with understanding speech in noisy environments or locating sounds. To the mother, and to me, it was amazing seeing how her second implant had dramatically diminished these challenges.

We all spend much of our lives functioning in environments where our brains receive a barrage of sounds and echoes. Yet somehow, individuals with typical hearing can block out most echoes (except for ones with long time delays, as in canyons) and do a very good job locating the sources of sounds around us. Moreover, in a noisy restaurant we can focus on what one person is saying despite a cacophony of chatter and clatter in the background. These abilities are driven by an intricate set of connections in our brain known as the 'binaural system' which combines information from the two ears to help us live full, socially rich lives. Throughout my research career I have been passionate about understanding how our brain uses binaural information to compute sound locations and suppress echoes, and how we can use this science to guide clinical practices.

My lab at the Waisman Center has been instrumental in showing that, for those children and adults who choose to receive cochlear implants, bilateral implants provide significant advantages, especially in noisy environments. However, we have also found that bilateral cochlear implant users continue to face daily challenges because current cochlear implant technology strips out much of the information that the brain uses to build a three-dimensional picture of the auditory world. Armed with this knowledge, my lab has used reverse engineering approaches to develop new ways to coordinate information between the two implants. Our goal is to improve users' quality of life by helping them better localize sounds, understand speech in noisy settings, and expend less cognitive resources to learn, socialize and communicate in their daily lives.

LITOVSKY BINAURAL HEARING AND SPEECH LAB

Young child fitted with bilateral cochlear implants is seated in a sound proof testing room in the Litovsky Binaural Hearing and Speech Lab. The child is listening for words that are presented from the loudspeakers, and using a computer game to indicate what they are hearing and where the sounds are coming from.

My lab at the Waisman Center has been instrumental in showing that, for those children and adults who choose to receive cochlear implants, bilateral implants provide significant advantages, especially in noisy environments.

Research on binaural hearing in my lab has recently expanded into a unique population of individuals with Down syndrome (a common genetic cause of intellectual and developmental disability). There is a high incidence of hearing loss in this population, but there has been little prior work on binaural hearing and functioning in everyday environments and on whether these factors correlate with cognitive and language delays. We aim to identify ways in which treating hearing loss can improve everyday listening and enhance social integration.

Research on binaural hearing is also an important consideration in understanding the normal aging process. There is growing evidence to suggest that active and effortful listening is costly to some brain mechanisms. This explains why even low-grade hearing loss, if left untreated, can cause social isolation. Moreover, gradual declines in hearing may even be a direct contributor to age-related declines in cognition (memory, attention, executive function), also known as dementia. For this reason, I am excited to be launching a new line of research where I can use my knowledge of spatial hearing to develop better diagnoses of binaural decline, and guide clinical practices aimed at improving communication and quality of life in later years.

About the author

Ruth Litovsky is Oros Family Chair, and Department Chair of Communicative Sciences and Disorders in L&S. She has been on faculty for 21 years, directs a research lab at the Waisman Center, has won multiple career awards and served in many leadership positions in scientific organizations and at UW-Madison.

DEPARTMENT OF PSYCHOLOGY / DEPARTMENT OF GENDER & WOMEN'S STUDIES

Innovating Care for Sexual Violence Survivors

KATE WALSH

I study ways to improve the mental, physical, social, and general well-being of sexual violence survivors. Decades of research have revealed that about one in five women in the United States will experience a rape during her lifetime and nearly one in two will experience unwanted sexual contact. Indigenous and multiracial people, as well as bisexual, transgender, and non-binary people, are at highest risk for sexual violence. Sexual violence is associated with physical and mental health conditions, including cardiovascular disease, poor reproductive health, posttraumatic stress disorder (PTSD), depression, suicidal ideation, and substance misuse. If survivors report their assaults, they also face challenges navigating our legal system.

As a clinical psychologist, I focus extensively on preventing and treating the mental health and behavioral consequences of sexual violence. Research shows that one month after sexual assault, 75% of adult survivors suffer from PTSD, an emotionally exhausting and debilitating condition. Without treatment, about 40% of survivors still experience PTSD one year after the assault. PTSD is often accompanied by depression and suicidal ideation, and those with PTSD may self-medicate with alcohol, marijuana, nicotine, and/or opioids. To prevent these consequences, my colleagues and I have developed and tested brief interventions that can be used in the immediate aftermath of sexual violence. For example, in the emergency room, we have found that survivors who receive a brief video addressing avoidance and coping skills have fewer PTSD and depression symptoms, fewer suicidal thoughts, and lower alcohol, marijuana, and nicotine use six months after the assault, than those who do not view the video. We currently are working to see if this video is effective for all genders and whether these messages can be delivered effectively in other formats, such as text messages.

COLTON MANSAVAGE

The Red Gym is home to several important student groups and organizations who provide resources and community to international students (International Student Services), students of color (the Multicultural Student Center), and LGBTQ+ students (the Gender and Sexuality Campus Center). The GSCC has hosted events in the past related to survivorship at UW-Madison and several of the students in Dr. Walsh's Sexual and Relationship Violence Research and Activism course displayed art projects and other works at the event they held in spring 2022 for Sexual Assault Awareness month.

Research shows that one month after sexual assault, 75% of adult survivors suffer from PTSD, an emotionally exhausting and debilitating condition. Without treatment, about 40% of survivors still experience PTSD one year after the assault.

Developing and testing interventions for mental health and behavioral conditions is key, but even the best interventions are not effective if people do not know about or cannot access them. For example, only 20% of female rape survivors seek post-assault medical care, and societal stereotypes about rape often play a role in preventing survivors from seeking this needed care. Since coming to UW-Madison in 2020, I have begun examining trauma-informed ways to empower survivors and provide them with choices and options. Data collected from UW-Madison students in 2019 indicated they were largely unaware of, and rarely utilized, forensic medical care, which can connect survivors to important follow-up services, including legal options. Through a partnership with a local non-profit, Dane Multi-Agency Center (DaneMAC), and a grant I received from the Department of Justice's Office for Victims of Crime, UW-Madison can now offer students forensic nurse exams on campus during business hours. In its first year, the program has served nearly 50 survivors who reported that they would not have gone off campus to receive this care. In spring 2022, the campus launched a social media campaign and students in my Sexual Violence Research and Activism class created and printed brochures about the on-campus forensic exams. We will continue spreading knowledge about options for care and anticipate heightened awareness and use in the years to come.

My colleagues and I are now focusing on ways to make forensic exams themselves more culturally sensitive for survivors of color and/or bisexual, transgender, queer, and non-binary people in the state of Wisconsin. Advisory boards of community survivors and nurses will guide our research and ensure appropriate development of our methods. Our findings will be critical to improving training for forensic nurses with the ultimate goal of expanding access to services for all survivors and improving long-term physical and mental health.

Preventing violence is critical, but until the scourge of violence is eradicated, I am committed to using research to advocate for access to, and improvement in, care that can enhance immediate and long-term wellbeing for sexual violence survivors.

About the author

Kate Walsh is a professor in Psychology and Gender & Women's Studies and director of the Sexual Violence Research Initiative. Her research and teaching focuses on violence, mental health, and substance misuse. Other current projects include evaluating Wisconsin's Housing First Pilot Program and studying campus contexts that contribute to sexual violence.

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DEPARTMENT OF ART HISTORY

Philanthropy, Charity and the Fabric of Cities

WELLCOME COLLECTION. PUBLIC DOMAIN MARK

The Sir Jamsetjee Hospital (in the right background), Grant Medical College, and surrounding grounds, Bombay. Wood engraving after H. Hinton.

PREETI CHOPRA

In the heart of the Fort—the nucleus of colonial settlement in Bombay (now known as Mumbai)—is an impressive building that was once the city's town hall. Constructed in 1833 in the Greek Revival style, the building demands attention with its wide flight of steps. In this building one finds statues of both noteworthy British figures and two native elites. How was this possible in a colonial-era building? Who were the patrons and users of this building? In what ways was it a public building? By asking these types of questions of the built colonial environment—the shaping of space in buildings and cities–my research reveals insights about society and colonialism.

Colonial cities are too often thought to be the products of the singular visions and needs of the colonial regimes that founded them. My work is a corrective to that distortion, concentrating on the role played by native communities in the physical transformation of the urban fabric of British Bombay from 1854-1918. Key to understanding this urban history is seeing that the colonial city was the location for a range of new social spaces, such as the public realm, and new social practices including, importantly, philanthropy by native elites. The name of Sir Jamsetjee Jeejeebhoy (1783-1859), a native elite, is synonymous with charity and philanthropy. Bombay's first native general hospital and its first school of art bear his name. In recognition of his charities

About the author

Preeti Chopra is Professor of Architecture, Urban History and Visual Studies in the Department of Art History. She trained as an architect, landscape architect, urban planner, and architectural historian and has conducted research in India. Her work examines the landscapes of colonialism to expose power dynamics, so we can imagine and build decolonial futures.

PREETI CHOPRA

View of Hira Baug, C. P. Tank Circle, Bombay. 1905. This dharamshala or rest house was constructed by and for the use of the Jain community. While the façade draws on western influences, it is organized around a courtyard, a planning device traditional to South Asia among other places.

and philanthropy, he received a knighthood and baronetcy and his statue came to be housed in the town hall.

I use the term "joint enterprise" to characterize the intentional cooperation that forged British Bombay in several main ways. The colonial government, together with both Indian and European mercantile and industrial elites, shaped an urban infrastructure to serve their needs as well as those of the general public. European and Indian engineers, architects, and artists collaborated with each other to design water fountains, railways, docks and other spaces. Indian laborers and craftsmen also left their mark on the designs they executed. Indian philanthropists partnered with the colonial regime to found and finance institutions for the public that would include hospitals, an asylum and educational institutions. The creation of secular public institutions and urban spaces where people of all castes, religions and races would interact at a more intimate level was a new phenomenon. This led to the formation of what I have called the "joint public realm," helping to foster an Indian identity above that of one's own community.

Colonial cities are too often thought to be the products of the singular visions and needs of the colonial regimes that founded them. My work is a corrective to that distortion, concentrating on the role played by native communities in the physical transformation of the urban fabric of British Bombay from 1854-1918.

At the same time, colonial Bombay was made through charity. I demonstrate that the colonial government thought that native elites were responsible for the care of their own communities. In the case of charity, not only well-known native elites, but a greater range of individuals contributed towards the care, housing needs, and other infrastructure of their own communities. Contributions and volunteer efforts large and small helped to build the city. These numerous donations of money, time, and volunteer work are hard to record, track and quantify, but were and are integral to helping communities flourish in everyday life. I see evidence of community charity in the spaces of individual communities all over the city.

Colonial Bombay was thus shaped by what I call "communities of care." Native philanthropy created an infrastructure for the public at large, while native charity sustained individual communities. Yet the joint public realm was a landscape of contradictions. It was both a fractured landscape that distinguished communities from one another, as well as a cohesive landscape that brought people from diverse ethnicities, races and religions together. This dynamic of the state, philanthropy, charity, multiple modes of making, and the joint enterprise can be used to analyze not only colonial cities, but cities across the world. The example of colonial Bombay has made me realize the importance of communities of care in sustaining populations in the ever-ongoing process of shaping and reshaping our world. In these divided times, the joint public realm is an essential reminder to look beyond our differences at the city, state and national level. If we recognize that we are all members of the same public and communities of care, nothing is impossible.

DEPARTMENT OF COMMUNICATION ARTS

Rhetoric as a Civic Good

ALLISON M. PRASCH

"What is rhetoric?" Every semester, I begin by asking my students this question—and I invariably get a variety of responses. Rhetoric, what Aristotle defined as "all the available means of persuasion," describes how individuals use language and other strategies to move people to action. But students also tell me that they hear rhetoric used in a negative sense. We often encounter descriptions of rhetoric as "hot air," words politicians use to get what they want, with little regard for what is good for the larger community.

As it turns out, Plato also had this concern. He warned against those who used the powers of speech as "flattery" that would make audiences feel pleasure in the moment, but do them harm in the end. If there was to be an ethical form of rhetoric, Plato wrote, it would be a "guiding of souls through words" towards what was right and true.

Today, we see both definitions of rhetoric play out in our political and cultural landscape. My goal is to help students identify the various strategies speakers use to move publics, whether for good or for ill. I explain that rhetoric is not just something that is done to us; it is a mode of intellectual inquiry and a way of knowing and engaging the world in which we live. Developing a rhetorical perspective allows us to critically analyze what people say, how they say it and why it matters.

In February 2020, as the first COVID-19 cases began to spread in Washington, Oregon, and New York, I played clips of then-governor Andrew Cuomo's daily press briefings and led a discussion about how he invited New Yorkers to rally together against an unknown virus. I didn't know it at the time, but this initial example would quickly turn into a theme of my Spring 2020 course: analyzing how politicians and public health officials characterized and responded to a global pandemic. When UW-Madison switched to remote instruction, I moved my lectures online and scoured the news for the best accounts of a rapidly changing crisis. From the (dis)comfort of my home (bedroom) office, I asked students to compare various strategies government officials used to communicate with the public. We discussed how some worked, and others didn't—and why.

For the Fall 2020 semester, I designed a course around the U.S. presidential campaign. Zooming in from dorm rooms and houses across Madison and around the state, we talked about the principles of rhetorical leadership and what the public should expect from our political leaders. We analyzed the presidential and vice presidential debates and considered the historic significance of the first Black and South Asian woman on a presidential ticket. I was impressed by how students engaged difficult issues and complex conversations with care, honesty and intellectual rigor. They give me hope for the future.

More recently, I showed my students clips of Ukrainian president Volodymyr Zelensky's address to the United States Congress in March 2022. We discussed how Zelensky used this speech to do much more than just request military aid from the United States and other Western allies. Speaking from his concrete bunker in a city surrounded by Russian forces, Zelensky called on President Biden to "be the leader of the world" and stand up to Vladimir Putin. He cited key moments of U.S. national tragedy—Pearl Harbor and 9/11—and compared them to the plight of his own country. Zelensky made the Russian invasion of Ukraine relatable to an American audience and argued that the United States' stated commitment to defending democracy around the world required immediate action. This was an example of rhetoric at its best.

Rhetoric is always working around us—the challenge is learning to identify where and how. My goal is to illuminate the communicative processes that inspire action and create communities. By critically analyzing the constant flow of words, images, and soundbites that fill our lives from a rhetorical perspective, we learn how to think and reason as engaged, active citizens. We learn what questions to ask and what perspectives to consider. We learn what to expect from our leaders. And we learn that it is possible to see rhetoric as a civic good.

J. SCOTT APPLEWHITE

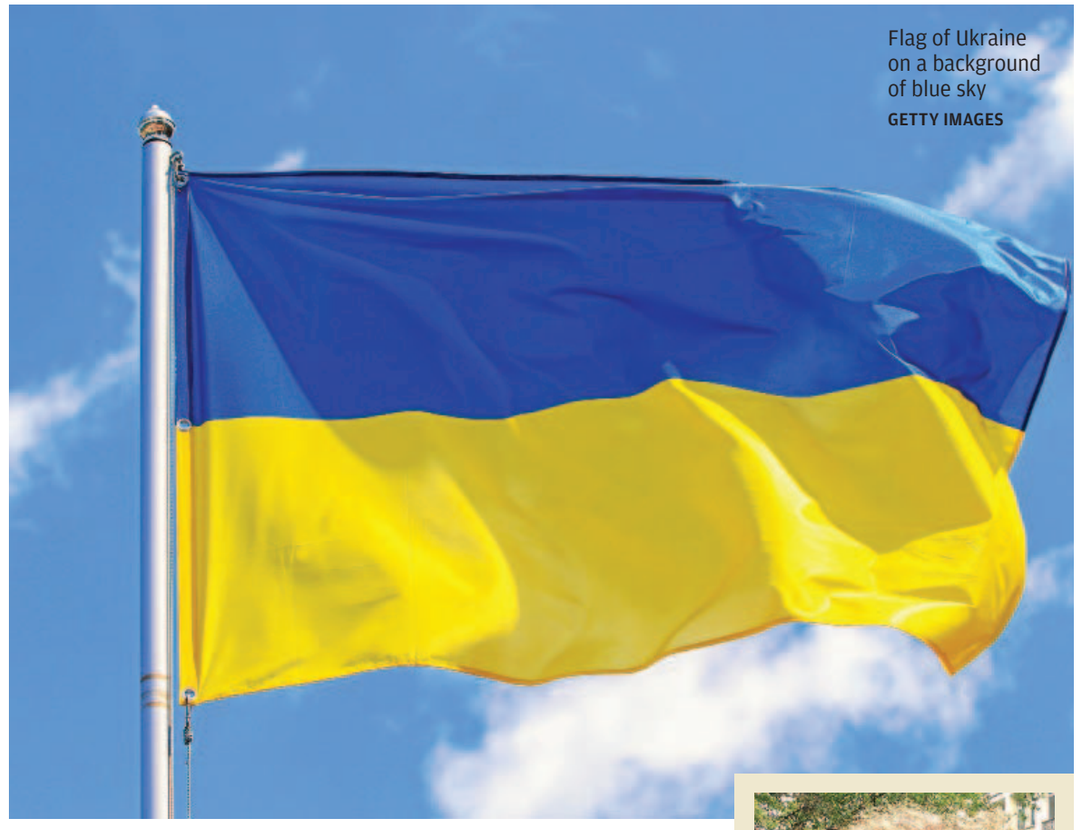
Ukrainian President Volodymyr Zelenskyy speaks to the U.S. Congress by video to plead for support as his country is besieged by Russian forces, at the Capitol in Washington, Wednesday, March 16, 2022.

About the author

Allison M. Prasch is Assistant Professor of Rhetoric, Politics & Culture at the University of Wisconsin-Madison. Her research and teaching focus on the history of U.S. presidential discourse, national identity and foreign policy. Her first book, *The World is Our Stage: The Global Rhetorical Presidency and the Cold War*, is forthcoming from the University of Chicago Press in January 2023.

DEPARTMENT OF GERMAN, NORDIC & SLAVIC+

Teaching the complex histories of Russia and Ukraine



Flag of Ukraine on a background of blue sky
GETTY IMAGES

KIRILL OSPOVAT

On February 24, 2022, the Russian Federation launched a massive invasion of Ukraine, a neighboring nation of 44 million people. How do teachers of Slavic languages and history grapple with this event, and formulate new perspectives and new ways of talking about the region?

Russia and Ukraine emerged as independent nations after the collapse of the Soviet Union in 1991. In 1994, Russia co-signed (together with the United States and the United Kingdom) the Budapest Memorandum on Security Assurances. The memorandum was meant to safeguard Ukraine from Russian military aggression, in exchange for its surrender of Soviet-era nuclear weapons.

In 2014, Russia violated the terms of the Budapest Memorandum when it annexed the Ukrainian peninsula of Crimea and occupied, with the help of local separatist groups, some of Ukraine's eastern territories. The current invasion that began this spring is taking a terrible toll. Cities have been destroyed, many thousands of civilians killed and millions more displaced.

My colleagues and I in the Slavic Studies program, in particular those of us who research and teach about Russia, have been struggling with how to reassess our understanding of the region and its history in light of current events. Russia, as the core of the Russian Empire and the Soviet Union, had conquered Ukraine along with many other nations before those countries regained independence in 1991. Therefore, it was usual for much of the world to perceive Russia as the most important—or even the only—relevant cultural and political player in the region. After all, if all these territories and populations had been governed by Russia for centuries and Russian was spoken and written across them, shouldn't we be looking at the region through the imperial lens?

Certainly Russia's president, Vladimir Putin, justifies the invasion by claiming that Ukraine has always belonged to Russia and should forever remain its province. But as we can see in the news, Ukrainians vehemently disagree. While many of its people speak Russian as a native or a second language, Ukraine possesses its own language and a different cultural tradition. In fact, Ukrainian language and identity have been associated with the democratic legacy of the Cossack republics, which existed from the 16th to the 18th century.

Recognizing this plurality of traditions and voices behind the unitary image of Russian domination changes how we think and talk about the history of the region. In the humanities, we call this a post-colonial or a decolonial perspective, and our curriculum will adapt as a result.

Beginning in Fall 2022, courses on Ukrainian language and culture will be taught by Dr. Oksana Stoychuk. Outside these courses, we must think about how the Ukrainian perspective affects our accepted interpretations of Russia and its cultural tradition. To give one glaring example, the medieval state by the name of "Rus" that is often presented as a direct precursor to the historical Russian Empire was in fact located largely in what is today Ukraine and gave rise to several contemporary nations including, of course, Ukraine.

As Ukraine's former president Leonid Kuchma famously said, "Ukraine is not Russia." But this is not the only takeaway from current events. In my introductory survey of nineteenth-century Russian literature, I will be devoting time to what Ukrainian writers who experienced Russia's rule first-hand teach us about Russia itself. Ukraine's national poet Taras Shevchenko (1814-1861) mounted a poetic critique of Russia's imperial order, proclaiming solidarity with other ethnicities colonized by it. Russian literature of the period was also indebted to Ukrainians. One of its towering figures, known in Russian as Nikolai Gogol and in Ukrainian as Mykola Hohol (1809-1852), became a founder of critical realism, a literary mode that highlighted the social evils of the Russian empire and helped give rise to a radical, revolutionary tradition which culminated in the Russian Revolution of 1917.

In recent history, the successful Ukrainian revolutions of 2004-2005 and 2013-2014 represented hope for democracy, not only for Ukraine but also for neighboring Russia, where Putin's dictatorship was consolidating. Today, Russia's authoritarian leadership is waging war not only on Ukraine's identity and sovereignty, but also on the democratic principles that Ukraine represents.

About the author

Kirill Ospovat is an Assistant Professor of Russian in the Department of German, Nordic, and Slavic+. He researches and teaches on the intersections of literary and political history and theory with a main focus on Russia of the imperial period (eighteenth to twentieth centuries).

DEPARTMENT OF BOTANY

Harnessing plant chemistry to build a sustainable society

HIROSHI A. MAEDA

Plants cannot easily move, but some plants, like bristlecone pines, live nearly 5,000 years where they initially germinated. Instead of moving around like we do, plants deal with life matters by producing thousands of chemicals. For example, plants make nasty chemicals to protect themselves from being eaten by insects and infected by viruses and bacteria. Other plant chemicals create the sweet smells of the petunia and the beautiful colors of the strawberry, and these attract butterflies and birds that pollinate and carry seeds to distant locations. Strikingly, plants make all these chemicals using mainly carbon dioxide (CO_2) from the air and energy from the sun.

Dr. Marcos de Oliveira, a scientist in the Maeda Lab, screened nearly 80,000 Arabidopsis plants and isolated several mutant plants that show elevated CO_2 uptake and aromatic compound production in leaves (left). Reading the whole genome DNA sequences of these mutant plants discovered point mutations that alter the functionality of a specific protein, called DHS enzyme, and caused these dramatic metabolic changes (right).

As an undergraduate, I became fascinated by this tremendous power of plants to convert CO_2 into a variety of chemicals. "This must be critical for solving many issues in the future," I thought—somewhat vaguely at the time. I then came to the U.S. Midwest for my graduate study, where plant biochemistry research is very active. Now, my laboratory at UW-Madison studies how various plants control and decide which chemicals to make through a process called "metabolism."

We know that studying human metabolism helps prevent human diseases. But did you know that studying plant metabolism can improve human wellbeing, by helping us understand how to create healthier foods and essential medicines? In one study, we analyzed beets and related plants like cactus and four-o'clock, which produce vivid red pigments called betalains. These red colors of beets and cacti are different from the more typical red pigments found, for example, in cranberry fruits and rose petals. By studying the metabolism of these betalain-producing plants, we learned they have a very efficient way to make a specific amino acid, called tyrosine, the starting material for betalains.

Betalains have antioxidant activity, beneficial to human health, and are used as the major natural red dye in our food. If you carefully read a label of organic strawberry ice cream, you often find beet juice, or betalain, is added. The problem is that betalains are much more expensive than artificial food dyes made from petroleum. We are applying our basic finding to make more tyrosine in various plants and to efficiently produce betalain pigments. Plants also use tyrosine to make many pharmaceutical compounds, such as morphine and related alkaloids, and we can use the same technology to improve the production of medicine made from tyrosine.

Understanding and improving plant metabolism can also battle against global warming. Plants have been converting CO_2 into diverse chemicals for over 500 million years, which shaped the environment we live in and generated many fossil fuels we use today. In our recent work, we discovered genetic mutations in plants that can accelerate the process of converting CO_2 into one group of chemicals, called aromatic compounds. Further digging into the molecular mechanism, we found that these mutations release a natural "brake" that controls a key connection between photosynthesis and the metabolic pathway to synthesize various aromatic compounds in plants. Relaxing the brake allowed more CO_2 to be captured and converted to aromatic compounds.

Aromatics are highly stable chemicals and used everywhere in our society from plastics, fuels, food dyes, cosmetics, medicine, and many more. Unfortunately, most of them are currently extracted from fossil fuels. Our findings can be utilized to enhance sustainable production of aromatic chemicals and also to reduce atmospheric CO_2 at the same time. While the technology is still at an early phase of development, we are working to translate these basic discoveries in fast-growing plants such as bioenergy crops, sorghum and poplar, to capture more CO_2 and produce essential aromatic chemicals without relying on fossil fuels.

I am now certain that studying plant metabolism is key to building a truly sustainable society. My job is to foster a supportive lab, classroom and community, where people from diverse backgrounds and career stages can bring together various ideas and tackle this enormous challenge. One thing that has changed since my college time is that the situation is much more urgent.

About the author

Hiroshi A. Maeda is a professor in the Department of Botany at University of Wisconsin-Madison. Maeda's research and teaching focus on exploring and harnessing plant chemical and biochemical diversity with the ultimate goal of building a sustainable society.

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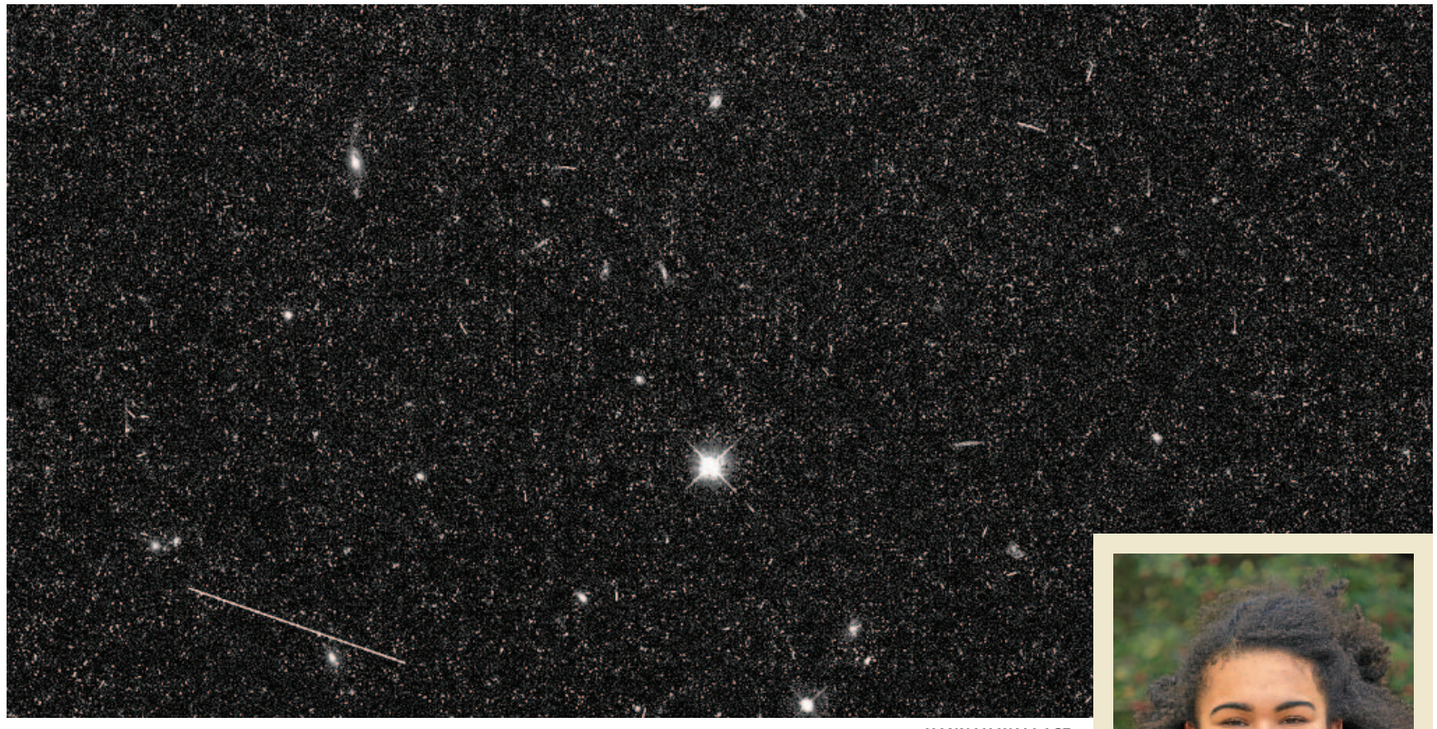
Exploring a New Kind of Supermassive Black Hole

HANNAH WALLACE

This past summer, I participated in UW-Madison's LASER Summer program, a program designed to pair students with faculty members on research projects. During this period, I worked with the UW-Madison Department of Astronomy on a newly classified type of quasar called an Extremely Red Quasar (ERQ) being researched by my mentors, Christy Tremonti, an assistant professor of astronomy, and Dr. Greg Mosby, a scientist at the NASA Goddard Space Flight Center.

What is a quasar? It is a supermassive black hole with an accretion disk, along with a cloud of gas positioned right above that disk. In the accretion disk, gasses and dust are collected and bump into each other quickly—so quickly that these materials get extremely bright and block the view of the quasar's host galaxy with their brightness. Is an ERQ just a quasar that is tinted red? Not quite. When looking at a standard quasar, we expect the accretion disk to be composed of multiple materials that spread across all different wavelength spectrums. Some of these materials exist in ultraviolet wavelengths, some in X-ray wavelengths and some in radio wavelengths. ERQs defy this logic and mostly have materials in the infrared spectrum in their accretion disks. We believe that this is mostly caused by red dust, but this study is seeking to answer that question.

My role in this project was to align the pictures of the ERQ that were taken by the Hubble Space Telescope. These images are essentially the same picture taken at different positions, and aligning these pictures gives us a more in-depth look at the objects we are studying.



HANNAH WALLACE

An example of the raw images provided by the Hubble Space Telescope. The small lines seen throughout the image are cosmic rays, which are later "cleaned" using a coding process.

My role in this project was to align the pictures of the ERQ that were taken by the Hubble Space Telescope. These images are essentially the same picture taken at different positions, and aligning these pictures gives us a more in-depth look at the objects we are studying.

I started this process by removing or "cleaning" cosmic rays off our pictures. Cosmic rays are high-energy particles that originate from outside our solar system and end up making annoying little lines on our pictures. After I clean the images, I align them all using other fixed sources found in our images such as stars, pieces of galaxies and other media. After I have figured out which sources to use, I run the coordinates through a code that aligns the matching sources with our Hubble images, giving us both pictures and data we can study.

I am still working on this project, and I have had such a good time. Everyone with whom I have worked has been so nice and is always willing to answer any question I have. I really have no idea how I would have even begun to work on something like this without my mentors. They have taught me so much about the skills and knowledge I need to work in astrophysics.

About the author

Hannah Wallace is a sophomore majoring in astrophysics and atmospheric and oceanic science with a certificate in data science. She has always been interested in space science.

Room for expression

CORINA ROBINSON

BRYCE RICHTER, UW-MADISON

An eastern bluebird perches in a tree on the outskirts of Curtis Prairie at the University of Wisconsin-Madison Arboretum during spring on April 20, 2020.

About the author

College of Letters & Science senior **Corina Robinson** is a double major in Psychology and Environmental Studies, with a certificate in African American Studies.

When I started my college journey in 2019, I had this mental image of the world of research and what it looked like: A bunch of old(er) people in lab coats, attached at the hip to their computers, bent on succeeding in discovery and innovation. In my mind, research was nothing but a rigid rulebook of hypotheses and theories with no room for expression. I had no intention of diving into that world. At that point in time, I was labeling myself as an artist, and artists had no business masquerading as researchers. As if that weren't enough, I was someone who was (and proudly still is) laughably terrible at math and science.

Given all of that, I was concerned by a new requirement of my scholarship program: take part in the Undergraduate Research Scholars program (URS). My scholarship centralizes hip hop and urban arts and to me, that did not mix with the mission of URS. But scholarships are scholarships; if they told me I had to run up and down Bascom Hill ten times a day, I would do it in a heartbeat, because they pay for me to be here.

When I get to my first URS Seminar, run by two amazing fellows, this term "creative practice" is being thrown around next to "research" and I'm thinking, I know how to do creative practice. But I'm hesitant because that still has nothing to do with research, in my mind.

My URS project focused on environmental racism and its relationship with bird conservation, which come off as two very separate topics. But as I work with my mentor, I began to see connections between the two. Do keep in mind that this was the year COVID-19 kept us inside and completely remote for a school year. Initially, I thought research equated to hands-on lab work. Yet here I was in my apartment, learning about the ways environmental racism has also affected our avian friends. In my meetings with my mentor, he would always end by reminding me the work we were doing was pushing the body of research forward, moving the world. It was hard to feel like I was moving the world, which was at a kind of global standstill, and doing it all from my bedroom. But it was happening, nonetheless.

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My mentor encouraged me to translate my research into my creative medium of spoken word poetry. Never in a million years did I think I would enjoy writing poems about literature review. However, the familiarity of my own creative practice cultivated a smooth tandem with the research that had felt intimidating to me. That was when I started to realize that maybe I've been looking at research in the wrong way; maybe I've been defining it so that I was actually building the constraints of it. Maybe the reason I was opposed to research was that I didn't have creative practice to fill in the gaps I had created. It was humbling. I'm thinking, if I can connect these two topics, and call it research in the way that I'm doing it, and I'm not in a lab and I'm not old, maybe this isn't what I thought it was.

At the URS Symposium, I presented my research along with a poem that was overlaid on top of an artistic video. I'm typically someone comfortable with performance and public speaking, but there was nothing more nerve-wracking than being in this Zoom room, where most of the presentations were about cell processes I couldn't pronounce, and the superposition of galaxies, and here I am with my poem on birds. But it wasn't until the end of my presentation, when an audience member complimented me and said they had no idea research and creative practice could be so beautiful, that I finally made the connection as to why it was important for me as an artist to be a URS Scholar.

Research and creative practice need each other. The world does not move forward unless we have both. The work that URS does for its scholars should not only exist within the space of URS. We do ourselves a disservice as UW-Madison students to let that happen.

If you've ever seen the URS homepage, it reads that part of the mission of the program is to both develop and follow your curiosity, such that what you learn in the classroom can become reality. I have the tools to do that. Research is beautiful because it has us.

Understanding Recovery and Development in CHILDREN with Early Brain Injury and Cerebral Palsy

ALINA GRIMALDO

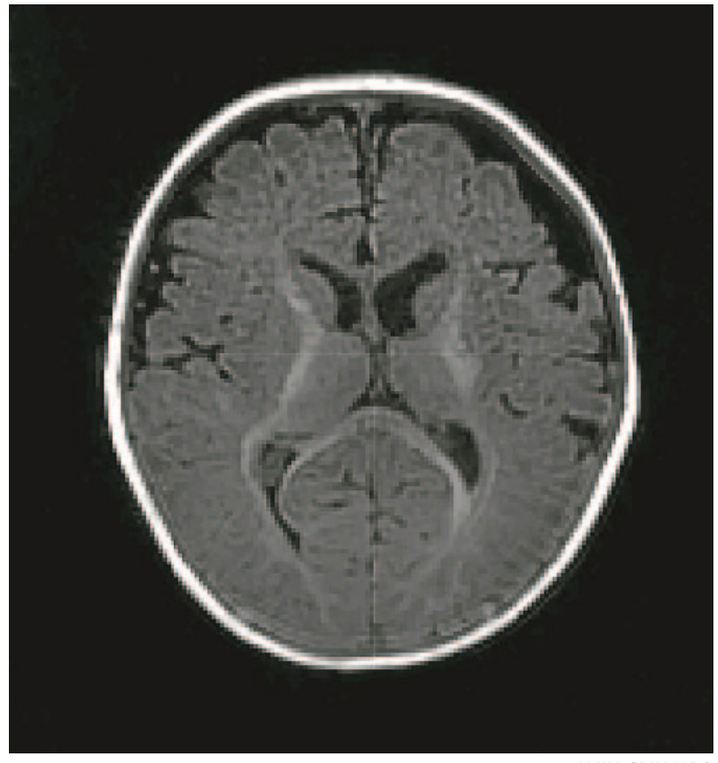
Early interventions in children with cerebral palsy can be pivotal to improving motor and cognitive outcomes. The University of Wisconsin-Madison Pediatric Neuromodulation Laboratory (PNL), housed within the Waisman Center, is home to the National Institutes of Health-funded Baby Brain Recovery Study, the first of its kind. The focus of this study is to longitudinally assess, over the first two years of life, the recovery and development of the infant brain after early stroke or brain bleed.

During the first year of my undergraduate career, I was eager to explore all the research opportunities UW-Madison had to offer. I was fortunate to have connected with Dr. Bernadette Gillick, an associate professor in the Department of Pediatrics for the School of Medicine and Public Health and the Director of the PNL. Her research focuses on neuroscience and neurorehabilitation, which was a great match for my interests as an aspiring physician.

Since joining the lab, I have learned that the way the brain functions is astonishing. It can reorganize itself by forming new neural connections in response to learning, interactions, or even after injury. We call this ability to change neuroplasticity. From our study, we hope to learn more about how the brain develops and changes after experiencing a stroke or a brain bleed around the time of birth. Early brain injury is a primary cause of cerebral palsy, which is the most common motor disability in childhood.

Our lab uses three tools to assess development and neuroplasticity of an infant's brain after early injury: magnetic resonance imaging, behavioral and developmental assessments, and transcranial magnetic stimulation. Magnetic resonance imaging allows us to create an image of the brain and be able to analyze how the brain structures change at different ages post-injury. Our developmental assessments are performed by pediatric physical therapists to analyze developmental milestones, behavior, muscle tone, and reflexes. We use specific assessments that are age appropriate for the infants who participate in our study. Lastly, we use transcranial magnetic stimulation to assess brain connectivity and excitability. We do this through gentle magnetic pulses that activate motor pathways that connect the infant's brain and arm muscles. With this collective information, we can track the infant's brain and motor development over time, and this may help identify early predictors of motor outcomes or later cerebral palsy diagnosis.

For infants with early brain injury, early detection allows for access to therapies and other interventions. However, we are still learning about how we can identify early risk factors for cerebral palsy, and the types of intervention that will have the greatest impact.



ALINA GRIMALDO

This image depicts the MRI scan of a typically developing infant brain taken at the Pediatric Neuromodulation Laboratory at the Waisman Center.

I maintain an active role as an undergraduate research assistant. I have been heavily involved in recruitment, data collection methodologies, refinement of study documents and processes, grant writing and working with our participant families. As part of my work this past summer, I started the Multilingual Access Project within the PNL, reaching out to underrepresented communities and allowing them to learn more about our work and potentially participate in our study in their preferred language. Currently, we have translated our recruitment materials to Spanish, but we are working to expand this further. Additionally, I was awarded the Waisman Center's Intellectual and Development Disabilities Research Center Undergraduate Student Award. I am honored to be able to work with such a talented and dedicated multi-disciplinary team and I am grateful to them for graciously showing me the wonderful world of research.

About the author

Alina Grimaldo, from Brookfield, WI, is pursuing a bachelor's degree in biochemistry and a certificate in French. She is an undergraduate research assistant in the Pediatric Neuromodulation Laboratory directed by Dr. Bernadette Gillick. Alina aspires to attend medical school to become a physician. She expects to graduate in May 2025.

ALINA GRIMALDO

University of Wisconsin-Madison Pediatric Neuromodulation Laboratory's open house at the Waisman Center on 6/22/2022. The PNL team members presented to the Wisconsin Idea Seminar about shared experiences and research techniques. In attendance was Dr. Bernadette Gillick (first row, on right), Veronika Mak (right corner of frame), Rodrigo De La Torre (first row, second from left), Preston Christopher (first row, on left), Sally Jones (second row, on right), Marissa Galli (last row, on left), Alina Grimaldo (Back row, third from left), and other Wisconsin Idea seminar attendees.

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