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

In late February, I sat down to write an opening piece for this special section of the Wisconsin State Journal.

My essay was full of pride for my College of Letters & Science colleagues and the ways in which they are working to understand and influence how we all think about our world.

The last few months have turned the world upside down.

As I write this, the University of Wisconsin–Madison has transitioned all in-person instruction to alternative modes of delivery and I, like my colleagues and many of you, have been adapting to working remotely. We are all facing unprecedented challenges as a result of this global pandemic.

As the crisis unfolds, I am convinced more than ever of the importance of what we do in the College of Letters & Science. What you will find in this “Fueled Discovery” supplement to the Wisconsin State Journal is a celebration of research – the act of discovering – that happens every day in the college.

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 pieces in this supplement were chosen well before the start of the global outbreak of the virus behind COVID-19 and do not specifically touch on the pandemic.

Yet, the underlying principle of curiosity-driven research that guides the College of Letters & Science, reflected here, also infuses our efforts to understand the virus, its spread and its impact on society.

We believe deeply in the importance of curiosity-driven research. My colleagues in L&S seek to understand the natural world we inhabit, be it the complex functions of atoms and molecules, our own brains, the lakes and ecosystems of Wisconsin, or the universe as a whole.

We are compelled 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.

Our college’s research is also inspired by thinking about our political systems, our histories and cultures.

Understanding the stories we craft and share, and the art and music we create, leads to a greater understanding of who we are as human beings.

As technology has changed our world, including the availability of massive amounts of data and the need for ever-greater computing power, we see not only the value of curiosity-driven research, but also of research inspired by an obligation to understand the nature of our rapid transformation.

We often see a push for more applied research that might have an immediate impact on society. And this remains important.

Yet, the profound importance of curiosity-driven research is its impact on future generations. The knowledge, technology and understanding we sometimes take for granted today are rooted in curiosity-driven research and discoveries made years, decades or even centuries ago.

By fueling discovery today, we are investing in our futures, in our children and in the world they will inherit.

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Steve Kean
Wisconsin Foundation and Alumni Association

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Conservation biology and environmental studies student

Natalie K. Pahapill
Biology student

Rebekah Pryor Paré
College of Letters & Science Career Initiative

Jeffrey Benerker
Department of Classical and Ancient Near Eastern Studies

Kenneth R. Mayer
Department of Political Science

Sam Schalk
Department of Gender & Women’s Studies

Neil Kodesh
Department of History

Michael G. Titelbaum
Department of Philosophy

Marzena Rostek
Department of Economics

Armando Ibarra
Chican@ and Latin@ Studies

Rebekah Willett
Information School

Ankur Desai
Department of Atmospheric and Oceanic Sciences

Audra Sterling
Department of Communication Sciences and Disorders

Diane C. Gooding
Department of Psychology

Stephanie Robert
School of Social Work

Autumn Kent
Department of Mathematics

Caroline Gottschalk
Druschke
Department of English

Aws Albarghouthi
Department of Computer Sciences

Loris D’Antoni
Department of Computer Sciences

Mark Saffman
Department of Physics

Claire Eversions
Biochemistry and mathematics student

ABOUT THE SECTION

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SECTION STAFF

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Whatever may be the limitations which trammel inquiry elsewhere, we believe that the great state University of Wisconsin should ever encourage that continual and fearless sifting and winnowing by which alone the truth can be found.” - UW Board of Regents, 1894

This past September, those words – inscribed on a plaque at Bascom Hall’s entrance – turned 125 years old.

In that time, UW-Madison created a tradition of free thought and a culture of presenting, challenging, analyzing and advancing ideas.

From that culture, our faculty have established a legacy as one of the nation’s leading research universities.

Faculty across the College of Letters & Science are executing critical research on worldwide topics ranging from regulating sleep in the Department of Integrative Biology; the effects of warming oceans in the Department of Atmospheric and Oceanic Science; laser sailing as a means of space transportation in the Department of Physics; and how threats to people’s sense of identity drive protest movements in the Department of Political Science.

Those examples represent only a snippet of the amazing innovation, creativity, and knowledge our faculty pursues.

Earlier this year, Badger alumni John and Tashia Morgridge announced another gift that will support up to $70 million in matching donations for faculty recruitment and retention at UW-Madison.

Their incredible generosity comes at a time when budget cuts have challenged the university’s ability to hire and retain talented faculty.

Private gifts now play a pivotal role in preserving the university’s legacy and its ability to expand research and ignite new ideas.

Since the Wisconsin Foundation launched the All Ways Forward campaign, the College of Letters & Science has been able to more than double the number of endowed professorships and chairs.

During this campaign, thousands of friends and alumni have contributed millions of dollars to funds in Letters & Science that support our research across the breadth of our disciplines.

I hope that you will continue to support our faculty and students so that we can uphold our long tradition of continual and fearless sifting and winnowing. Thank you for your support!

About the Associate Vice President
Steve Kean is associate vice president and managing director of development at the Wisconsin Foundation and Alumni Association, leading 16 development professionals working on behalf of the College of Letters & Science.

Discover more
Making a Gift
Consider making a gift to the College of Letters & Science by visiting www.allwaysforward.org/schools-colleges/ls or contacting Steve Kean at steve.kean@supportuw.org or 608-512-2097.

All Ways Forward
Find out more about the university’s All Ways Forward capital campaign at www.allwaysforward.org.

The power of private gifts to UW-Madison is reflected in the transformative research that is conducted across the College of Letters & Science, and in the entire university’s reputation as a research leader.

Philanthropy bolsters UW legacy as a top 10 research university
A WORLD OF POSSIBILITIES

Join us to learn about the fascinating research happening in UW–Madison’s College of Letters & Science (L&S). Enrich your mind with some of the UW’s top faculty members and hear from L&S interim dean Eric Wilcots.

Fueling Discovery, a partnership between L&S and the Wisconsin State Journal, invites the college’s faculty members to submit articles about their innovative work for inclusion in this special, annual section of the newspaper.

Visit www.ls.wisc.edu to learn more about the event.

Sponsored by:
Wisconsin Alumni Association
College of Letters & Science
University research is often a mysterious and murky concept to undergraduates arriving on campus.

But through the College of Letters & Science’s Undergraduate Research Scholars Program, each year we help approximately 200 first- and second-year undergraduates participate in research and creative endeavors with mentorship from faculty and staff.

By showing them the research opportunities and methods available on campus, we help undergraduates mold their futures.

One of our strengths is introducing undergraduates to the wide array of knowledge being produced at UW-Madison. URS is a high-impact practice that builds a diverse community of scholars, both in terms of students’ intellectual interests and life experiences. Many of our students come from historically underrepresented groups on campus.

According to a 2017 National Survey of Student Engagement, 38 percent of UW-Madison students participate in research during their undergraduate careers. The URS program is unique because the majority of our students are in their first year.

Our hope is that this early research experience will help our students make informed decisions about the classes they take, the majors they declare, and the career and post-baccalaureate plans they pursue.

Most incoming URS students are new to research. They apply to URS seeking a hands-on research experience, often without a clear understanding of precisely what that means.

Many of us – maybe even most of us – associate research with science, technology, engineering, and mathematics. As you see in this supplement, however, research extends to all disciplines.

I empathize with these students. When I entered UW-Madison in 2007, I had no sense of how scholars conducted research in fields that interested me. From what I could tell, research was the purview of pre-med students. I had difficulty aligning my goals with the big questions that fascinated me.

I am indebted to exceptional professors in the Departments of History, French & Italian, and Gender & Women’s Studies who validated my natural curiosities and introduced me to research methods that would help me pursue them.

Faculty members challenged and supported me to find my own answers to the research questions about inequality and systems of power that interested me.

Leaning into my natural curiosities as an undergraduate student became a habit for lifelong learning. I learned that the questions that resonate with you as an undergraduate can determine your entire career.

When students identify the questions that preoccupy them, they are best situated to make the most of their undergraduate research experiences.

Every fall, URS students are stunned by the variety of available research projects. Incoming students rarely foresee that they can investigate how members of Congress communicate with constituents, the ways that 3D printing and modeling might be used to represent dream sequences, or situations in films that are deemed “funny” across cultures.

A common refrain during our student-research matching process is, “I can study that?” Thanks to research mentors, upper-level URS Research Fellows, and peers, students soon realize that the world of research is broader and richer than they imagined.

**About the director**

Hannah E. Bailey is director of the Undergraduate Research Scholars program in the College of Letters & Science. A 2010 graduate of UW-Madison with bachelor of arts degrees in history and French and a certificate in Gender & Women’s Studies, she is working towards a doctorate in history at the College of William and Mary in Virginia.

DISCOVER MORE
- urs.ls.wisc.edu
UNDERGRADUATE RESEARCH FELLOW

Hands-on research experience opens door to role as ecologist

SAM AHLER
Special to the State Journal

T he opportunity to ask my own research questions and develop new experimental procedures as an ecologist has made me aware of my potential as a researcher.

In fact, this research experience has been instrumental in my decision to pursue a doctorate after finishing my undergraduate degree at UW-Madison.

My work in the lab of Ellen Damschen, a professor of integrative biology, focused on yearly vegetative growth in Midwestern prairie plants. That growth is dominated by below-ground buds as opposed to germination of new plants.

Reliance on buds over seed germination means researching the stress tolerances of the bud bank is a critical step in understanding a prairie’s response to climate change.

Winters in temperate regions are changing quickly, with increased frequency of freeze-thaw cycles due to fluctuating temperatures and a loss of continuous snow cover. The literature surrounding bud bank stress tolerances focuses almost exclusively on response to drought and fire or grazing, with little attention paid to the effects of cold.

We examined the effects of winter climate change on prairie plant bud survival and growth. Rhizomes from two dominating prairie grasses were collected.

Samples were collected from four management scenarios: spring burn, fall burn, mowing and no management. Bud cold tolerance was measured by removing buds from rhizomes and placing them in a cold bath with a programmed cooling rate. A thermal camera recorded the buds’ temperature to determine the temperature of ice formation.

I have been exposed to the world of ecological and evolutionary biology, and I’ve capitalized on our ability to study the natural communities around us are changing in response to human actions.

By digging into my honors senior thesis, I have become aware of the importance of understanding not only how to remediate human-induced damage, but also restore natural sites to their former glory.

About the student

Sam Ahler is majoring in conservation biology and environmental studies. He has worked on numerous research projects, including focusing on the environmental impact of road salt and the response of Wisconsin tall-grass prairies to winter climate change. He grew up in Lake Geneva and expects to graduate in May 2021.

Natalie K. Pahapill, shown here in the lab, focused her research on Parkinson’s disease. Her work involves brain and behavior relationships and uses genetic rat models. She says her undergraduate research work “allowed me to grow in countless ways.”

The neurotransmitter dopamine is associated with movement as well as reward-motivated behavior, and without it, people are likely to have feelings of anxiety, depression, mood swings and feelings of helplessness.

Once these motor signs appear, approximately 70 percent of these key dopamine neurons are already lost. By the time of diagnosis, the disease is already in a mid- to late-stage of progression.

Early diagnosis is challenging, as few reliable biomarkers exist. Their absence results in delayed treatment.

About the student

Natalie K. Pahapill, of Elm Grove, Wis., is majoring in biology. She expects to graduate in May 2021. Her research is in the lab of Professor Michelle Ciucci in the Department of Surgery, Division of Otolaryngology.

Our laboratory’s work seeks to change this and identify early behavioral and neurochemical biomarkers and better understand the disease process. In my work, I have capitalized on our ability to study brain and behavior relationships in genetic rat models.

I am testing the hypothesis that anxiety is an early sign of Parkinson’s disease.

Mutations in certain genes including the Pink1 gene, have been linked to early-onset Parkinson’s disease, a hereditary form of the disease. We use rodent models to identify the presence of prodromal anxiety, the anxiety that occurs before the onset of key disease features.

Detecting the presence of anxiety in an early stage can allow for earlier disease detection, earlier treatment and better outcomes. Additionally, the findings of the current study allow for further exploration of the disease process and the integration of motor and non-motor deficits.

This research allowed me to grow in countless ways.

Last summer, I volunteered at the American Parkinson’s Disease Optimism Walk in Madison. I met members of the community and their families affected by Parkinson’s disease. These experiences further validated the importance of our research.

In any research setting, you’ll encounter unexpected issues requiring problem-solving skills and determination to find alternative solutions.

Research allowed me to integrate this refined skill set into other disciplines in my academic career, making me a better student, learner and thinker.

Natalie K. Pahapill, shown here in the lab, focused her research on Parkinson’s disease. Her work involves brain and behavior relationships and uses genetic rat models. She says her undergraduate research work “allowed me to grow in countless ways.”

Parkinson’s project helps student build skills, understand disease

NATALIE K. PAHAPILL
Special to the State Journal

Parkinson’s disease is a neurodegenerative disorder that affects 10 million people.

It is identified by limb motor deficits, including tremor, shuffling gait and slowness related to the death of neurons and key chemicals in the brain.

The neurotransmitter dopamine is associated with movement as well as reward-motivated behavior, and without it, people are likely to have feelings of anxiety, depression, mood swings and helplessness.

Once these motor signs appear, approximately 70 percent of these key dopamine neurons are already lost. By the time of diagnosis, the disease is already in a mid- to late-stage of progression.

Early diagnosis is challenging, as few reliable biomarkers exist. Their absence results in delayed treatment.

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Undergraduate research sparks career success

As College of Letters & Science students help advance life-saving research into liver cancer, lung diseases and other fields, their work sets them up for a future of career success.

Our undergraduates pursue extraordinary research opportunities across campus, even taking advantage of those in the School of Medicine and Public Health and local hospitals.

For L&S students pursuing medical and public health professions, laboratory research can be as valuable as an internship.

In the lab, students apply skills from the classroom, such as developing, testing and evaluating hypotheses and experiments. As biochemistry major Jinan Sous explains, the lab is also a place to apply creative thinking.

“Research taught me often the best solution is not the most direct,” she says.

Labs are a fertile learning environment, helping students develop professional skills needed for a job in many fields. Students work on assignments independently while contributing to the team’s broader goal. They learn to take initiative and articulate their findings.

As Natalie Morel says, “I worked with scientists, doctors and researchers of all levels. To have your opinions and presentations valued and taken seriously by people with Ph.D.s and MDs means a lot as an undergraduate.”

At SuccessWorks, students work with advisors to market these experiences for the job market.

Morel, now a clinical research coordinator at Mount Sinai Hospital in New York, worked with a career advisor on her resume, cover letters and interviewing skills.

“With the help of SuccessWorks, my job search process turned into me negotiating multiple offers – it made a big difference,” she says.

About the Associate Dean

Rebekah Pryor Paré is associate dean of the College of Letters & Science Career Initiative. The initiative helps students build successful careers by establishing connections with alumni and employers, identifying their strengths and interests and thinking beyond their degrees much earlier in their college experiences.

DISCOVER MORE
successworks.wisc.edu
No topic is more divisive than politics. And yet, during an election year, there may be no topic more in need of exploration.

One approach that allows for peaceful dialogue is to examine the politics of another place and time, to find examples that ring true in the modern era but which we can discuss without offending our fellow citizens.

My research on Plutarch of Chaeronea, a Greek author from the first century A.D., focuses on someone who took just this approach. By Plutarch’s day, classical Greece was long gone, and the old cities were subject to the Roman emperor. Even so, they were largely self-governing and required competent leadership.

Both a historian and a practicing politician, Plutarch believed the past could inform the present. In a series of essays, which I have recently translated, Plutarch recounts stories about great leaders from the classical past, taking pains to distill from his historical examples the essence of wise political leadership.

He describes, for example, how Themistocles and Aristides set aside their partisan rivalry whenever they were representing Athens abroad; how Theopompos, a Spartan king, surrendered some of his power to make the monarchy more stable; and how Epaminondas of Thebes took the same pride in overseeing the streets as he did in leading the army.

Drawing on the experiences of dozens of historical figures, Plutarch makes examples from the past relevant to his contemporary audience, and in the process, he has made them relevant to a modern audience as well.

Professor Jeffrey Beneker edited and translated this selection of Plutarch’s essays, which reflect on wise political leadership. The published essays provide a lens through which to view modern political leaders.

Jeffrey Beneker is a professor in the Department of Classical and Ancient Near Eastern Studies. He studies ancient Greek and Roman biography and history, and teaches courses in Greek language, mythology and religion. His current projects include a biography of the Roman general Pompey the Great and a translation of the medieval story of Sinbad the Philosopher.

My current interest is the question of examining alternatives to partisan redistricting.

Almost nobody defends partisan gerrymandering – at least not honestly, or when the other side does it.

As the saying goes, the practice of elected officials choosing their voters rather than the other way around violates core principles of democratic governance, representation and responsiveness.

But we don’t have a full understanding of how to best draw neutral plans, or how – or whether – different definitions of “neutral” will affect how legislators engage with constituents.

Along with colleagues in computer science and geography, several of us in the political science department will investigate these questions from a truly interdisciplinary standpoint.
My research focuses on issues of race, disability, and gender in contemporary American literature and culture. My first book, “Bodyminds Reimagined,” analyzes representations of disability, race, and gender in black women’s speculative fiction, arguing that this non-realist genre provides unique ways to explore social systems and the relationships between them.

I have also written about race, disability, and gender in popular culture, like in the films “Avatar” and the Wisconsin-based American Girl brand.

My current research project explores how black activists, specifically the Black Panther Party and the National Black Women’s Health Project, have addressed disability as a political concern in ways that differ from the mainstream, predominantly white, disability rights movement.

As an interdisciplinary scholar — meaning my work crosses disciplinary boundaries including literature, history, and ethnography — the thing that links all my work is not the objects I study (a book, a film, dolls or archival materials), but the political and social issues that these objects help us understand.

What are the relationships between racism, sexism, ableism — discrimination against disabled people — and other forms of oppression?

How have marginalized groups — such as women, disabled people, people of color, lesbian, gay, bisexual, and queer people, transgender and non-binary people — sometimes done harm to one another or to multiply marginalized people with their group, such as queer people of color, in their fight for collective liberation?

What I aim to accomplish with my research is an understanding of the relationships between oppressions in our modern world so that, perhaps, in conversation with the many brilliant scholars, artists and activists I read and work with, we can develop new strategies for political and social change that can address multiple oppressions at once and refuse to leave anyone behind.

I bring this work to the classroom by encouraging my students to ask questions of their own assumptions.

What beliefs do you hold that you have never questioned? How did you come to know what you think you know about people who are different from you? From TV and movies? From your parents or community of origin? Who benefits from these beliefs and who suffers?

Are the beliefs you hold helping you be your highest and best self — helping you make the world better — or are these beliefs holding you back from that?

What I love about teaching in the Department of Gender & Women’s Studies is that my students come open, earnest and eager to learn.

I learn from and with my students constantly and every year at least one student e-mails me to say that my class changed their thinking, even changed their life or career path.

Everyone needs to have a basic understanding of systems of oppression because all of us will interact with people different from us and potentially hold power over people less privileged than ourselves. We need to understand our role within these systems in order to change them for the better.
Since 1925, WARF has been investing in research at the University of Wisconsin–Madison, partnering with companies all over the world to help the landmark discoveries of the university improve the lives of millions.

From new ways of combatting bacteria to technologies that lead to faster, greener and more powerful computers, from long-lasting, reliable batteries to improved tools for scientists and physicians, WARF helps innovations from across campus benefit the world.

Helping UW–Madison improve the World

INVESTING IN RESEARCH, MAKING A DIFFERENCE.
My research on the history of health, healing and medicine is animated by a series of intriguing questions, all helping a growing number of UW-Madison students better grasp global health issues.

What was it like to be a patient in a hospital established by British medical missionaries in East Africa in the early 20th century? Or at one run by British colonial officials? Or at a healer’s shrine in one of the villages surrounding these hospitals?

How did patients perceive and understand the treatment they received in these different spaces?

And, what was the relationship between deeply-rooted therapeutic practices and ideas in East Africa and those introduced by medical missionaries and colonial medical officers beginning in the late 19th century?

Interest in global health has grown tremendously during my 15 years at UW-Madison. Many students, particularly aspiring medical professionals, participate in global health field experiences in other countries as part of their degree programs.

I have led two such experiences in recent years: a three-week program in western Uganda for graduate students on the topic of mapping disease hotspots; and a month-long program in Botswana for undergraduate students that focused on community and environmental health.

An historical perspective – one that both foregrounds the concerns of African communities and also considers the historical lineages of global health interventions in Africa – bridges the gap between past and present for future practitioners.

This approach also blurs the distinction between the local and the global, allowing us to better understand connections between our lives and conditions and those of people living in seemingly distant parts of the world.

About the scholar

Neil Kodesh is a professor in the Department of History. His research and teaching focus on the history of East Africa, with a particular focus on medical history, historical anthropology and multidisciplinary methodologies for writing African history. He is currently working on a historical ethnography of Mengo Hospital, the first hospital established in what today is Uganda.

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- go.wisc.edu/neilkodesh
- go.wisc.edu/kodeshinterview
Join the Shared Solar community.

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Understanding knowledge and learning from different views

Every year I teach epistemology, which is Greek for “theory of knowledge.” My students and I try to understand what knowledge is, and how to get it.

Knowledge starts with evidence. We might acquire evidence from scientific experiments, combing through books, talking to others, or even just opening our eyes and seeing the world around us. But evidence doesn’t always wear its lessons on its sleeve. Sometimes we have to combine multiple pieces of evidence, or dig deeper into what our evidence says, to draw a conclusion. This requires reasoning.

Most of my research is about reasoning. In particular I study Bayesian models of reasoning, which are based on statistics and probability mathematics. I ask what makes reasoning good, or bad. Is there only one good way to reason? If two people start from the same evidence, and reach different conclusions, must one of them have made a mistake? Or do our different perspectives, upbringings and points of view allow us to draw different lessons from the same experiences?

Two people might watch the same political debate and disagree about which candidate would be best for our country. Two scientists might look at the same experimental data, and form different theories.

Most importantly, I ask what we should do when we find ourselves in these disagreements. Must we dismiss the other person’s conclusions as confused or ill-informed? Or can we learn from different perspectives, without having to abandon our own?

Despite being studied for millennia, these questions feel more important now than ever.

About the scholar
Michael G. Titelbaum is Vilas Distinguished Achievement Professor and chair of the Department of Philosophy. His research centers on rationality, primarily as it comes up in epistemology (the theory of knowledge) and ethics, but also as it arises in meta-ethics, decision theory, political philosophy, logic and the philosophy of science.

DISCOVER MORE
- go.wisc.edu/titelbaum

Michael G. Titelbaum, Vilas Distinguished Achievement Professor and chair of the Department of Philosophy, is shown here teaching a Philosophy 211 class at Helen C. White Hall. Titelbaum’s work revolves around rationality and ethics.

Keeping up with the changes in the financial system

The floor of a stock exchange was once the headquarters for financial transactions. In merely a couple of decades, however, financial markets have gone through an unprecedented transformation.

The number of alternative trading venues and the volume of trade outside traditional, open exchanges have increased severalfold. Looking just at the top U.S. equity markets, the New York Stock Exchange currently creates less than 25 percent of the trading volume of its listed assets. The remaining trades occur in more than 10 other public exchanges, more than 30 private exchanges (restricted mostly to large institutional investors) and more than 200 dealer networks.

Moreover, a significant fraction of transactions has shifted to electronic trading. With advances in financial technology came access to faster speeds, new financial instruments and more flexible and rapidly evolving trading protocols and platforms.

These changes have created unique opportunities to contribute and a sense of urgency. It would be an understatement to say that financial markets are ahead of economic theory. The financial crisis provided another stimulus to the demand for new models and tools that could inform and assist in evaluating the regulatory reforms that followed.

The rising questions concerning the market structure of the financial system, its efficient design, and, possibly regulation, are core economic questions. These are the questions that keep me up at night.

There is enough to understand to keep an army of researchers busy. In the process, I discovered the joys of working with and learning from UW-Madison students.

About the scholar
Marzena Rostek holds the Juli Plant Grainger Distinguished Chair in the Department of Economics. An expert in microeconomics, theory of financial markets and game theory, her research has recognized the potential for market decentralization to increase efficiency. Her work suggests new possibilities that economic theory and market design offer in accomplishing certain efficiency, revenue and incentive objectives.

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- go.wisc.edu/rostek

This graphic depicts the complex modern market structure. It shows the network of the granular and aggregate exposures of the Euro area banking sector (blue nodes), non-financial corporates (red nodes), the government sector (purple nodes), the financial corporate sector (green nodes) and the household sector (light blue nodes).
Trained as a political scientist, I study and teach on migration and settlement and the social and cultural transformations that these processes create.

For me, the Wisconsin Idea means producing knowledge about these issues in collaboration with community stakeholders. I see this work as a way to help all of us learn to live together as we face economic, demographic and environmental change.

And make no mistake: the United States is changing.

During the last 30 years or so, trade and foreign policy initiatives by both parties have made us increasingly interdependent with our neighbors to the south. The old era of “gunboat diplomacy” with Latin America has more or less ended, but our new relationships are still fraught and asymmetrical.

As the U.S. political economy moves resources north, life in countries like Mexico, Guatemala, El Salvador and Honduras becomes untenable for large numbers of people.

Climate change exacerbates these conditions. As a result, labor, too, moves north, even as some formerly secure U.S.-based jobs move south and further afield.

This new interdependence is reshaping the population of the United States even as it concentrates more and more wealth in fewer and fewer hands both here and abroad.

Most demographers agree that in the future the United States will be more racially and ethnically diverse than it is now, and economic trends point to continued change that will make tomorrow’s labor market different from today’s.

In this context, change and inequality generate anxiety and conflict. Policies and political positions emerge from incomplete information, strengthening myths and feeding rhetoric that polarizes our country.

Some of my academic friends who study social movements say the United States is as divided politically and culturally now as it has ever been. I think I agree. So, what to do?

In a climate that creates the conditions for division and reactionary politics against the “other,” I engage in community-based research that seeks to identify root causes and consequences of these dynamics and consequently offers practical evidence-based conclusions and recommendations.

In addition to preparing academic publications and reports that could allow political leadership and policymakers to strengthen our communities by receiving newcomers from Latin America effectively, I have documented the lives, dreams, and struggles of ordinary workers, mostly people of Mexican descent, in our state.

This work has added a Wisconsin voice to national social science debates on labor, migration, politics and integration.

These debates are not new. For Latinos, reaching out through the Wisconsin Idea to help policymakers adapt to changing demographics is an important part of Armando Ibarra’s work, along with documenting the stories of ordinary Wisconsin workers of Mexican descent.

About the scholar
Armando Ibarra is an associate professor and director of the Chican@ and Latin@ Studies Program and a faculty member at the UW-Madison School for Workers. His research and field of specialization are Chicana/o Latina/o working communities.

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they encompass generationally linked issues such as exclusion, segregation, policing, racialization and unequal access to education.

These debates and these realities also inform my work with students.

In partnership with community organizations in Madison, Milwaukee, and beyond, I have trained students to collaborate with marginalized communities in the production of knowledge that can help them address their most pressing concerns.

In all of this work, I seek to find ways for all Wisconsinites to build common ground and work for a shared, more just and equitable future.
A mid all of the confusion regarding how to raise children in a technology-saturated world, everyday household routines connected with screens have become a source of struggle.

What parent or caregiver has not been stressed over questions about their children and technology? What apps are OK, and how worried should we be about YouTube? How much time is too much? When can children handle their own social media accounts?

Parents and caregivers are constantly developing family rules connected with digital media and technologies. They struggle with contradictory advice about providing children access to screens or about regulating screen access.

Parents are told that children need to have full access to technologies to succeed academically, prepare for the workforce, be a part of their peer culture and learn how to handle issues such as privacy and misinformation.

On the other hand, parents are told to be wary of online risks and potential harm.

My research provides new ways of thinking about children's media engagements that go beyond benefits and risks. I explain that there is danger of over-celebrating the potential for children's interactions with media while promising results that likely will never materialize.

In addition, over-regulation on a national and even household level can reduce children's access to the benefits of media engagement, create family anxiety and shut down dialogue with children.

My aim is to put children, families, and their experiences at the center of conversations about children's media culture.

I demonstrate ways parenting advice in media and in everyday conversations often set up hierarchies that indicate "good" versus "bad" parents.

Some parental practices are set up as "good" by describing certain media-related activities as safe and educational, and by indicating that "good parents" are those who provide these apps and activities while also carefully regulating their children's media time.

Other parents are viewed as less discerning; allowing their children to play in virtual and real-life spaces where there are risks, such as "stranger danger," privacy issues and exposure to advertising pressures.

These hierarchies privilege middle-class families' media usage, which does not account for the multiple ways our culture consumes media. I argue that the framing of parenting in this good parent–bad parent way is not new and has been used throughout the history of children and media.

This history means that the everyday advice that society seems to understand as norms, is hard to change.

Parents today are faced with questions and concerns over how much screen time is too much or too little. Professor Rebecca Willett said her aim is to put families and children in the center of discussions about media use for kids.

It seems like common sense that children should primarily be consuming media with parents, that media should be mainly educational and that screen time is strictly controlled.

However, it is important to recognize these assumptions favor particular types of families; but all families are different.

My research analyzes the factors that shape decisions families make about screen media ranging from disabilities, ethnicities, religious beliefs through to work schedules, access to technologies and geographical isolation.

My aims are for researchers to see the complexities and meaning-making that happens as families negotiate children's media use and for professionals who provide guidance about media to better see families as individuals.
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As the sun rises around the world, hundreds of trillions of leaves open their pores to start a daily cycle.

Every leaf is filled with these pores, called stomata, more than a million per leaf. Each second, each stomate allows several billion molecules of water to escape and carbon dioxide to enter. These ingredients allow an elaborate recipe, photosynthesis, to store the sun’s energy in the form of carbon. This process is what I call the breath of the biosphere.

Each year, all the plants on land take up more than a 100 billion tons of carbon. After accounting for respiration and decomposition, land ecosystems on net offset a quarter of our fossil fuel emissions. Plants lighten the burden for future emissions reductions needed to prevent the worst effects of a warming planet.

Can we keep counting on plants for that service?

In the Ecometeorology Lab at the Department of Atmospheric and Oceanic Sciences, students and scientists are monitoring that breath to answer this question. We build towers in forests, wetlands, lakes and farms across Wisconsin and Michigan. These towers range from six feet to 1,400 feet tall, and loom over the plants and soil being monitored.

Sensors on these towers measure gusts of winds and the amount of carbon dioxide and water vapor in the air 10 times a second. Using the laws of turbulent fluid dynamics, we can turn those observations into information about rates of carbon uptake and water loss by plants.

We want to understand how this breath changes from one hour to the next, from one season to the next, from one year to the next.

What happens in a hot summer, a wet spring or during an extended cloudy spell? How quickly does the breath restore after an insect outbreak, an ice storm, or a severe drought? Do stomata open less as carbon dioxide in the air increases from fossil fuel emissions? How much do older forests breath compare to younger forests?

This is what we seek to understand in our lab.

For example, to detect subtle shifts in the breath, researcher Jonathan Thom monitors and calibrates sensors collecting real-time, open-access data every day, expertly climbing the towers to maintain them.

Graduate student Jess Turner is using these data to learn how peatlands carbon sequestration changes with their size and how windy they are. Another graduate student, Bailey Murphy, is calibrating complex computer simulations of forests with the towers to understand how forest age and management influence carbon uptake. Undergraduate researcher James Mineau is using a floating tower in a lake to explain unique seasonal patterns. Meanwhile, post-doctoral researcher Susi Wiesner is tracing all sources of carbon dioxide and methane on a dairy farm in a quest to see how the dairy industry could become carbon neutral.

Our work is done with federal partners such as the Forest Service and the Departments of Agriculture and Energy and alongside state groups such as the Department of Natural Resources, the Wisconsin Educational Communications Board and the Wisconsin Potato and Vegetable Growers Association.

Each seeks its own understanding of the biosphere. Ecometeorology researchers and partners learn one breath at a time.
Helping children thrive by combatting language impairments

Language is a fundamental aspect of human communication, and impairments result in lifelong struggles. Imagine having trouble communicating basic wants and needs and understanding the fast pace of the world around you. It's a frustrating and scary scenario.

For children with neurodevelopmental disorders – including Down syndrome, fragile X syndrome, and autism spectrum disorder – language impairments are a part of life. These struggles begin early in development and continue throughout life. Unfortunately, language impairments are associated with difficulties in school, difficulties with relationships and eventually problems with employ-

**About the scholar**

Audra Sterling is an associate professor in the Department of Communication Sciences and Disorders. Her research focuses on the cognitive and language development of individuals with developmental disabilities. She is interested in children with fragile X syndrome, autism spectrum disorder and Down syndrome. She seeks to understand how biology and environment affect development of language and cognition in children with developmental disabilities.

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**Audra Sterling**

Professor Audra Sterling's research centers on assessing and treating language development in children with neurodevelopmental disorders, such as Down syndrome, fragile X syndrome and autism spectrum disorder. Here, a girl with Down syndrome interacts with her teacher in a classroom setting.

Risk factors may help unravel mystery of schizophrenia

Schizophrenia is one of the most severe and persistent of the mental illnesses.

While schizophrenia is usually diagnosed between the ages of 18 and 30, many mental health professionals believe that the factors causing it are present since birth. In my research, I identify risk factors, which increase the likelihood of the later development of the disorder, and precursors, which are signs that appear before the full-blown disorder.

I accomplish this by studying schizophrenia in patients at various stages in their illness as well as studying individuals at risk for it.

People at risk for schizophrenia are identified in various ways: Are they related genetically to someone with schizophrenia; do they share a relatively infrequent biological or personality characteristic as someone with schizophrenia; or do they display a clinical symptom as someone diagnosed with schizophrenia?

**About the scholar**

Diane C. Gooding is a professor in the Department of Psychology. Her research focuses on schizophrenia and schizophrenia-spectrum disorders. Her studies include biological bases and early identification and development of psychotic disorders. Students working with her are taught psychophysiological, neurophysiological and clinical assessment techniques.

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My lab is an extension of my classroom, so I include both undergraduates and graduate students in my ongoing quest to uncover how schizophrenia develops. One risk factor I've identified is social anhedonia, which is when a person doesn't experience pleasure from social interactions.

Social anhedonia can be detected using questionnaires, enabling me to study it in college students, community samples, patient groups and cross-culturally.

I developed a new scale known as the ACIPS, with child, adolescent and adult versions.

This is exciting because until now, there has not been a way to measure social anhedonia in youths. And it is important, because the earlier we can detect risk factors, the sooner we can intervene and help prevent further decline.

**Diane C. Gooding**

By identifying risk factors for schizophrenia and studying patients at various stages of their illness, and those at risk for it, Professor Diane C. Gooding hopes to understand the puzzle of the mental illness and help professionals better treat it.
“Aging is not for wimps,” or so my friends and family say when we get together and share stories about our lives.

While older age can come with opportunities for spending time with family, friends and hobbies, it also often comes with health challenges.

At some point in our lives, approximately 70 percent of us will need supports and services to help with daily care needs on an ongoing basis – such as managing medications, preparing meals, bathing and dressing.

Although most long-term supports and services are provided at home, moving to a nursing home can be appropriate to meet intense care needs.

However, my research team found that older adults sometimes move to nursing homes not because it is the best place to meet their care needs, but because they can’t afford both their housing costs and their care needs at home.

Low income and a lack of affordable housing can result in premature nursing home care, which is both more costly to society and less preferred by older adults.

My research team investigates how a range of factors affect our options for long-term supports and services at older ages – factors such as our income, race, living situation, informal supports, and aspects of our community context.

The goal of this research is to understand how we can improve policies to ensure that all of us have the economic, social, and health supports we need to live comfortable and dignified lives in old age.

The goal of Professor Stephanie Robert’s research is to understand how to improve policies to ensure that seniors have the social, health and economic supports needed to allow them to live in comfort and dignity.

Understanding how to help older adults meet long-term care needs

**About the scholar**

Stephanie Robert is a professor and director in the School of Social Work. Her research focuses on how social and economic aspects of people’s lives affect their health and well-being throughout their lives. She views social policy as health policy – determining how to best improve social policy rather than only healthcare policy to maintain people’s health and reduce health disparities.
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In the Atari game Asteroids, you fly a triangular spaceship that destroys asteroids with a ray gun. When you fly off the top of your TV screen, you reappear from the bottom. When you fly off the right, it reappears from the left.

The top of the TV is “glued” to the bottom, forming a cylinder, and the left end of this cylinder is “glued” to the right end, forming a doughnut. The universe of Asteroids is a doughnut.

Despite being a doughnut, the geometry of the TV screen is flat, and we call the Asteroids universe a “flat torus.”

TVs used to have 4:3 aspect ratios, and now they are usually 16:9. We can play Asteroids on both. Both universes are flat tori, but they’re different shapes.

Imagine Asteroids in a television with a 100:1 aspect ratio. This gives us a very skinny doughnut, and a dizzying universe.

If we took a triangle ship captain out of her universe, and marooned her in a new one, would she be able to tell? Can she determine the shape of her universe without being told the shape of the TV?

From inside, there would be no way to tell the difference between a 2:1 universe and a 1:2 universe.

If the TV were a parallelogram, would she be able to tell if it weren’t a rectangle? Could two different TVs give her the same universe? Are there directions she can fly that will take her to every point in her universe?

These questions are basic versions of the questions I address in my research: What are the possible shapes of a given object? Can we tell two objects apart by studying the geometry from within, as in the dilemma given our marooned captain? Can we deform a given geometric object the way that we deformed our TVs?

Exploring the world of Atari, doughnuts and geometry

About the scholar

Autumn Kent is a professor in the Department of Mathematics. She specializes in geometry and topology. Her research is focused on deformations of geometric structures. Specifically, she studies the geometry of spaces of geometric structures called moduli spaces, which lie at the interface of algebra, analysis, geometry and topology.

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Sometimes the best experiences arrive when you least expect — and most need — them.

In 2018, Tamara Dean, from the Driftless Writing Center in Viroqua, asked if I would serve as the “humanities expert” for an idea they were dreaming up. Called “Stories from the Flood,” it developed into an ambitious, community-based project to collect and share stories about catastrophic flooding in the Kickapoo River and Coon Creek watersheds. They hoped to help flood-affected residents process their trauma, while creating a historical record to inform future planning and support community healing. I immediately pledged my support.

As a tenured professor 15 years into work on community engagement, public discourse, and freshwater management, I have relevant expertise. But this ongoing collaboration is a constant reminder I’m not the expert when it comes to the human impacts of flooding.

Community members lived through 2018 flooding and so many floods before. After multiple 100-year floods in the last decade, there is little relief in sight; climate forecasts predict this pattern will intensify.

In Vernon County, 2018 flooding caused an estimated $29 million in damage — an average of almost $1,000 per person — to businesses, homes, and infrastructure. Residents need help, but the “Stories from the Flood” archive is filled with creative problem-solving, selfless generosity and deep resilience.

My job is to show up and listen; build relationships to understand what community members need and want; and leverage university resources to support those needs.

I’m so grateful they’ve welcomed my students and me along for this work, and I hope I’m giving back even a fraction of what this experience has given me.

The community-based “Stories of the Flood” project helped some residents in the Driftless area of Wisconsin to heal from the trauma of summer flooding. Here, the flood-prone Kickapoo River overruns its banks and inundates a farm in a valley near Soldiers Grove in 2018.

Storytelling that helps heal and plan in the wake of disaster

About the scholar

Caroline Gottschalk Druschke is an associate professor in the Department of English. She directs a research group working at the intersection of public engagement and natural resources management. Through the study of rhetoric, they build critical theory and conduct social and ecological research and public outreach about stream restoration, migratory fish passage, trout conservation, wetlands restoration, watershed-based agricultural outreach and coastal storm impacts.

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As software permeates our personal lives, corporate world, and bureaucracy, more of our critical decisions are being delegated to opaque software – hiring, welfare allocation, prison sentencing, policing, and many others. Software artifacts have thus become powerful arbiters of a range of significant decisions with far-reaching societal impact.

Picture, for instance, a hiring computer program that sifts through job applications and selects what it perceives as the top candidates, or an algorithm that computes a person’s credit score.

In such scenarios, the computer program is carrying out a sensitive task, and could potentially be discriminating – advertently or inadvertently – against a protected group.

A recent alarming example is racial bias in risk-prediction software used in criminal sentencing, which is employed in a number of states, including Wisconsin.

With the range and sensitivity of software-based decisions expanding by the day, it is natural to ask whether these computer programs make fair decisions or how these programs operate at all.

The notions of fairness and transparency of computer programs have captured the attention of a broad spectrum of experts: machine learning and theory researchers; law scholars and social scientists; governmental agencies and non-governmental organizations.

Notably, two recent White House reports warn: “Powerful algorithms ... raise the potential of encoding discrimination in automated decisions.” They recommend that, “Federal agencies that use AI-based systems to make or provide decision support for consequential decisions about individuals should take extra care to ensure the efficacy and fairness of those systems, based on evidence-based verification and validation.”

In our work, which is led by our student Samuel Drews, we envision a world in which we can automatically certify fairness of decision-making programs, explain reasons for unfairness, automatically eliminate unfairness, and make the decisions made by these programs more transparent.

It is hard to decide whether something is fair, and even talking about fairness requires one to have a well-grounded knowledge of ethics and sociology.

Computer scientists, however, have recently shown that several ideas from the fairness literature can be put into action. These abstract definitions can sometimes be translated into mathematical models. We often call this translation a “formalization.” A formalization is a powerful tool that enables mathematical reasoning, and this is the aspect our work builds upon.

A formal model enables us to reason about and understand fairness issues in automated decision-making.

Indeed, building atop such formal models of fairness, we have developed automated techniques that answer a number of thorny questions, including: Is a program fair? How can we fix an unfair program, making it fair? How can we explain the results of complex programs in a way that is human-understandable? And, how can we help data scientists build fair decision-making tools?

The answers to these questions would not have been possible without the generous support from the National Science Foundation, which provided $1 million for investigating fairness and $750,000 for investigating transparency.
NOT ALL HEROES WEAR CAPEs

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We live in an age of information processing in which computers play an irreplaceable role in daily life. The smartphone in our pocket that we use to stay in touch with family and friends, read the news, check the weather and find our way in a new place, is a more powerful computer than the world’s fastest machines that filled large rooms 50 years ago.

Modern supercomputers with processing power that was previously unthinkable are tackling grand challenges such as predicting the weather, designing new medicines and unlocking secrets of nature.

The electronics technology that underpins development of smaller and faster computing machines is now approaching the limit where every bit of data and every processing element consists of just a few atoms, and it might seem that further miniaturization will stop at this atomic scale barrier.

Remarkably, computer progress at the atomic limit is not forced to slow down but is instead poised to take a great leap forwards in the domain of the quantum.

Our scientific understanding of the world around us at the scale of everyday life builds on classical physics dating back centuries.

At the level of single atoms that classical physics no longer works, and we need the theory of quantum physics which was invented in 1925.

When we build computers with bits and transistors made of individual atoms, their behavior is described by quantum physics, and it is very different from that of our usual classical world.

In a classical digital computer data is stored as binary bits, either 0 or 1. In a quantum computer, built from atoms we have quantum bits, or qubits, that can be any combination of 0 and 1 at the same time.

In a classical digital computer data is stored as binary bits, either 0 or 1. In a quantum computer, built from atoms we have quantum bits, or qubits, that can be any combination of 0 and 1 at the same time.

This is a view inside the quantum computer in Mark Saffman’s lab. The grid is an image of an array of 121 atomic qubits that are the quantum processing unit. The atoms are cooled by laser beams, held in place by other laser beams, and then directed to perform computations with yet more laser beams.

About the scholar
Mark Saffman is a professor in the Department of Physics. His research interests include atomic physics; quantum computing with neutral atoms; quantum optics; entanglement; nonlinear optics; solitons; and pattern formation. His laboratory conducts research on use of neutral atoms for quantum information processing. He is also chief scientist for quantum information for the Colorado-based firm ColdQuanta, which also has a Madison office.

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A liberal arts education recognizes that we have a diverse range of interests and encourages us to pursue all of them.

You wouldn’t know it from my major studies in biochemistry and applied math, but humanities have been a central part of my student experience. I’ve been a member of the Clarinet Studio and Wind Ensemble since my freshman year and am grateful that we have a music school that is so welcoming to students who want to keep music in their lives.

I’ve also taken classes ranging from 20th century Indian culture to the rise of internet infrastructure disparities to African storytelling traditions.

Some of these classes are mainstays of a UW-Madison liberal arts education and connect generations of Badgers; my mom took that same African storytelling course.

Unfortunately, liberal arts education is facing challenges as some universities shift their focus toward preparing students for particular career paths.

This shift ignores one of the most important aspects of a college education: exploration and flexibility.

College is a unique time; we’ve moved past highly structured course schedules in high school, and we’re not yet to the point where we need to jump into the workforce.

If there was ever a prime time to support the love of learning, college is it. When else will an aspiring computer scientist have the chance to read a wide range of Asian-American literature, or a future French teacher have the chance to take a class on climate change?

Once we leave UW-Madison, we will have to work much harder to find these diverse learning opportunities, so a liberal arts education can be a once-in-a-lifetime opportunity.

As some universities are shrinking or eliminating humanities departments, it’s important that leaders in science, technology, engineering and math make a conscious effort to fight this trend by emphasizing concrete ways in which the sciences and the humanities strengthen one another.

Work in this area is exciting. Recently, I’ve seen articles on how we can use mathematics to model the origins and diversification of human language, and how linguistics is an essential tool for designing artificial intelligence machine learning programs.

To me, a love of learning is reflected by people who are engaged in something, big or small. I’m surrounded by these people every day at UW-Madison, and I’m so happy to be a part of a campus determined to ensure that we don’t just earn a degree, but that we leave here as broadly educated global citizens.

Claire Evensen

About the student

Claire Evensen, of Verona, will graduate this month with a bachelor’s degree in biochemistry and mathematics, with comprehensive honors (honors in biochemistry and in the liberal arts). She is also a Marshall Scholar, a Goldwater Scholar, an Astronaut Scholar and was a finalist for the prestigious Rhodes Scholarship. Next fall, she plans to begin a master’s degree program in mathematical modeling and scientific computing at the University of Oxford in England.
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