Wisconsin engineer. Volume 121, Number 2 Spring 2017

Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

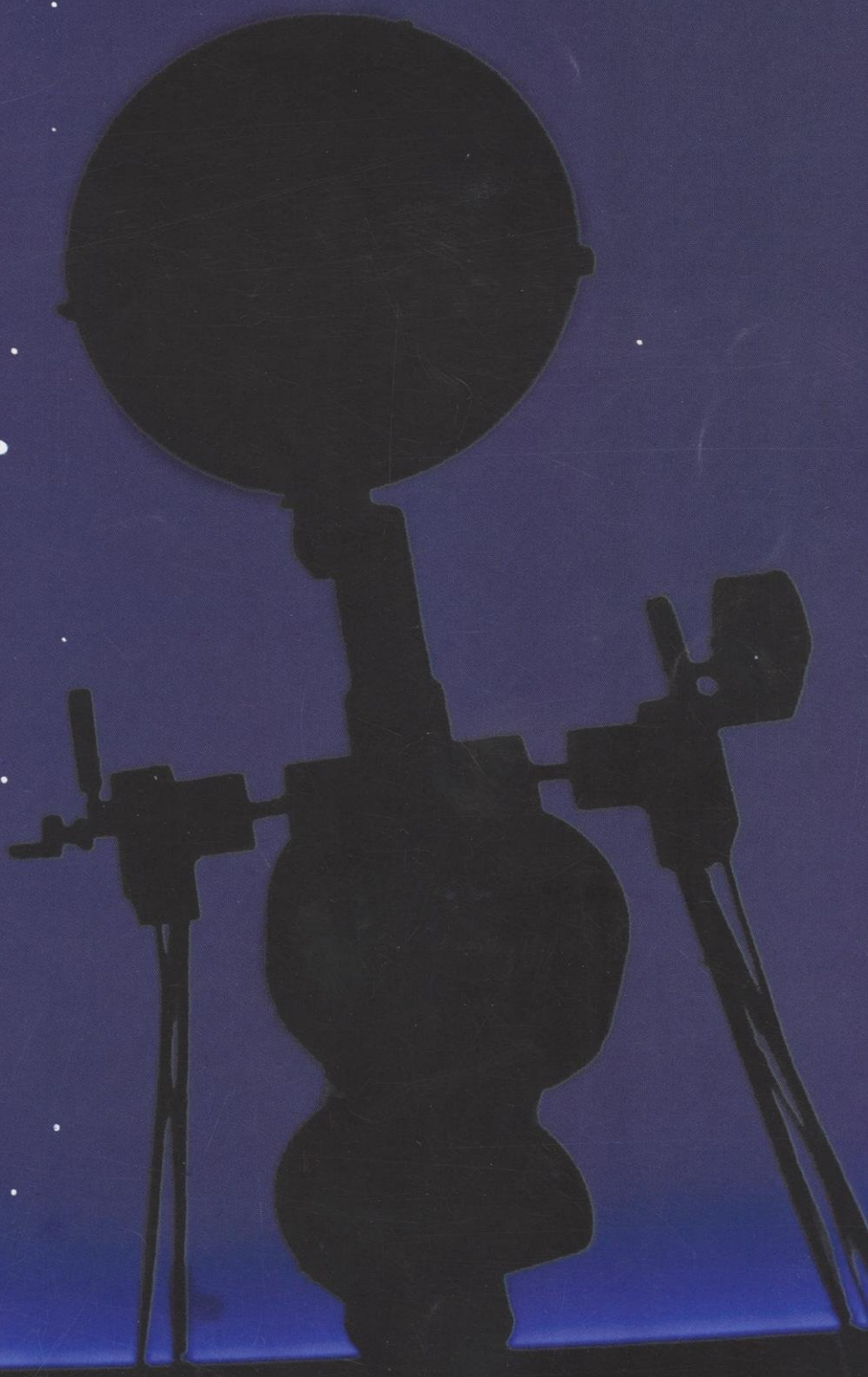
https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I

wisconsin engineer
SPRING 2017 VOLUME 121, NUMBER 2

SPACE ON EARTH

THE MADISON-METROPOLITAN SCHOOL DISTRICT PLANETARIUM

P. 4



Featured Articles:

College of Engineering
UNIVERSITY OF WISCONSIN-MADISON

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

ASM

Funded in part by an Associated Students of Madison viewpoint neutral grant.
Contact request@asm.wisc.edu for accommodation information.

The *Wisconsin Engineer* Magazine, a member of the Associated Collegiate Press, is published by students at UW-Madison. Philosophies and opinions expressed in this magazine do not necessarily reflect those of the College of Engineering and its management. All interested students have an equal opportunity to contribute to this publication.

Faculty Advisor: Steven Zwickel **Publisher:** Department of Information Technology, University of Wisconsin-Madison **Web address:** http://www.wisconsinengineer.com

Correspondence: *Wisconsin Engineer* Magazine; 1550 Engineering Drive; Madison, WI 53706 **Phone:** (608) 262-3494 **email:** wiscengrmagazine@gmail.com

The *Wisconsin Engineer* is published four times yearly in October, December, March and May by the Wisconsin Engineering Journal Association.

wisconsin engineer

Published by the students of the University of Wisconsin-Madison | VOLUME 121, NUMBER 2 | SPRING 2017

General

Cover photo by:
Carter Swedal

Podcasts Killed The Radio Star

If you don't listen to podcasts already, now's the time to start.

How the iPod changed the way people consume music has always been obvious. It's far less necessary to tune into a music broadcast on the radio if you're carrying thousands of songs in your pocket. What has been less obvious is that the same invention disrupted the news, talk, and storytelling aspects of radio with the introduction of podcasts. This happened more slowly, but with the media research and polling company Edison Research estimating that 57 million Americans and counting now regularly listen to podcasts, the trajectory is clear.

Sophomore Tara Roach laughs at a story being told during her favorite podcast from the Moth Radio Hour.

Podcasts are audio programs that can be downloaded or streamed on phones, tablets, or computers. Listeners use an app, such as Stitcher or the built-in podcast app on iPhones, to listen to single episodes or subscribe to shows and receive regularly released, often weekly, episodes. Podcasts are free and are supported by ads read by the host during the show. The word "podcast" was coined in 2004 as a combination of the words "iPod" and "broadcasting." It caught on quickly and in 2005 it was named Word of the Year by Oxford Dictionary. That same year, Apple launched support for podcasts in iTunes. The number of people regularly listening to them has grown ever since.

Many podcasts are put out by traditional radio networks such as National Public Radio (NPR), but the offerings are widespread and growing. The startup cost to produce a podcast is small, so both celebrities and regular people routinely start podcasts covering nearly every topic. Some are heavily produced and formatted, such as Serial, a spin-off of the radio program This American Life, which, like many other radio shows, is now available in podcast form. Others are less formal and take the format of hosts and interviewees conversing around a mic. There are podcasts about everything from the Green Bay Packers to local politics in Texas.

Podcasting is democratizing the creation of audio content in a similar way that blogging did for written content. It seems like everyone is starting a podcast. These podcast producers can tap into a lucrative ad market with advertisers eager to access the targeted audiences that podcasts draw – especially with the added benefit of having the podcaster personally present their ads.

The release of Serial in 2014 was a critical moment for the success of podcasts. It's considered to be the first podcast that wasn't originally a radio show to go truly viral. The show narrates a real life story

Talented personnel from radio, television, journalism, and beyond are flocking to podcasts to supplement to their regular content.

week by week, heavily relying on interspersed interviews, music, and other production elements to tell a compelling and addicting story. This program is illustrative of a current trend in podcasting: Moving away from amateur radio conversations and towards revenue-generating, professionally produced shows. Large audiences and the associated ad revenue have made the creation of high-quality programs presented by talented hosts like 99% Invisible, Reply All, and Planet Money the rule, not the exception. Talented personnel from radio, television, journalism, and beyond are flocking to podcasts to supplement their regular content; actor Alec Baldwin, astrophysicist Neil deGrasse Tyson, sports analyst Bill Simmons, and reality TV icon Snooki all host podcasts.

When Apple first added support for podcasts, Steve Jobs described them as being "sort of like TiVo, for radio, for your iPod." However, it's become clear that what podcasts have evolved into over the past decade might be better described as "like Netflix, for radio, for your iPhone." According to Edison

It's a mirror image of the major revolution of the television industry brought about by on-demand streaming services like Netflix and HBO Go.

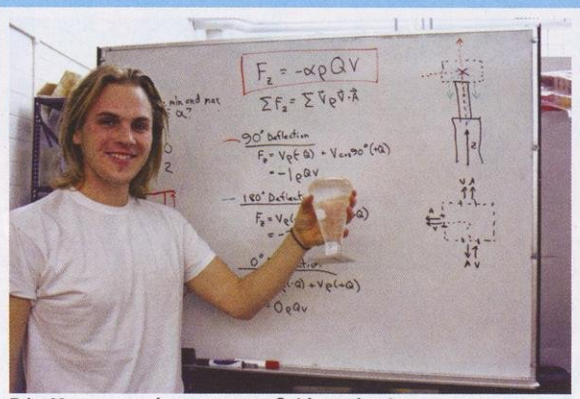
Research, the primary way people are listening to podcasts has transitioned from downloading them on computers to streaming them on mobile. The change to widespread, on-demand audio streaming has coincided with a surge in quality recurring content that keeps listeners hooked week after week. It's a mirror image of the major revolution of the television industry brought about by on-demand streaming services like Netflix and HBO Go. The perpetual improvement in mobile data coverage and download speeds as well as the increasing prevalence of internet-connected devices in our everyday lives (such as car dashboards that can stream audio) points towards a continuation of this trend towards content on-demand.

Podcasts are great to listen to when doing dishes, walking to class, waiting in lines, or driving to work. They can fill any moment with laughter, suspense, or curiosity. There's a podcast for nearly every interest – just ask your friends for a recommendation. Millions have already gotten hooked, and with a rapidly expanding slate of top-quality content, there's little reason for you not to join them.

Written by: Eric Fleming
Photography by: Beth Enright
Design by: Tim Campbell

TA Profile: Eric Mortensen

Meet one of UW-Madison's most entertaining and instructive TAs.



Eric Mortensen demonstrates fluid mechanics concepts with an engaging, enthusiastic energy.

Eric Mortensen is better known as the engaging and incredibly helpful TA for Civil Engineering 310: Fluid Mechanics. While Mortensen is not dazzling his students with his fluids finesse, he is working for his two master's degrees from the UW-Madison College of Engineering and UW-Madison's Nelson Institute in water resource management and water resources engineering. The Wisconsin Engineer Magazine sat down with this exceptional teacher to explore his experience of coming to where he is today.

Wisconsin Engineer Magazine:
So Eric, what brought you to teaching fluid mechanics?

Eric Mortensen:
So honestly, the first time I took fluid mechanics, I hated it and thought because of it, I was not going continue with my degree in civil engineering from the University of Iowa.

W/E : How did you get from hating fluid mechanics to instructing the class?

EM:
It has to do with two things you know, the first being I had to suck it up. It's difficult with the equations and the concepts, but it's a pretty cool topic when you look beyond these things. And second, just serendipity came into play. It worked out in Iowa that I needed some extra cash and I like teaching and I like people, so I first began to TA for fluids there, and when applying to Madison, Paul Block offered the position to me here, and here we are today.

W/E : So, you survived undergrad and have made it to UW-Madison. What is your area of research?

EM:
I research for both the engineering and water resource management degrees here at UW-Madison. For the engineering degree, I am doing a project based in Peru with Professor Paul Block, and the technical term we use to describe the research is "reducing climate vulnerability for stakeholders." In southern Peru, there are a variety of stakeholders, as there is a lot of mining and farming as well as some big cities, and they all need water. Because of the climate, the water availability changes from year to year – and sometimes, there's not any water. The research we do tries to give them opportunities to prepare for instances where they have no water. We make these predictions a season ahead by using computer models that take in account sea surface temperatures and El Niño indices… So giving this model to these people, we can help them prepare for the impending crisis by soliciting international donors or government aid, which I'm excited for as it has more of the person aspect – numbers are great, but helping people is the goal.

"The numbers are great, but helping people is the goal."
-Eric Mortensen

W/E : And for your other research? There were whispers about a pond.

EM:
Oh yes, the pond. There was a group of about 10 of us last summer, and we got together to go to an impaired pond in Middleton to, essentially, roll around in the mud. My contribution to the group consisted of modeling with HydroCAD to create simulations of what the pond was doing, and with that information, give the city recommendations of what they could do to remediate the pond. Funnily enough, this site was not originally a pond, but a wetland. However, urban development caused increased water concentration in that area. Currently, the pond is used by the city as a storm water management site, but people use it recreationally to fish and kayak.

W/E : What are your plans after your Master's?

EM:
Well, by the end of Spring 2017, I will have achieved my two Master's in Water Resource Management and Water Resource Engineering. Most importantly, I want to go out and work in the "real world" before, and if, I go on to get my PhD.

W/E : You're nearing the end of your school time then, but you have had a very active school career. How have you managed to keep your sanity?

EM:
The key to sanity is to involve yourself in other things. For me, here at Wisconsin, it's been important for me to reach outside of engineering and research management and having friends outside of these fields. Another thing I do is BRIDGE, the international friendship group here, that has helped me reach outside of typical social settings and gives me international friends. That's truly been the key for me to enjoy my time at Wisconsin.

You may catch Eric Mortensen around the UW-Madison campus or in the fluid mechanics lab for a limited time only! Otherwise, we wait patiently to hear more about his accomplishments as he goes out to save the world, one water resource problem at a time.

Written by: Stacy Montgomery
Photography by: Stacy Montgomery
Design by: Marvyn Hsu

EXPLORING SPACE... ON EARTH

Local planetarium draws significant interest from the community.

At the dawn of the Space Age, a beach ball sized satellite named Sputnik was launched into orbit, leaving the United States – and the world – in awe. In response, planetariums were built all over the country as an initiative to interest students in studying science, math, and engineering. In 1966, a company named Spitz built the Madison Metropolitan School District Planetarium. Today, Geoffrey Holt, the planetarium director, runs this multipurpose planetarium which welcomes audiences of all ages.

According to Holt, the audience the planetarium caters to includes toddlers, students, adults, and senior citizens. Notably, most students who come to the planetarium are not there for science or math purposes. These students come for inspiration, and Holt says the students who come "learn in different narrative styles, so we talk about mythology and its connection to stars." Holt also has social studies students come through to further a U.S. History or World History lesson, or to discuss the scientific revolution.

Many of the adults that visit come for the theme-based shows which vary every month, though popular programs are often repeated. "For the past year, most of our shows were nearly or already sold out before the date of the program." One upcoming show is titled "Space Pioneers: Today and Tomorrow," focusing on private companies across the world that are attempting to put the average citizen in space. Holt tries to incorporate current sky events into every program except in December, when he holds annual shows which look at the astronomical connections of several cultures and religions.

Holt seemed most enthused about his January show, "a spectacular finale" that shows the spacecraft Cassini as it leaves its orbit around Saturn and enters the rings of Saturn toward the beginning of January. Cassini travelled to the first ring of Saturn at the beginning of December 2016. According to NASA, between Nov. 30, 2016 and April 22, 2017, the spacecraft will have dipped into and out of the poles of Saturn about 20 times. This mission had offered the opportunity to observe the many small moons that orbit the planet, and it is particularly exciting as Cassini's position will be the closest to Saturn's surface since its first launching. Starting its journey in 2004, Cassini is expected to plunge into the atmosphere on Sep. 15, 2017. This dive will feed scientists data about the chemical composition of Saturn, and at this point Cassini will be only 1500 miles away from the surface. The first few dips were shown in the planetarium and the rest demonstrated by the instructor during the show, creating an interactive connection to current sky events.

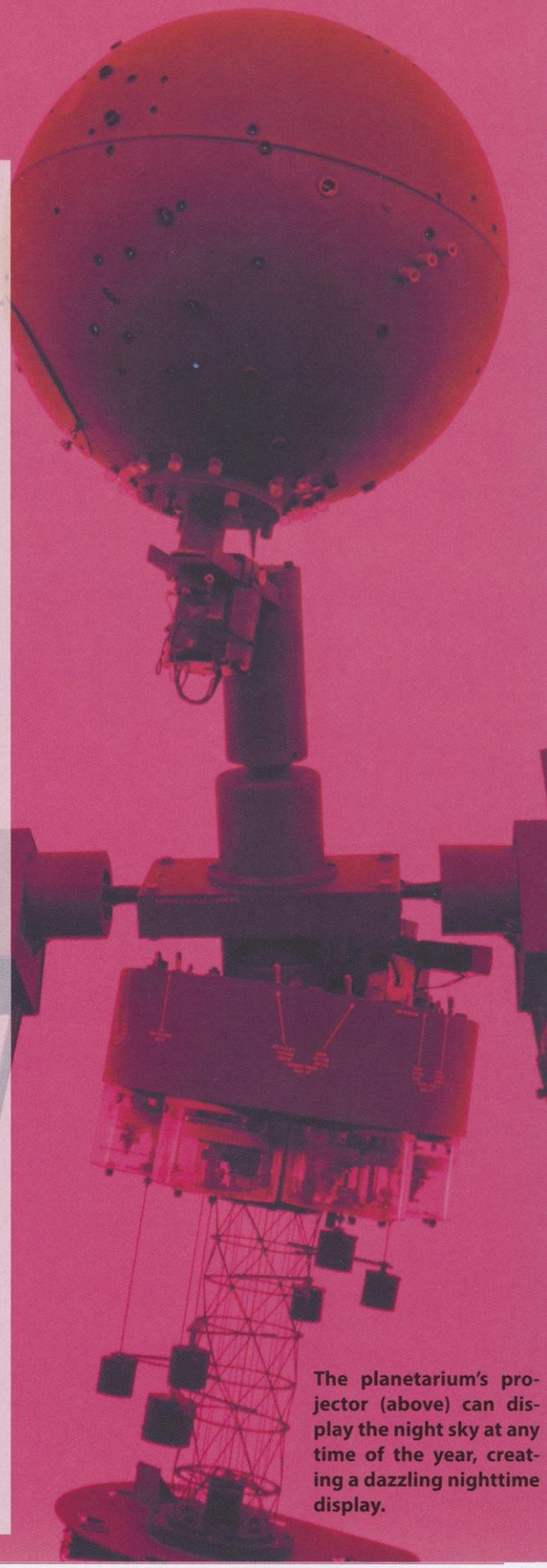
Another exciting event for Holt includes an opportunity to fly on a NASA aircraft, SOFIA. SOFIA is known as the largest airborne observatory in the world for having a 2.5 diameter telescope which stays within Earth's atmosphere to observe several space phenomena. According to NASA, SOFIA is "capable of making observations that are impossible for even the largest and highest ground-based telescopes." SOFIA provides the ability to observe star birth and death, the formation of new solar systems, black holes at the center of galaxies, and much more. Using his experience with SOFIA, Holt plans "as an educator, to bring his knowledge back" to the Madison Metropolitan School District Planetarium as he observes NASA researchers and engineers aboard the aircraft.

Holt hopes to inspire and teach students to explore the wonders of our universe, to find new discoveries, and to keep ahead in the new space race to Mars. With this in mind, Holt keeps the planetarium agenda modern and interdisciplinary. Private companies are joining governments in the modern space race, working together to push the boundaries of what we know. Planetariums such as the Madison Metropolitan School District Planetarium provide the opportunity for people of all ages to observe the work of NASA and other private companies as well as to explore the greater cosmos from here on Earth.

Written by: Nena Nakum

Photography by: Carter Swedal

Design by: James Johnston



The planetarium's projector (above) can display the night sky at any time of the year, creating a dazzling nighttime display.

Connecting the World Connecting One Another

Student organization aims to continue the study abroad experience on campus

Xavier, Derek, Heather (GLOBE founders), and Dylan (exchange student from Melbourne Australia)

Studying abroad is a unique experience for students; they live, study, and travel in another country and gain valuable insight and perspective. But when students return home, their international experience comes to a sudden stop with no transition back to life in Madison. GLOBE is an organization that was started in September 2016 which aims to bring the international experience to campus.

The founders Derek Burling and Xavier Cervantes noticed that one of the most difficult parts of studying abroad is returning home and not having a group of people who understand their journeys with whom to share their experiences. Both students studied abroad and completed the Certificate in International Engineering. "After you study abroad, it just kind of ends," explained Burling. There is no continuation of the experience of connecting with people internationally at the UW-Madison College of Engineering besides a single seminar class after spending an entire semester or year abroad, meeting new people and experiencing new things.

GLOBE aims to help not only students transitioning from study abroad back to life at UW-Madison but also international students who are studying at the university. One aspect of the foreign exchange that is missing on the engineering campus is the lack of a program pairing foreign exchange students with UW students. Realizing that the UW-Madison College of Engineering did not have this type of system in place, Burling and Cervantes set out to provide that opportunity for the international students in the College of Engineering.

With this buddy system in place, international students may connect with other students in their field and experience what it means to be a Badger with a friend who understands what it is like to be adjusting to life in a foreign country. GLOBE organizers host social events such as a football viewing party at the beginning of the semester, where the members can get to know each other.

Another goal of this organization is to connect students professionally around the world. "The idea of the club was to create a coalition between UW-Madison students and international students, specific to engineering," Burling said. To help generate interest in both the organization and studying abroad, GLOBE will be hosting a panel about working abroad. This panel will outline the steps that students can take following a study abroad experience to find internships and full-time positions abroad.

"The idea of the club was to create a coalition between UW-Madison students and international students."
-Derek Burlington

The organization is open to all engineering students, but currently the demographic is mostly engineering students that have completed their study abroad experience. Focusing on providing social gatherings and professional meetings, the club allows the students to build their networks of engineers. "The professional aspect of the organization is important because we're all here to start a career," Burling said.

As the organization continues to grow and expand, both Burling and Cervantes look forward to the events next semester. "Moving forward, there is an exciting future for this organization," Cervantes says. The connections built through this organization will further help both local and international students in the College of Engineering by fostering new friendships, advancing cultural understanding, and inspiring other undergraduates to study abroad.

If you have any questions or are interested in joining GLOBE for the spring 2017 semester, contact the co-presidents Derek Burling (dburling@wisc.edu) or Xavier Cervantes (xcervantes@wisc.edu).

Written by: Emily Morzewski
Photography by: Lilium Haskins
Design by: Julia Mauser

Species Relocation

The warming of the climate poses a severe risk to the survival of many species; can managed relocation provide them with a path to continued existence?

As the climate warms and alters ecosystems across the globe, many species are discovering their habitats are changing drastically and that they must adjust or risk extinction. One proposed solution is managed species relocation, which involves moving a species to a new habitat where conditions are similar to those in the species' original environment. To illustrate the concept, Dr. Jack Williams, director of the Nelson Center for Climatic Research, uses the example of brook trout in northern Wisconsin that need cool water temperatures to survive. Fish are often some of the highest-risk species because unless several bodies of water are connected, they have no way to move to a more beneficial environment once the original habitat becomes unsuitable (in this case, too warm). Managed species relocation would address this issue by identifying new bodies of cooler water to which the trout can be moved, and transporting them to the new location.

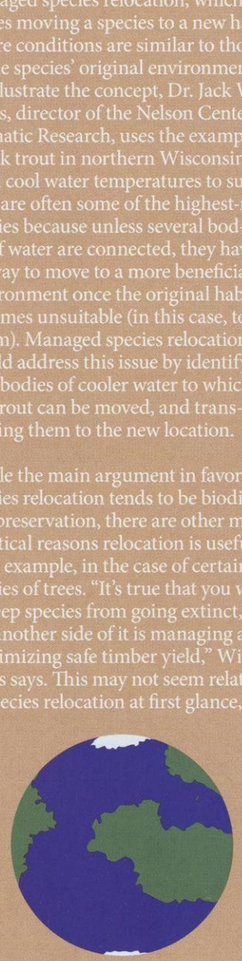
While the main argument in favor of species relocation tends to be biodiversity preservation, there are other more practical reasons relocation is useful – for example, in the case of certain species of trees. "It's true that you want to keep species from going extinct, but another side of it is managing and maximizing safe timber yield," Williams says. This may not seem related to species relocation at first glance, but in order to account for climate change, foresters have to consider when it might be beneficial to get seeds for a certain tree species from a more southerly or lower elevation source. "[Alberta foresters] are already starting to plant for the forests of, say, 50-80 years from now, and so they're already building climate change forecasts into their scenarios," Williams says. The benefit of doing so is that planting seeds of a strain that is better suited to the climate of 30 years from now (i.e. a warmer or wetter climate) could improve the quality and quantity of timber when it is eventually harvested. This kind of interest in the uses and dangers of species relocation can extend to many different applications. Even industries like tourism, where the appeal of unique local plants or animals draws visitors and money to a region, could benefit from such considerations.

It's clear that there is much to gain from utilizing species relocation, but there are many concerns associated with it as well. The risks are well-documented and, unfortunately, grounded in instances from the past when invasive species have been introduced into an ecosystem and wreaked havoc on native plants and animals. One example of how species relocation can go wrong is seen in the problems caused by buckthorn, a plant that many Wisconsin natives know well. Buckthorn was first brought to the United States in the 1800s as a hedging material but was quickly found to be incredibly invasive, crowding out and killing off local plants. The reason it is so successful here is that it leafs out very early in the spring and retains its leaves until late into the fall, suffocating many native plants. This instance of species relocation backfiring illustrates how important it is to consider not only the impact that relocation will have on the species being moved, but also its effect on any local species that may suffer as a result. Cases like that of buckthorn illustrate one of the earliest lessons that ecologists learned about species relocation: moving species from one continent to another is almost never a good idea. "There are different kinds of assisted migration," Williams explains. "My general philosophy is that I'm against intercontinental or continent-to-island assisted migration. That to me is a very bad idea, but I'm generally okay with assisted migration within continents." The paleological justification for Williams' philosophy is that many species naturally move outside of the area their original habitats. Therefore, movement of a species within a small region of the world is not nearly as risky. "Species range shifts are one of the primary mechanisms by which species accommodate climate change, so all we're doing is facilitating a natural mechanism in that sense," Williams says.

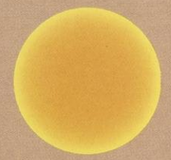
Even disregarding any concern about the impact a move might have on local species, we still must be careful in choosing which species are good candidates for potential relocation. As Williams puts it, "there are some [species] that are doing fine on their own, some that are savable, and there are some that are un-savable – and so you focus on the savable ones. That's where you choose put your resources." Scientists have developed an acronym, DAMP, which summarizes the different ways that a species can deal with the changing characteristics of their native habitats. The first possibility is that the species simply dies out (D) because they are incapable of any other form of response. If it doesn't immediately die out, a species can adapt (A), a strategy typically available to species with short life cycles or those capable of evolving quickly in other ways to match the new challenges of the new environment. A species might also move (M) to a more suitable environment. This is the approach that managed species relocation simulates artificially. Finally, some species can simply persist (P) without changing at all. Typically species that already are suited to living in a wide range of climates might be able to do this successfully. Considering these four possible approaches and a given species' likelihood of falling into one of those categories is a good way of deciding if they are a candidate for managed relocation.

Species relocation as a solution to the threat that climate change presents to biodiversity has both supporters and opponents within the scientific community. While for some people the root causes of climate change are still up for debate, the fact that the earth is warming up is undeniable. The associated changes in ecosystems around the globe will have to be dealt with somehow, and species relocation provides an implementable, concrete solution that has the chance to save many species from extinction. There are demonstrable risks involved that must be seriously considered in each individual case before any actions are taken, but there are also very real concerns about the future of biodiversity and survival of many species on earth that need to be addressed. "People are starting to rewrite the rules and the codes that they use for managing these forests and these systems," Williams says. So while species relocation is a tough issue to get right, hopefully some of these new changes to the rules will make it well worth our efforts to figure it out before it's too late.

Sunrise in the forest next to the Social Sciences Building called Muir Woods.



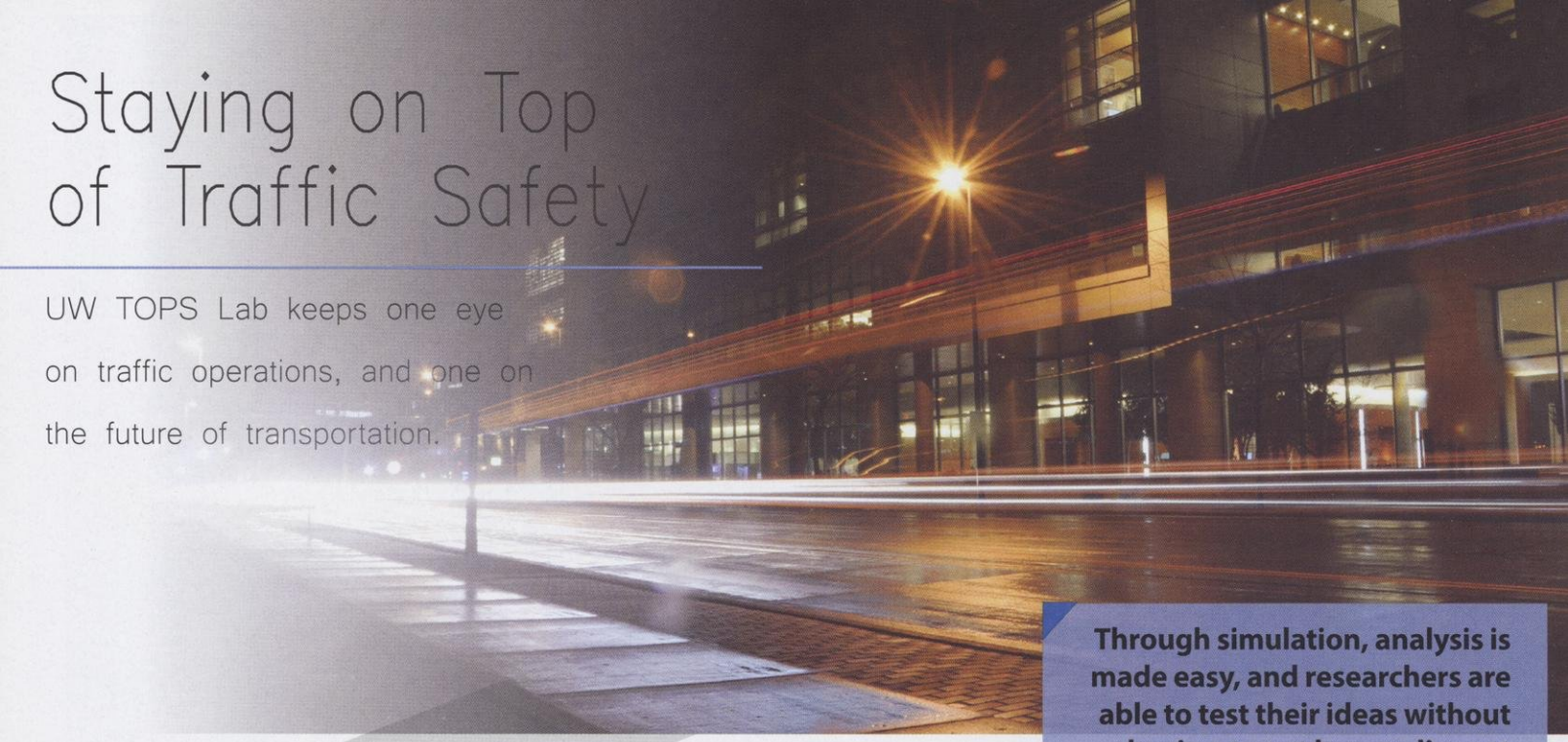
"There are some [species] that are doing fine on their own, some that are savable, and there are some that are un-savable – and so you focus on the savable ones."
– Dr. Jack Williams



Written by: Ben Zastrow
Photography by: Abhi Kumar
Design by: Jonathan Evans

Staying on Top of Traffic Safety

UW TOPS Lab keeps one eye on traffic operations, and one on the future of transportation.

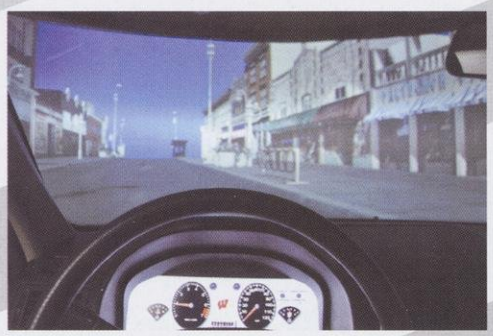


Through simulation, analysis is made easy, and researchers are able to test their ideas without having to put human lives at risk.

The transportation industry is one of the largest and fastest growing in the world. However, this rapid growth does not come without its fair share of downfalls. In 2015 alone, over 35,000 people died from a motor vehicle-related incident. One of the most notable organizations making sure that we commute safely is housed right at UW-Madison; the Wisconsin Traffic Operations and Safety Laboratory, or TOPS Lab, aims to improve everyday traffic concerns, while keeping an eye on the future of transportation.

The TOPS Lab, housed in the Department of Civil and Environment Engineering, was established in 2003. The lab is directed by Dr. David Noyce and started as a small set of research projects with the Wisconsin Department of Transportation. The lab is now comprised of about 50 people at any given time. The lab has evolved to include three sectors: One focused on human factors, one on traffic data, and the last on the transition towards autonomous vehicles.

The first component of the TOPS Lab is the human factors portion that focuses on driver behavior and comprehension. The most notable aspect of this lab is the driving simulator that is housed in the Mechanical Engineering building. Researchers look for new traffic control devices and efficient roadway configurations that facilitate quicker and more intuitive understanding for drivers. Through simulation, analysis is made easy and researchers are able to test their ideas without having to put human lives at risk. But as much as qualitative analysis is important, in a data driven society, quantitative data is often more helpful.



Driving simulation protrayal taken from the TOPS lab.

This leads to the second major component of the lab: the data-driven powerhouse of the TOPS Lab is the Wisconsin Transportal, an enormous database that houses safety and operations data dating from the mid-1990s. The head of IT operations, Dr. Steven Parker, works to analyze and integrate supersized data sets to make sense out of the numbers. For every crash or police report, the Transportal collects the data for the incident. By analyzing this data, it is possible to determine the location of the high density problem sites, which may lead to determining the specific issues associated with driving through that site. The Transportal works with local news stations, like Madison's Channel 3, to supply crash maps. Loop detectors are used to determine traffic flows, and the quantity and speeds of vehicles are collected in real time and stored in the database. The resulting speed flow density analysis on the freeway is used to inform the public of delays as well as road work to reduce congestion.

The last and fastest-growing portion of the lab is working with the development of autonomous vehicles and refining them before these vehicles are safe for operation on our public roads. Autonomous, or driverless, vehicles are at the forefront of media controversy, as many people fear the risks of an automobile controlled by artificial intelligence (AI). Since AI is new to the market, many states don't yet have any legislation on driverless vehicles. TOPS plans on becoming involved in state and national government to help develop autonomous vehicle guidelines to improve the state of transportation. Since other countries have already begun examining these issues, researchers at the TOPS Lab understand that collaboration on an international level will accelerate the process. They are working with overseas partners to study the effects of an autonomous automobile industry.

The TOPS Lab has goals of developing a broader transportation institute on campus as well as grabbing student interest through collaboration with UW clubs and research. The lab is currently working with campus officials to introduce test sites for autonomous vehicles. It may not be long before our campus bus drivers are replaced by robots!

Written by: Chris Hanko
Photography by: Dylan Geulig
Design by: Sydney Seim

Faster Than the Speed of Light:

Challenging One of the Greatest Minds of All Time

Two international astronomers developed a hypothesis that could prove Albert Einstein's theories wrong.

Asking the average person on the street who they believe is the smartest person to exist, many will say Albert Einstein. This German physicist was light years (pun intended) ahead of his time when he published his theory of relativity in 1905. This theory is the basis of many ideas about black holes, time travel, and how the universe was created. One of the primary assumptions that Einstein made was that the speed of light, represented by the letter c, is a constant value in any time and space – a value of around 186,000 miles per second.

However, at the end of 2016, astronomers João Magueijo and Dr. Niayesh Afshordi, derived a numerical hypothesis that the speed of light, c, is not constant, but rather varies with time. This could be a potentially groundbreaking idea because much of physics assumes that the speed of light is constant. Because of this assumption, Einstein postulated that the values of space and time change relative to one another, and the laws of physics are different when objects move at speeds near light speed. Magueijo and Afshordi's hypothesis of changing light speed could mean that space and time behave differently than previously thought. Thus, Einstein's relativity equations may need some tweaking.

João Magueijo, a professor from Imperial College London, and Dr. Niayesh Afshordi, a researcher at the Perimeter Institute in Canada, first hypothesized their theory in the 1990s but only recently developed a mathematical model to test the hypothesis. These astronomers tested their model against data from Cosmic Microwave Background, also known as the sources of radiation that still exist from the Big Bang. Looking at this data, Magueijo and Afshordi compared the microwave variation to their model's predicted radiation values. The slight deviation from predicted and experimental data is called spectral index, and Afshordi and Magueijo's new model had promisingly close values to the observed data.

The astronomers' hypothesis, much like Einstein's theory of relativity, was very radical when first proposed. Their hypothesis opposes the prominent theory for expansion from the Big Bang, inflation, which states that the universe expanded very rapidly at the time of the Big Bang, and then more slowly as time went on. It relies on Einstein's principles and equation of relativity with a constant light speed. Contrastingly, the astronomers supporting the theory of inconstant light speed state that at the start of the Big Bang, the universe was very dense because all the matter was compacted into a small volume. After the Big Bang, it's hypothesized that the universe continues expanding while the total mass remains constant, so that the density of the universe is still changing. Yet, assuming the speed of light is constant, there could not have been enough time for light to travel to all parts of the universe. The inconstant light speed hypothesis would account for the missing gap in time for light to travel to all parts of the universe because this theory states that light travelled faster during the Big Bang.

A random person on the street most likely would not be able to prove these theories correct, much less fully understand what they mean. Fortunately, physicists like Albert Einstein can conduct the rigorous math so that we can benefit from the science without spending the time and money required to get a PhD in physics. Overall, Magueijo's and Afshordi's hypothesis will be groundbreaking if proven correct. Einstein's relativity has withstood the test of time since first proved, but now there could be a different outlook on time and space as we know it.

Written by: Jordan Wolff
Photography by: Lianne Komen
Design by: Patricia Stan

Sources:

Imperial College London. "Theory that challenges Einstein's physics could soon be put to the test." ScienceDaily. 25 Nov. 2016. Web. 27 Nov. 2016. https://www.sciencedaily.com/releases/2016/11/161125084229.htm

Afshordi, Niayesh and Magueijom Joao. "Critical geometry of a thermal big bang." Physical Review D. (2016). http://journals.aps.org/prd/pdf/10.1103/PhysRevD.94.101301

Predicting Cardiovascular Flow:

How Computer Simulations Can Save Your Life

UW-Madison's Cardiovascular Fluid Dynamics Laboratory use computational fluid dynamics to analyze and predict fluid flow in patients.

Imagine a child having a potentially life-altering heart surgery in which there is very little room for error. If a surgeon makes a cut in the wrong place or clamps a blood vessel in the wrong orientation, the child's life could be put in severe danger. What if there were a way for surgeons to predict what will happen to their patient's blood flows during a procedure or during their recovery? UW-Madison's Cardiovascular Fluid Dynamics Laboratory (CFDL) directs its research towards this problem by modeling the optimal way for fluid to flow through a body during surgery. Through their work, computer simulations are becoming an invaluable tool to use before surgery to know if a procedure will work without dire consequences.

3D printed cardiovascular model.

UW-Madison professor and CFDL director Alejandro Roldán-Alzate leads the way for the research in this laboratory. Roldán-Alzate, a native to Colombia with a background in biomedical engineering, came to UW-Madison at the age of 22 to study mechanical engineering. His mother was a surgeon in Colombia, leading him to choose a career path in health research. He uses both of his engineering backgrounds in his research to encompass all the intricacies of the human body and to apply mechanical concepts to it. "We want to try to apply fluid dynamic concepts that have been applied to engines and planes...to the cardiovascular system, and try to understand it better from the physics point of view," Roldán-Alzate says. The goal of his laboratory is to find noninvasive ways to assess the cardiovascular flow in the human body. Roldán-Alzate and associates do this by applying computational fluid dynamics (CFD) techniques to predict how changes in the body affect blood circulation.

Professor Rolda-Alzate

> **"Everything we do is looking for a better quality of life for both patients and the doctor."**
> **- Alejandro Roldán-Alzate**

To accurately predict how each of the external or internal forces play a role in the function of the human body, the lab needs to go through a comprehensive procedure. Doctors bring MRI and CT scan images to Roldán-Alzate, and then he evaluates them, giving surgeons an idea of the best route to take for the procedure. Roldán-Alzate and associates then try to reproduce what they see with computer simulations using software like Solidworks and ANSYS or 3D-printed parts. These programs can track the fluid flow through veins and arteries and can help visualize any possible abnormalities in the flow. Looking at these abnormalities, Roldán-Alzate tries to optimize the process so the blood flows regularly throughout the section in which they look. Patients not only will benefit during the surgery if the surgery is optimized, but their recovery time will also be much shorter. "Everything we do is looking for a better quality of life for both the patients and the doctor," Roldán-Alzate says. Doctors can benefit from these techniques because they could perform one surgery on a patient that would otherwise require many.

In these computer simulations, researchers make virtual cuts in the locations where they would occur in the actual surgery, and then look at how the fluid flow is affected. An example of this is with a patient with cirrhosis of the liver or liver

cancer that needs a liver transplant. "15,000 people in the United States are waiting for a liver. 5,000 die. 5,000 get transplanted. The list is always as big," Roldán-Alzate stresses. To combat this problem, some Asian countries conduct live liver transplants where part of a donor's healthy liver is transplanted into a patient's unhealthy liver, and the liver regenerates for both parties involved. This surgery is dangerous for both patients and donors, but the CFDL is trying to make it safer so it can be used more widely in the United States. Roldán-Alzate and his laboratory perform computer simulations for these risky surgeries to locate the optimal place to make a cut that still allows fluid flow to all parts of the liver. They use this information to predict how much and which part of the organ to cut in order to optimize the flow to and from the patients' livers to ensure a normal recovery for both the patient and donor.

Even though these computer simulations and 3D models are accurate, there is still further improvement needed for surgeons to implement these techniques as a benchmark. "The most challenging part of this research," Roldán-Alzate says, "is implementing it as the gold standard because surgeons face different situations every time." Many surgeons often trust their gut instinct during vital parts of a surgery, and they conduct the surgery based on what they see unfolding as the procedure goes on. Processes that occur inside the body are much more complex than those that occur inside of an engine. Mechanical parts in an engine could be replaced easily without having too much of an effect on the rest of the machine, but every part of a biological system continuously affects each individual other part. "That's the whole point of research—trying to understand how each of the little details will improve our understanding and our techniques to go further," Roldán-Alzate says. Learning how cutting one organ will affect fluid flow and other organs' health is something that will require much more research.

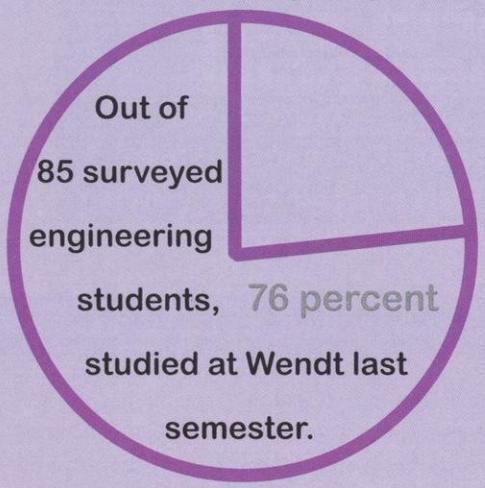
The biggest impact that this research has on the community is that researchers are coming come up with ideas and techniques that can solve a lot of problems all at once. The casual observer with no scientific or medical background may not know how much work goes into a "simple" surgical procedure or how much research needs to be conducted for these procedures to be feasible in a hospital. At some point in everyone's life, we will know someone with a cardiovascular disease or other medical problem that requires surgery, and research performed in the CFDL and other laboratories worldwide is what makes it possible for these surgeries to be successful. When these techniques are employed as the "gold standard," patients and their families can be assured that major surgeries will be successful.

Written by: Jordan Wolff
Photography by: Therese Besser
Design by: Suzanne Kukec

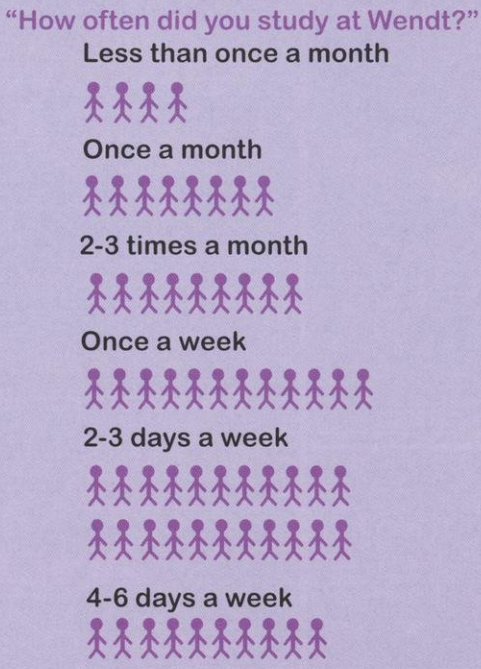
Student Viewpoints:

The Wendt Commons Renovation Project

At the end of the fall 2016 semester, the College of Engineering (CoE) shut down the second, third, and fourth floor of Wendt Commons for the commencement of a renovation project that will give the building a complete face-lift. The College announced that the renovation would convert the second floor into a "makerspace," a "high-tech DIY laboratory" where students and faculty can "invent, 3D print, create, collaborate, and fabricate." The third floor will be transformed into "modern interactive engineering classrooms." To evaluate the student body's attitude to these major changes, the Wisconsin Engineer Magazine conducted a survey of 85 engineering students.



While the project has many students excited to use the new technology that will be available in Wendt, it's also left many scrambling to find a new place to study. Previously, the second and third floors of Wendt housed quiet study space, while the fourth floor was home to tutoring services provided by the Undergraduate Learning Center (ULC) and Wisconsin Collaboratory for Enhanced Learning (WisCEL) classes. Now, students must search for open tables in the much more limited study areas available in other engineering campus buildings such as Engineering Hall, Mechanical Engineering, and the Engineering Centers Building (ECB). Meanwhile, ULC tutoring and WisCEL classes have been temporarily relocated to the less-than-ideal Tong Auditorium in ECB. One student commented that "the ECB new tutoring space is less open for large groups," and another mentioned that "Having to take WisCEL classes in Tong Auditorium is inconvenient because the class is split up into other rooms of ECB due to lack of space in Tong."



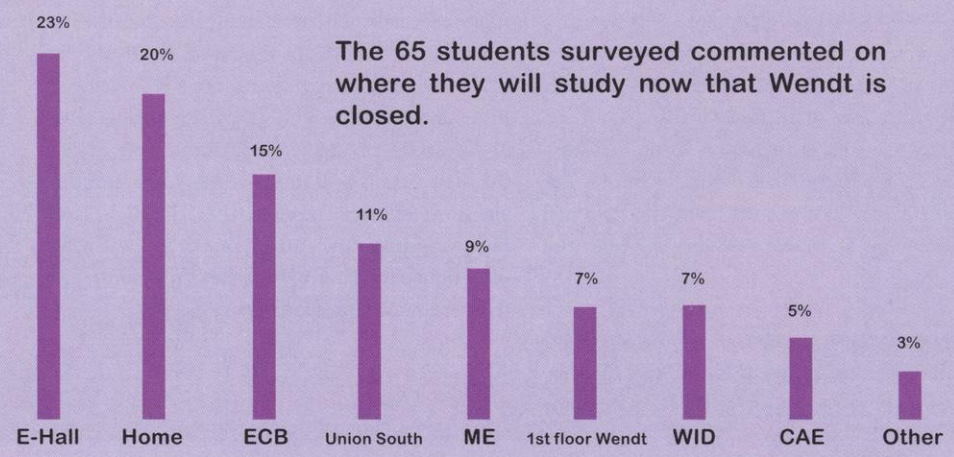
Though CoE Dean Ian Robertson has promised that the inconvenience caused by the renovation project is only temporary, some students are concerned that may not be the case. "I hope they keep some quiet study places and don't turn everything into collaborative workspaces…since I strongly prefer to study in a quiet setting," commented one student. However, the floorplans released last year at the end of October confirm the student's fears: the vast majority of the second and third floor study tables will be removed, with only a sprinkling remaining. Fortunately though, the first floor silent study space will remain open throughout the renovation project and will be left unchanged.

Other students are concerned about the lack of communication from the CoE regarding the details of the renovation project. Other than two e-mails from Dean Robertson (one sent last October and one sent at the beginning of this semester) announcing the closing of the library and a single very general article on the CoE website, students haven't heard any details about when the new spaces will open and who will get to use them. "More information to students about WHAT will happen/be available might make students less mad that it's closed," one student pointed out. "I'm concerned that the renovations are being done without sufficient student input," mentioned another.

Despite the inconveniences and the doubts, Badger engineers are remaining positive. 63% of students responded that they are looking forward to using the new high-tech spaces. Creativity and innovation require resources, and students are hopeful that the new spaces in Wendt will make these resources much more accessible to all. In the meantime, we'll hunker down in our new study spots and wait to see what the future brings.

Written by: Alyssa Hantzsch

Design by: Suzanne Kukec



THE IRONIC ENGINEER:

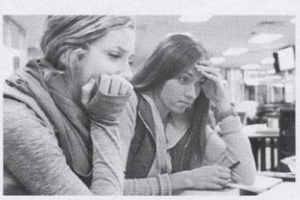
Minor Confusion Leads to Total Rebranding Campaign?!?!?

The campus is swept with a completely rational desire to rename everything.

If you have ever spent countless hours perusing the UW Course Guide to plan your next semester only to be struck by the uncomfortable, burning sensation that something just isn't right, then you are not alone. Thousands of Badgers have reported feelings of distress and melancholy prior to their enrollment deadlines, and local psychologists David Blaine and Criss Angel believe they have connected the dots.

The smoking gun in this epidemic is the fact that the Course Guide has been acting as a Trojan horse luring students into its dishonest depths under the false pretense that it may actually guide them. After conducting several rounds of psychoanalysis, Rorschach ink blot tests, and immersion therapy on about fourteen students in a double-blind study, Blaine admits "the data speaks for itself. We may have a real problem here. It's just not a guide. It's a catalog, for sure. Let's call it a catalog." Dean of Naming, Calling, and Dubbing, Tsudo Nim, takes this type of situation very seriously, and thanks to him we can now happily plan classes using the Course Catalog.

This is not the only example of heroic name changes for the betterment of the campus community. Recently, the Polygon Engineering Student Council was rebranded as the Wisconsin Engineering Student Council. This was a breath of fresh air for computer engineering student Pete Nurdsby, who still plays Pokémon Go, as he was the lone voice of reason among ignorant troglodytes. "This is America," Nurdsby says. "More importantly, this is Wisconsin. Not Polygon. I don't even know where that is. Why is our student council named after it?" Nurdsby took his complaint up with Dean Nim, and the issue was promptly addressed.



> **"Names are meant to be clear and concise, not sources of confusion and stress."**
> **– Tsudo Nim**

Nim was later honored for his positive impact on the student experience. "I take pride in my work. Names are meant to be clear and concise, not sources of confusion and stress. I consider myself a champion of change," Nim says. This was demonstrated when SOAR, the program that introduces incoming freshmen to campus and registering for classes, was renamed FLY. The name is much shorter, easier to say, and means pretty much the same thing. "I think it was a good move. It's not like SOAR was an acronym, it's just capitalized because it's a big deal. Right?" says Bobby Jackson, a confident first year student of undecided major.

Continuing his victory streak, Nim went on to change the name of Engineering Hall to the Big Building of Building, to the pleasant surprise of a few engineering students. After realizing that the SERF did not include a wave pool to practice surfing, Nim changed its name to SERFSUP in an attempt to convince whoever was in charge (he wasn't quite sure) to have his dream of indoor surfing become a reality. Despite failing to do so, the name stuck.

Dean Nim was hardly dissuaded by the SERFSUP fiasco; he immediately went on to more projects meant to clarify locations. The Lakeshore area was dubbed the Lake Proximity Zone while the Southeast campus was titled Not North and Also Where the Sun Rises. Badger families have already had a much easier time finding their loved ones who live in the dorms. In an anonymous campus poll that only takes fifteen minutes of your time and puts you in a drawing to win a real iPad, two out of the nine respondents said they "slightly agree" with the changes. According to Nim, these results "could not be more reassuring."

However, more and more students have begun seeking counseling from University Health Services due to increased anxiety and psychosocial stress. One student reported that he missed a final exam because he didn't know where the Scary Bomb Shelter Building for Humans was. "I don't even know where I am anymore. This has gone way too far. And this Nim guy thinks his names are great, but they're definitely awful," says fifth-year philosophy student Christopher Bratt. Dean Nim, after trying to change the name of the city of Madison to Madtown, has stepped down in lieu of protests. Some changes are simply too much to handle all at once.

Written by: Edwin Neumann
Photography by: Lauren Kuzminski
Design by: Elliot Kimmel

Top: Two engineering students become increasingly frustrated as they try to navigate the Course Guide. Bottom left: One of the last photos on Engineering Hall before it was changed to the Big Building of Building. Bottom right: The Southeast Recreasional Facility or SERF awaiting the nameplate change to SERFSUP

THIS COULD BE YOUR ADVERTISEMENT

Businesses • Apartments • Organizations

Advertising in the Wisconsin Engineer is a great investment, whether you are interested in easily reaching more than 6000 engineering students or simply supporting a worthy organization. The Wisconsin Engineer provides the most direct means of communication with the engineering community at the University of Wisconsin-Madison.

For more information on advertising, including current rates and deadlines, as well as our online ad offerings, please contact us at

wiscengrmagazine@gmail.com

or visit www.wisconsinengineer.com!


YOU SEE A STRONGER SOLUTION.
WE SEE A STRONGER LEADER.
U.S.ARMY
U.S.ARMY
If you excel in science, technology, engineering or math, you may have the critical-thinking skills needed to be an officer in the U.S. Army. Here, you'll lead from day one, and inspire strength in the Soldiers around you. There's strong. Then there's Army Strong. Learn more at goarmy.com/officer
For more information, contact Sergeant Houston at 608-203-2280 or stop in the office at 6610 Odana Road, Madison.

Wisconsin Engineer Magazine
Room M1066
Engineering Centers Building
1550 Engineering Drive
Madison, WI 53706

Presort Standard
U.S. Postage
PAID
Madison, WI
Permit No. 658

Join the wisconsin engineer on

LinkedIn

Keep up with the magazine ▪ Stay in touch with the staff
See the new issues first as they come out

CHECK US OUT ONLINE!

Find us on Social Media!
Search For: "The Wisconsin Engineer"