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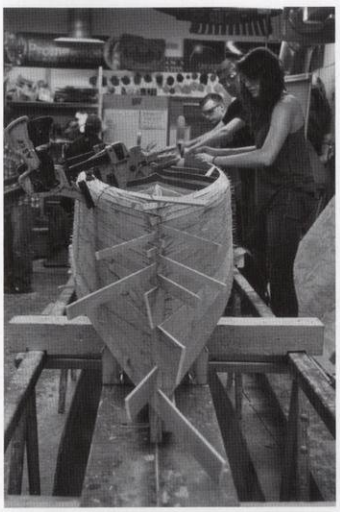
General



A wooden test canoe is made and used as a mold for the final concrete canoe.

Cover photo by Ciara Lotzer.

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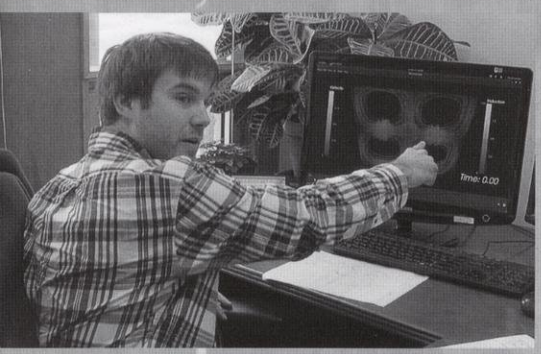
Professor Profile:

David Sondak

A man passionate about math, the students learning it, and the world affected by it.

Every college student has experienced the mediocre lecturer, but what about the outstanding – the abnormally instructive, supportive, valuable? As a student slouched in a lecture, one is only truly exposed to one dimension of the person writing on the chalkboard – the lecturer. However, for students in Dr. David Sondak's math classes, lecture is enough to become ensnared in his contagious passion for math and its relationship with the world. Even while immersed in two research projects, he remains dedicated to sharing his love of math with students and helping them succeed beyond the classroom. From his time in the classroom to his life outside UW-Madison, Professor Sondak realizes the important relationship between balance and learning.

Before coming to work at UW-Madison, Sondak attained his bachelor's in Mechanical Engineering from Lehigh University, a master's of science in Applied Mathematics from Rensselaer Polytechnic Institute, and a doctorate in Aerospace Engineering, also from Rensselaer Polytechnic Institute. He always loved math and physics, but his particular interest was turbulence. As a postdoctoral researcher at UW-Madison, he deals specifically with turbulence and its building blocks. He develops turbulence models to better understand magnetohydrodynamics, the study of electrically conducting fluids, such as those found at the center of the earth or in fusion devices. Along with the development of turbulence models, Professor Sondak is also studying thermal convection in systems where fluid motion is generated by changes in density (buoyancy-driven flows). Researching this creates a better understanding of the atmosphere and its circulation. His passion for his research flows into the classroom, where he has used his research to demonstrate the application of certain mathematical theories and equations.



Explaining turbulence modeling — one aspect of Dr. Sondak's research.

Professor Sondak is invested in more than turbulence modeling research at UW-Madison. He is truly invested in every student he teaches, not for their ability to do well on an exam, but for their deeper understanding of the material and the ways in which it applies to their everyday lives. In fact, for Professor Sondak, one of the most challenging aspects of teaching is putting in a lot of effort and still seeing a lack of enthusiasm in students. However, he truly values the students who are invested. "It only takes two or three to make it worth it," he states. It is professors with this mindset who change students' minds and lives at a university.

Along with his balance of research and teaching, Professor Sondak also provides variety in the classroom. He explains, "You need to have a balance between theory and examples." He uses real examples from his research in the classroom and explains new topics through a variety of mediums of both the chalkboard and the computer. Through his own experiences, he has realized the power this balance has on the understanding of and passion for a particular topic. He does not want his students merely learning to plug numbers into equations and get correct answers. "Robots can do that. I don't want to make robots, robots can't be passionate," says Sondak. Professor Sondak strives to instill a deeper level of understanding, even for students in beginning courses, such as Calculus II. The students who learn a deeper comprehension of the fundamental mathematical concepts are the ones who are not only better prepared for more challenging theories, but also more likely to look for math in their daily lives, such as the way heat is dispersed through their hot tea. "I don't expect my students to become mathematicians," states Professor Sondak. Instead, he wants students to be open to the appreciation of this most applicable field. His goal is to help them find mathematics interesting enough that they want to share it with those close to them. True passion cannot keep quiet.

Along with his balanced teaching style in the classroom, Sondak does not ignore the importance of balancing life outside its walls. In addition to working at UW-Madison, Professor Sondak has found time to explore the world around him. The summer after receiving his bachelor's degree, he and a friend went on a month-long backpacking trip through the United States. This escape from the intensity of college remains one of his fondest memories. He strongly encourages students to, if at all possible, take advantage of their summers before having a full-time job, for the opportunity may never arise again. It is important not only to research and study the world around you but also to get out and enjoy it too.

UW-Madison has an outstanding professor in Dr. David Sondak. His passion for his research, investment in his students and experiences from his own life combine for a powerful teaching style. His love of learning is contagious. By challenging students to apply math to the world around them, not just to the paper in the classroom, Professor Sondak helps to lead dedicated students to a better understanding and appreciation for the fascinating field of mathematics. WP

Written by: Jessica Thomas

Photography by: Sakura Kawano

Design by: Ryan Krull

Interstellar: More Science

A look at the fundamental science behind the film, Interstellar.

If one were to ask a random passerby what they knew about the mathematical basis of wormholes or implications of Einstein's theory of relativity, the chances are that the response will involve some befuddled mumbling or a blank stare. For the most part, we leave complexities like this up to astronomers and physicists. The one exception to this is science fiction, where the public is introduced to many high-level ideas. Often, it is difficult for the average viewer to distinguish the line between actual science and the cinematic fiction.

With current technological advances, scientific capabilities are rapidly expanding. "It's an incredibly exciting time for science" says Professor Richard Townsend.

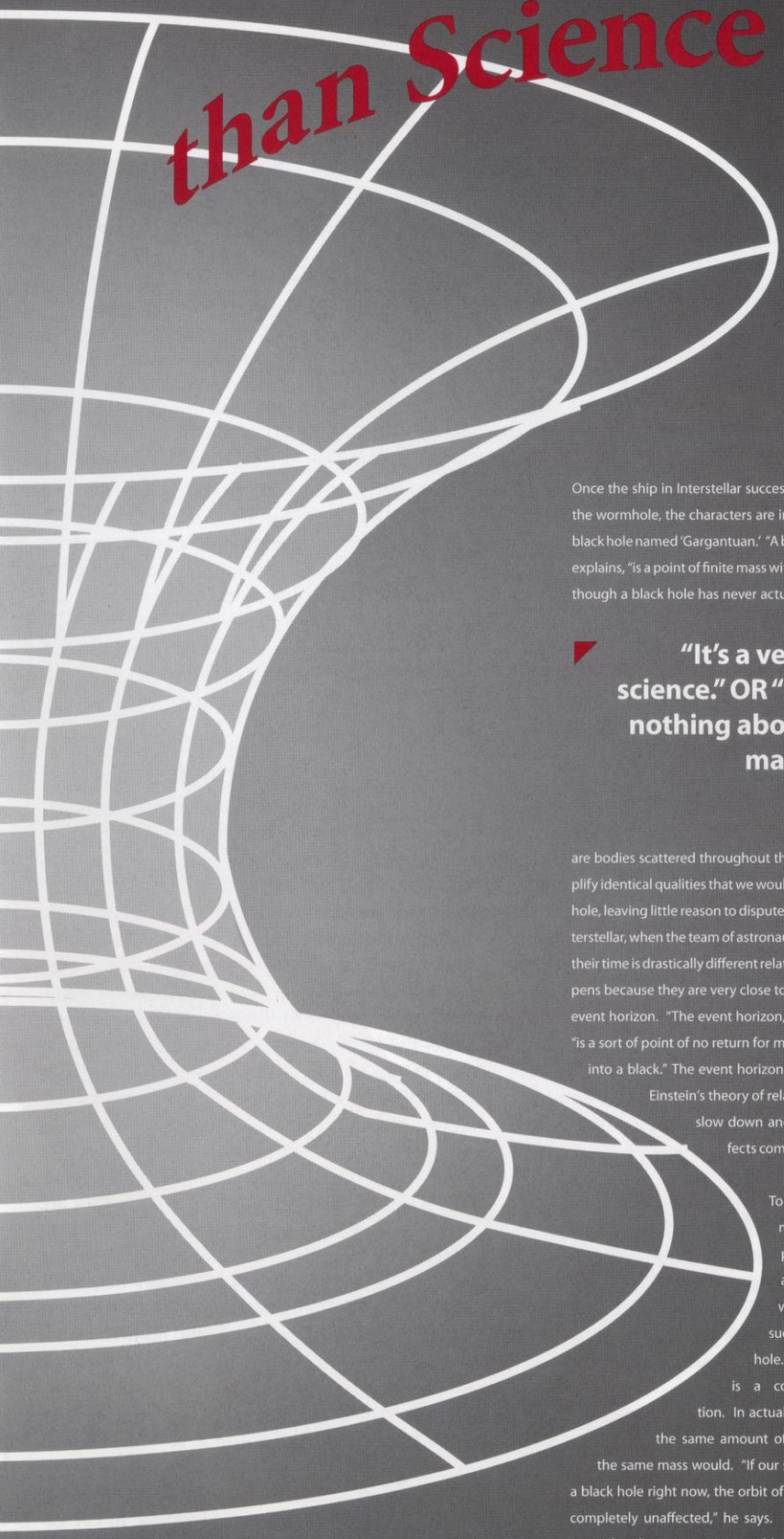
Christopher Nolan's most recent science fiction film, Interstellar, brings the viewer into a dying Earth where astronauts travel galaxies away to investigate other planetary possibilities of a new home for the human race. Time and gravity become variable, and operate in the 4th and 5th dimensions. Matthew McConaughey's character falls straight into the middle of a black hole and miraculously lives to tell the tale. By the end of the nearly three-hour movie, a non-physicist like myself will probably have a headache from trying to grasp the concepts.

In an effort to better understand the space science and investigate the feasibility of the events of Interstellar, I sat down with Richard Townsend, Assistant Professor in Astronomy at UW-Madison.

The first out-of-the-ordinary happening in the movie occurs when the astronauts travel through a wormhole to get to another galaxy. "Of course it's a wormhole!" Townsend chuckles, "[Wormholes] are common Sci-Fi plot devices used as a quick way to get people from earth to do fun stuff on other planets." But they also can be modeled by a real, physical framework. To explain the complicated physics of wormholes in layman's terms, Townsend uses an analogy of an ant walking on a balloon. "To the ant, only two dimensions exist: north/south and east/west," Townsend says. "It is not aware of the curvature of the balloon. Now, say someone pinches two sides of the balloon together, forming a tunnel through the center. The ant may walk along the tunnel, taking a shortcut to the other side of the balloon. It is moving in a third dimension unknowingly because its feet are always on the rubber of the balloon."

At this time, we only have the mathematical basis for wormholes. Townsend says, "We know virtually nothing about how one would make or control one," Townsend says. It is likely that, even if created, a wormhole would collapse and wouldn't be large enough to travel through. To skirt around this and several other major scientific caveats the creators of Interstellar leave the construction of the wormhole up to the humans of the future, who apparently have mastered the bending of space-time and other obstacles.

than Science Fiction



Once the ship in Interstellar successfully passes through the wormhole, the characters are in close proximity to a black hole named 'Gargantuan.' "A black hole," Townsend explains, "is a point of finite mass with infinite density." Although a black hole has never actually been seen, there are bodies scattered throughout the cosmos that exemplify identical qualities that we would expect from a black hole, leaving little reason to dispute their existence. In Interstellar, when the team of astronauts nears Gargantuan, their time is drastically different relative to earth. This happens because they are very close to something called an event horizon. "The event horizon," Townsend explains, "is a sort of point of no return for material getting drawn into a black." The event horizon is where, because of Einstein's theory of relativity, time begins to slow down and other abnormal effects come into play.

"It's a very exciting time in science." OR "We know virtually nothing about how one would make or control one."

To a non-physicist, it may have been surprising that the ship and nearby planet were not simply sucked into the black hole. Townsend says this is a common misconception. In actuality, black holes exert the same amount of gravity as a star of the same mass would. "If our sun were to turn into a black hole right now, the orbit of the planet would be completely unaffected," he says. So, it actually makes sense that the astronauts were able to fly around Gargantuan. However, when McConaughey's character actually crosses the event horizon towards the end of the movie, entering the black hole, he is in completely uncharted territory. We have no idea what is beyond the event horizon; properties of the singularity, or point of infinite density, are unknown. But, as Townsend puts it, if you enter a black hole "as far as we understand, [the gravity] should be squishing you to a tiny point. Things really aren't going that well for you." Again, in the movie, the future humans came in to save the day on this one.

The entire basis of the movie was to find a new planet to inhabit, tackling the aforementioned wormholes and black holes along the way. But in reality, Townsend notes excitedly, we might not have to go that far to find an inhabitable planet. "In the last few years, thanks to NASA's Kepler satellite, we've found planets whose mass is similar to our own Earth orbiting other stars. Some are only tens of light-years away. There are even ways … to analyze a spectrum of light off of a planet and tell what kind of biochemical processes are happening on it. It is an incredibly exciting time for science."

Overall, the space science behind Interstellar is sound. This can be accredited to the fact that Kip Thorne, an expert on Einstein's theory of relativity, worked closely on the film. Sure, there are some things that are completely impossible given our current technology and understanding. Nevertheless, in the (very) far future, nothing in the movie was beyond feasibility. But for now, we will have to settle for our own three-dimensional world.

Written by: Mikaela O'Keefe

Photography by: Matt Henricks

Design by: Maxwell Jin

Hydrogen Cars, Today

Hydrogen cars are on the market today. Are these too good to be true, or are they here to stay?

The hydrogen, fuel cell powered vehicle has been whispered about like an urban legend for over a decade now. With the unveiling of Toyota's hydrogen-powered Mirai, the legend comes alive, as these cars of the future are on today's market. Other international car companies like Hyundai, Chevrolet and Mercedes-Benz are demonstrating that they too can create a marketable hydrogen-fuelled car ready to hit the road. This is a car whose emissions are simply water vapor: so what is preventing this hydrogen fuel cell takeover?

The hydrogen fuel cell is undoubtedly an amazing piece of technology. By harnessing the naturally high potential energy of hydrogen and mixing it with oxygen, the energy of the chemical reaction is converted into electric energy and used to power an electric engine, leaving only water behind. The hydrogen is used in a liquid or compressed gas form, and the oxygen is used as a solid oxide or compressed gas. The gaseous forms of the two chemicals are more prevalent in fuel cells for fuel cell electric vehicles (FCEV) since they are more efficient. Cars are compared by their efficiencies, with efficiency as the ability for the vehicle to get all of the energy from the fuel source, with energy escaping as heat or forces like wind working against the car movement hindering its efficiency. So in comparing efficiencies of an internal combustion engine with a hydrogen fuel cell, with 40-70% efficiency in the fuel cell, the internal combustion (IC) engine efficiency is put to shame at an average 18-20% efficiency.

However, calling the hydrogen fuel cell engine a "zero-emission" solution would be inaccurate. Hydrogen, the most abundant element in the universe, is never found in its natural form. Today, 95% of hydrogen gas is made from methane, a natural gas. When integrating this fact into a wells-to-wheels analysis of the FCEVs, it's found that FCEV engines operate at 25% efficiency, since the efficiency of the factory's production of making the hydrogen is included. At 25% efficiency, the FCEV engine is not significantly better than IC engines. Proponents of FCEV claim that the methane-based production of hydrogen is only a transitional phase. There are other sustainable ways to make hydrogen gas, such as a wind-to-hydrogen electrolysis of water, which uses wind turbine electricity to decompose water into hydrogen gas and oxygen gas. Research is still being done to make this method a scalable and efficient option to provide enough hydrogen for a hydrogen economy.

Professor David E. Foster, a UW—Madison thermodynamics professor, proposes another option. "Solar energy is ultimately what we will have to turn to, since all energy on Earth comes from sun light… With today's technology, you can take a square 100 kilometers per side in the Mojave Desert and put parabolic sunlight collectors that follow the sun and focus onto a sterling engine, generating more than enough electricity that the United States would use in a day." Using this method of electricity collection, Professor Foster explains how you can then use this electricity to create hydrogen, or use the hydrogen to create a syngas with CO_2 from the atmosphere and the ample energy from the sun to create a renewable hydrocarbon. "In combing all these technologies, it's like taking a step backwards. But the technology exists today, and it shows there are ample options in renewable energy sources, not necessarily hydrogen based."

In addition to relying on methane as the non-renewable source for hydrogen gas, the FCEV vehicle requires a variety of rare metals. In the engine, a platinum catalyst is used to combine the hydrogen and oxygen, and the electric engine operates on batteries that use rare elements. Professor Foster explains, "The hydrogen fuel cell depends on a relatively high precious metal loading, so serious question: is there sufficient precious metals in the world to develop a scalable amount of cars for the world?" According to Foster, the answer is no. Evidence shows that not only are there not enough precious metals for the United States, but also, for the entire world and future markets.

Furthermore, in implementing the hydrogen vehicles to the modern market, one must address the infrastructure and societal paradigm changes that must occur in order to accept these cars into daily life. Firstly, more hydrogen production plants must be built. For these to be better than the current petroleum gas plants, the plants must find a more efficient and renewable method for harnessing hydrogen. Next, hydrogen fueling stations need to be built, and people would have to get used to fueling their cars for 3-5 minutes. People would also have to start planning trips around where hydrogen fueling stations are located. Although the FCEVs have about a 300-mile range, the scarcity of the fueling stations would limit the distance one could drive. Similar to electric vehicles, these hydrogen cars are better as small city vehicles than as vacation vehicles, which are more capable of pulling a boat up a mountain and traveling greater distances. "There are fueling stations, but not in rural areas, so the practicality comes into play. These are decisions people need to make: do you own two cars?… Do you take the bus?… To operate in the most efficient way, you would have a 10 car garage with a car specifically designed for its own function to use at that moment, but once again, practicality comes into play."

Because of these implementation difficulties, the future seems bleak for hydrogen-fueled vehicles. Many high-profile opponents of FCEVs such as Elon Musk (CEO of Tesla) have completely written them off due to the infrastructure challenges. However, the proponents of FCEVs believe that all of these obstacles can be overcome with time and persistence. In 2003, President George W. Bush started the hydrogen car craze and spurred a lot of research when he pushed for a hydrogen economy to wean our country off oil dependence. After President Bush, the Obama administration continued to show support for hydrogen vehicles by partnering with the private sector to speed up development. This resulted in enormous success since the cars are available today for a moderate price. With the support of the government, hydrogen powered vehicles show promise as newer technology is quickly developed to overcome the infrastructure obstacles. Furthermore, executives of car companies have been showing support for the technology with billions of dollars in research and by introducing the car to the economy before the infrastructure is completed. The logic of the executives seems to call for the consumer to choose to drive a hydrogen vehicle, and then to use this demand to speed up development of infrastructure to support the vehicles.

With implementation of the hydrogen fuel cells, traditional engines could be a thing in the past.

It's no secret that oil is going to run out soon, and that the environment has been neglected too long. Hydrogen cars are a great option for transportation that relies on renewable energy, but there are still many obstacles in implementation. As research continues to tackle these vehicles and the infrastructure problems, these futuristic cars can become more attainable and practical for today's driver. WE

Written by: Jaal Gandhi

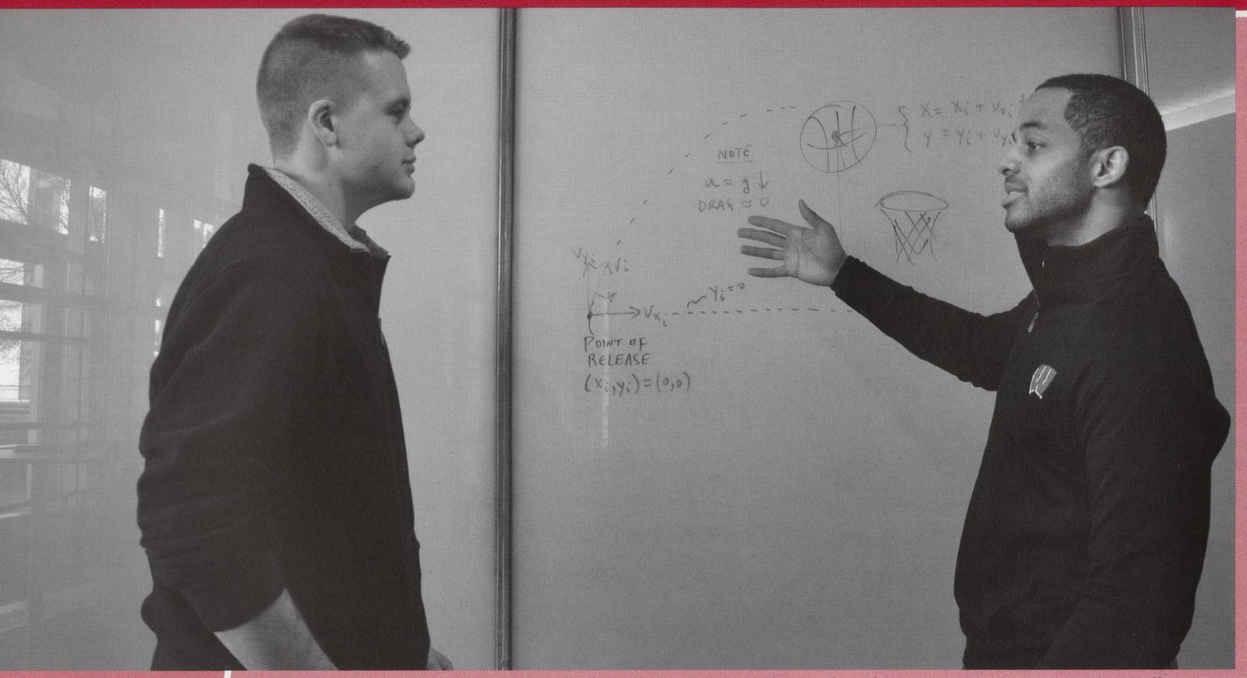
Photography by: Margo Labik

Design by: Ryan Krull

"In the world today, there are 1 billion cars, and by 2020, there will be 2 billion."

The Not So Free Throw

The subtle science behind a successful free throw.



Professor Towles illustrates the fundamentals physics governing the free throw shot to author and student, Nate Friar in Engineering Hall.

When asked to think about a sport, most people might bring to mind an image of their favorite team's jersey, thoughts of roaring crowds and bitter rivalries, the feeling of ecstasy from a big win, or the anguish of a tough loss. It is not often that athletics are thought of in a purely technical aspect, namely, the science behind them. Physics, environmental science, human biology and biomechanics are all facets of the complicated scientific principles that shape and affect how sports are played.

Playing the sport of basketball requires a variety of skills ranging across the athletic spectrum. One of the most important skills, however, is shooting – specifically, a free throw. No sure thing, a free throw is a high pressure shot from fifteen feet away that can often decide the outcome of a game. This aspect of basketball is simultaneously one of the most mechanical and calculative aspects of the game, while also being a skill that requires a certain sense of automation. Shooting a successful free throw requires taking into account many factors, variables and possibilities. Clearly, it is not a simple endeavor.

In fact, there is a great deal of physics, biomechanics, and force generation synchronously occurring that make a free throw possible. According to Professor Joseph Towles, a biomechanics professor in the department of biomedical engineering at UW–Madison, "The free throw is a whole body movement." Starting with the flexing of the ankles and knees, the motion travels up through the legs towards your hip, continuing up through the arms, wrist and finally, out through the fingertips, propelling the ball toward the basket. The synchronous energy transfer from the lower to the upper body is ultimately what determines the force of the shot. "You can also think of the free throw as applying what is called an impulse to the shot," says Towles. "An impulse is a force applied over a short period of time, and that is what you're imposing on the ball with your fingertips. When you take this force, and the angle and height at which you release the ball, you get a trajectory, which determines where the ball is going to go." According to Towles, the most common error is a failure to keep the elbow of your shooting arm pulled in (towards the center of the body). This can cause an unwanted force on the ball and alter both the trajectory and velocity of the shot. When considering the amount of variable biomechanics that are involved in this movement, one can begin to understand why some of the best players in the game struggle with free throws.

When shooting a free throw, one of the most common things one is told to focus on is "the follow-through," meaning the motions that are made after the ball is released from your hands. Since the ball has already left the shooter's hands, what possible effect could the follow-through have on the success of the shot? As far as the science of body mechanics is concerned, not much. The follow-through deals with a different science that plays a huge part in free throw shooting, or any sport aspect, and that is the science of psychology. "The follow-through might be a mental tool to help us become more connected to our shot," says Towles. This goes hand-in-hand with the various pre-shot rituals that are observed before almost every free throw. Dribbling the ball, stretching your arms, taking a calculated number of deep breaths, "these are all things that make you feel more confident and comfortable with the process," explains Towles, and this psychological side of the science of sports can make a huge impact on any athletic performance.

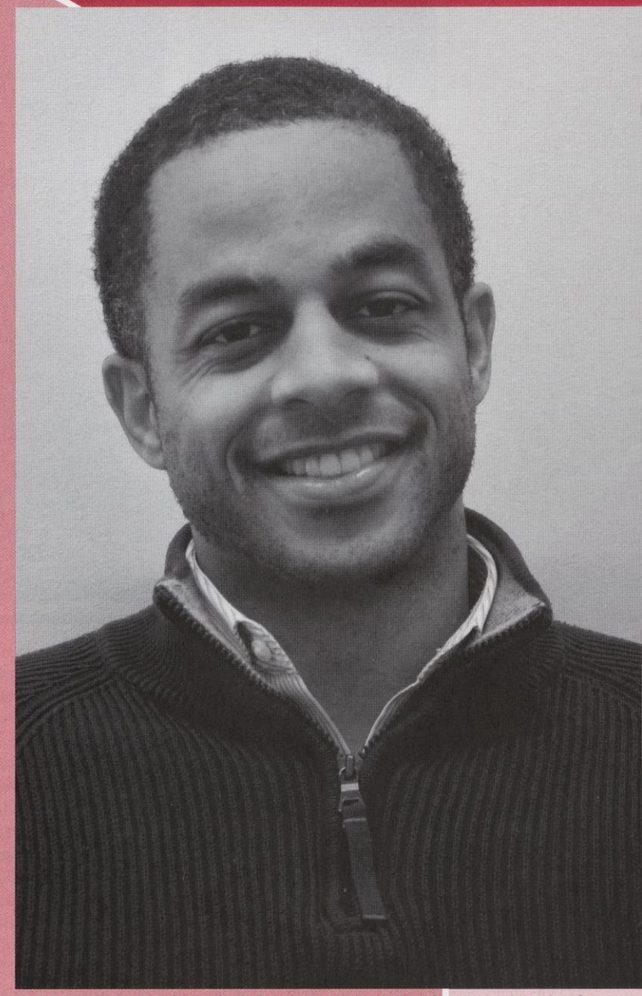
Discussing the biomechanics and kinematics behind a free throw shot can be helpful to an extent, but what really matters in the realm of competitive sports is quantifiable data and statistics. Luckily, a number of technologies are available to help both researchers and athletes alike analyze the motion of their bodies. One of the most widely used methods is called motion capture. Usually consisting of an array of cameras and a set of markers placed on a person's limbs and joints, motion capture uses software to analyze video of the markers and essentially generate a three-dimensional representation of a person on the computer. Force equations are then used to calculate that person's, velocity, acceleration and momentum. "And if you want to get really complicated, you can use a muscle EMG system, which involves attaching sensors attached to someone's muscles. These measure the electrical signals the muscles give off, allowing you to analyze their coordination with one another," explains Towles. With these methods and expertise being devoted to studying sport science, it is possible to get a more in-depth look at the physics behind the motion of sports.

When asked if there is a right way to shoot a free throw, Towles expressed mixed feelings. "There are multiple ways to perform the counter movements that are involved, multiple ways to set the trajectory of the ball with respect to height and velocity. So is there one right way to shoot the ball? No. Are there better ways? Probably, depending on your stature." This is good news for those who have an unorthodox shot or are struggling with their free throw skills in general. With the right tools, scientific knowledge, and practice, anyone can become a free throw expert. WE

Written by: Nathan Friar

Photography by: Jolene Enge

Design by: Jason Wan



Dr. Joseph D. Towles, Ph.D. is an Associate Faculty Associate in the UW Madison Department of Biomedical Engineering.

Kick-Starting a Company

Madison's Three Day Startup program is providing an outlet for young entrepreneurs to create their own businesses.

Paul Gerhartz, one of the event coordinators, and his friend who came to see the presentations talking after the program.

A team meeting after presenting their startup to help students study together.

For most college students, the next step in life after college graduation is obvious – find a steady job with an established company. However, for some students, the idea of leaping into the unknown and creating a company from scratch proves more appealing. Paul Gerhartz, local organizer of Madison's Three Day Startup (3DS), is working to provide self-motivated and creative students with the entrepreneurial skills required to start their own businesses. "There's one simple goal," Gerhartz says. "Start a company in three days."

First formed at the University of Texas in 2008, 3DS has steadily increased in size and now boasts 132 programs at 60 universities around the globe. If that isn't enough evidence of the organization's success, consider the fact that 3DS alumni have accumulated over $49 million from their businesses in the past six years, and the event has kick-started new and upcoming companies such as Timehop, perBlue, and Tamyca. Introduced to Madison in 2010, 3DS has held numerous events and has taught hundreds of students the entrepreneurial skills they need to bring their ideas to the market.

Twice a year, 3DS receives applications from some of the most driven students across UW-Madison's campus and invites the 40 brightest candidates to a rented space in downtown Madison for its weekend-long program. From start to finish, students in the 3DS program are fully immersed in their work. As soon as the event begins on a Friday afternoon, students with startup ideas take the stage to give a one-minute pitch of their proposed startup to the rest of the participants. Immediately afterwards, students form teams based on which startup idea best suits their interests and abilities. For the remainder of the night – and long into the next morning – teams work together to specify the problem their company is working to solve. "You have to move fast, and you have to complete a lot of work in a short amount of time," says Gerhartz.

Whether or not teams take a break to sleep on Friday night, the sun rises on Saturday morning and students continue to plan and develop their startups. Right away, startup teams are pushed out onto the streets of downtown Madison to speak directly with the people that matter the most to their companies – customers. "It's important to get feedback from consumers and incorporate it back into the product," says Gerhartz. By speaking with potential consumers, teams can learn what the general public likes and dislikes about their company's product.

After returning to the 3DS rented space early Saturday afternoon, startup teams work around the clock to make alterations to their product based on the feedback they received from consumers. Throughout the entire room, young business leaders form business models for their companies, graphic designers sketch new and creative logos and computer programmers race against the clock to complete their company's first working prototype before the end of the weekend.

"There is so much action going on – everyone is moving around and talking with each other. It's controlled chaos," says Gerhartz. The decisions that teams make during this period will have a significant impact on their company's final product and will help to prepare teams for their product presentations on Sunday evening.

In order to help facilitate productive communication and brainstorming within teams, 3DS provides a head facilitator and experienced professionals to mentor the individual teams over the course of the weekend. Since most of the students at the event have no prior startup experience, 3DS is their first real exposure to the grueling but exciting work required to run a successful startup. The mentors help teams push through these obstacles, ultimately assisting the teams to deliver a stronger, more well-rounded final product.

As the clock winds down to the end of the weekend, teams finally begin to see their hard work turn into something more than just an intangible idea. Teams are tired and some students are running on nothing more than the lingering taste of yesterday's Red Bull; however, everyone is fully committed to pushing forward in an effort to complete their business models and prototypes in time for the evening presentations. At 7 PM on Sunday, each startup team delivers an investor pitch to an audience of other 3DS teams and the general public. After 48 hours of intense decision making and creative thinking, each team incorporates all of their efforts from the weekend into the 10 minute presentation on their product.

At the end of the weekend, participants leave with much more than just fond memories of the exciting and challenging weekend. Parts of 3DS are taken with each student that exits its doors on Sunday night; newly formed connections, real life entrepreneurial skills and experience of what it takes to survive in the ever-changing startup world. More importantly, students leave 3DS as members of new startups that are full of potential and momentum. Whether one of these startups will evolve into the next 'Facebook' or 'Google' is up in the air, but it is clear that the lessons learned from 3DS will impact these students and their business endeavors for years to come. WP

Written by: Jon Smet

Photography by: Heather Schumaker

Design by: Ryan Krull

Bascom Hill: Controversy Atop UW–Madison's Most Famous Mound

A statue of President Abraham Lincoln is located at the top of Bascom Hill. He watches as students and faculty stuggle with the strenuous climb.

Bascom Hill, known by many as the home of the historic Bascom Hall and the famed statue of Abraham Lincoln, is nearing its final days. A team of construction firms, demolition crews and geological engineers are set to finalize their plans for the removal of the excessively strenuous terrain to traverse.

The plan, conceived with input from faculty as well as outside experts, is to remove the ground beneath the building layer by layer, lowering the buildings inch by inch. By going deep underground and removing the dirt from the same altitude repeatedly, the buildings' foundations remain rooted to the same ground they've been rooted to for years, and the construction crews can stay in a stable work environment. Students are unlikely to notice changes happening on a day-to-day basis, as the ground will very slowly start to lower over the course of many months.

Lead Engineer Robert T. Builder is in charge of the dirt removal and explains the process: "We set up camp a few hundred feet below Bascom Hill and start from the middle. A crew will set up a tunnel system with bracing to hold up the hill, and they will then use tools to scrape the dirt from the ceiling. This excess dirt is then taken out in carts and relocated. Within just months of this we expect to lower the highest point of Bascom Hill by at least 150 feet."

The greatest concern is building tilt, according to Builder, but when asked to comment, he pulled out a cheap plastic protractor from his backpack, smiled, and said, "Don't worry about it, I can fix that easily."

The final decision to remove Bascom Hill has been lauded by many staff members and student organizations. Tina Flats, president of the prominent campus advocacy group, Bascom Hill Adversaries (BHA), claims that forcing students to climb Bascom Hill is not only unnecessary, but also could harm academic performance. "There are so many consequences to building a university around a hill of this magnitude," Flats says, "Students are exhausted when they need to focus, they're skipping classes because of the hill and many of my peers claim they're restricted in course options because of it. Student performance will drastically increase once this barrier is removed; not to mention the increased freedom students will have. This will make a difference."

Experts in the field concur with BHA's assessment. "It is a known fact that it takes significant-

Bascom Hall is located at the top of Bascom Hill and functions as the university's main administration building. Along with the famous Lincoln statue, Bascom Hall acts as a goal for people climbing the hill because once they reach it, the strenuous climb is over.

ly more energy for humans to walk uphill and then downhill as opposed to walking on a flat surface," remarks kinesiology professor, Albert Walker. "It is reasonable to assume that Bascom Hill causes significant fatigue for students on a regular basis." Math professor Taylor Maclaurin expressed excitement that his students living near State Street would show up to class more often.

"Don't worry about it, I can fix it easily."
- Robert T. Builder

A small number of students and faculty protested the plan recently, including Lindsey Hillhugger of the Bascom Hill Preservation (BHP) advocacy group. "How can we destroy such a central part of our campus just for the sake of convenience?" asked Hillhugger. "What of the cost?" asks frustrated economics professor, Hayek Keynes, "We could improve education and fund research with the money it takes to remove the hill. Why are our reasonable complaints falling on deaf ears?" Hillhugger and her group marched up the hill holding signs and banners, but few students were aware of the event; most claimed they didn't have a proper view of such an inaccessible part of the campus.

Norm Smith, a UW–Madison student, expressed excitement about the change. "It's been 3 years, and finally I might feel encouragement to attend class again," he stated. "My life can be turned around!" John Guy, however, expressed hesitance, "I don't know what's up there... Obviously I've never actually climbed the hill. I don't think anybody has. I guess I'm a bit scared of what I'll find."

Construction is set to begin over the summer of 2015, and is estimated to take two years for full completion. As of now, there is a small sign posted on top of the hill saying, "This hike will be a thing of the past. Thank you for your support. We'll move mountains together," signed on the bottom by various contracting agencies and the Chancellor's office. It is unclear how far opposition will go to delay the project, and some fear further clashes atop the hill. It is unlikely, however, that students will hear of any more protesting for a few months due to the sheer altitude of the battleground. WE

Written by: Brandon Grill

Photography by: Cody Schwarz

Design by: Margaret Butzen

A Balancing Act in Wisconsin's Living Room

A conversation with the project manager of the 1988-2002 capitol restoration.

"The Capitol is not a museum; it's an office building. There are a thousand workers. You need to accommodate their needs, but at the end of the day, they need to have that same respect for the building," Professor Charles Quagliana says. Quagliana served as the project manager during the building's most recent restoration.

"It has to be a balance. That's what we always talk about in preservation. It has to be a balance between contemporary needs and historic preservation."
- Charles Quagliana

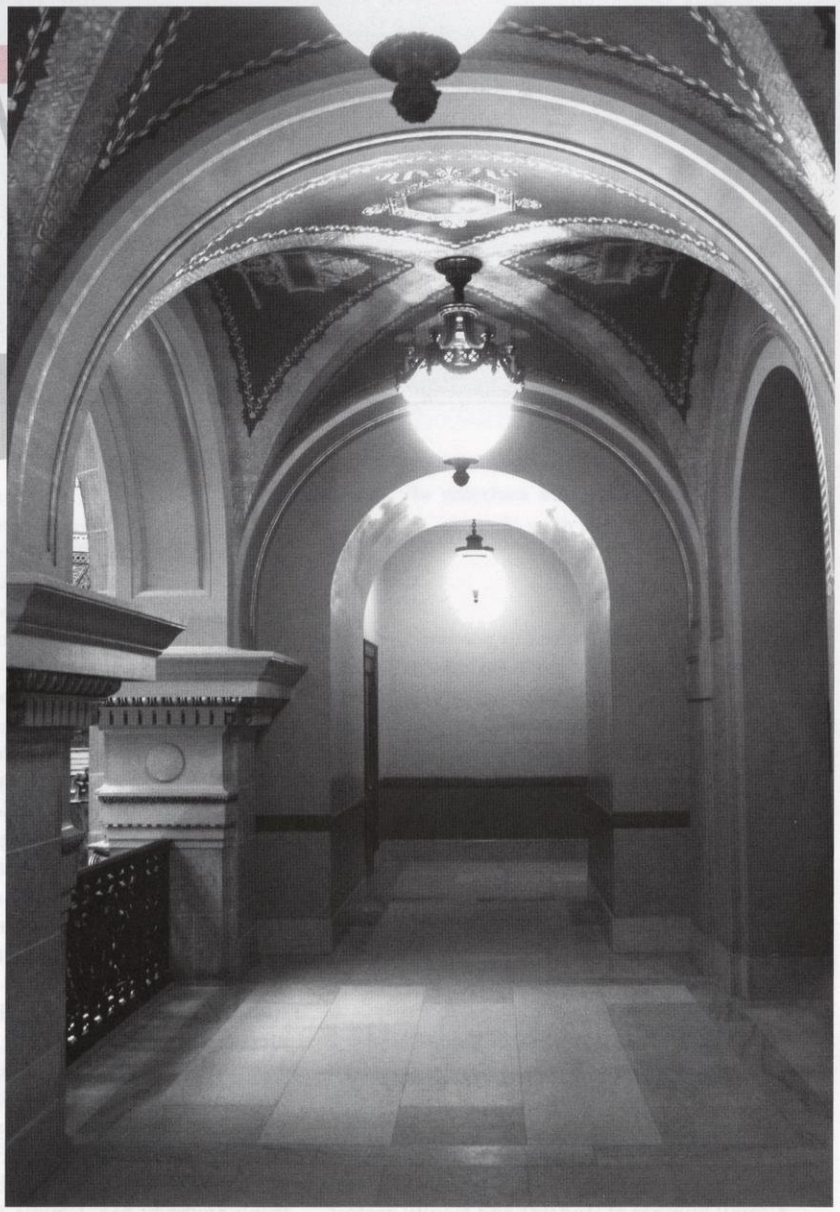
The shining Capitol that dominates Madison's skyline today is actually the structure's third incarnation. The building was designed by George Post and built between 1906 and 1917 after the second capitol burned to the ground in late February of 1904—just five weeks after a budget-conscience legislature cancelled the building's fire insurance policy. Ever since then, its caretakers have strived to balance the need to preserve its invaluable artwork, statues and decorative finishes with the realities of modernization.

Professor Quagliana, instructor of senior capstone design courses in the College of Engineering at UW—Madison, also restores buildings professionally. His refurbishments on campus include the Biochemistry Building, the Agricultural Dean's Residence and the Wisconsin Historical Society's reading room. He has also consulted on design aspects of capitol buildings in Kansas, Idaho and Florida, but his role as project manager during the latter part of the Wisconsin Capitol Building's 1988-2002 renovation remains one of his most treasured experiences. "We can do Biochemistry any day. You can only do a capitol once or maybe twice, if you're lucky," he says.

Quagliana attended Kent State's architecture school for his undergraduate studies. During his senior year, he travelled to Italy, where he learned building preservation methods just outside of Florence. This experience solidified his desire to become a restoration expert. His career makes this apparent; since becoming licensed in 1980, Quagliana has only designed three new buildings, the last one in 1982.

Quagliana sees a methodological difference between those that restore and those that build. "Quite frankly, architects who do new stuff need to have big egos," he says. "We, on the other hand, have to have more respect for the architect that did the original building. We have to have more reverence for the past. It's a different philosophy."

Along with his design team, he oversaw the systemic restoration the building one part at a time, beginning with the south wing and ending with the scrubbing of the dome. At the beginning of each phase, they spent a year investigating the wing to determine what needed to be preserved, restored or torn out. Consequently, they gained an intimate knowledge of the building's features, many of which were not apparent after the building was modernized in the 50's and 60's with air conditioners, fluorescent lighting and closed skylights. "We tried to understand how the architect built it originally. We found out that it really ventilated itself naturally, for one thing," says Quagliana.



The dimly lit hallways maintain a sense of gothicness. However, the vibrantly painted ceilings and elegant light fixtures give it the renaissance feel that it is known for.

The Wisconsin Capitol remains a truly iconic and integral part of the city of Madison. It also is the tallest in Madison due to legislation passed that limits the heights of buildings not to exceed that of the Capitol.

They then spent another year deciding how best to update the infrastructure, before moving everyone out for an additional two years while they implemented their designs. Renovations typically included cleaning frescoes, restoring the original gold leaf stencil work that had been painted over, replacing damaged wood trim and re-carpeting the floors.

Throughout the project, each area Quagliana's team worked in existed on a continuum between historic and modern. For instance, the rotunda and galleries were considered the people's place and were therefore restored to their condition when the building was new. On the other hand, private office spaces were updated to increase functionality and, to a lesser extent, the appearance of a modern office building. Every room had a different place on the scale. "It has to be a balance. That's what we always talk about in preservation. It has to be a balance between contemporary needs and historic preservation," says Quagliana.

Despite this, Quagliana believes that the spirit of the building will never change regardless of its appearance. The Capitol has been, since it creation, the State's most iconic public space and it will remain that way so long as people are engaged with their government. The student and teacher protests in 2011 are the most recent demonstration of the power, both symbolic and political, that the building has seen. Quagliana and his team even refer to the Capitol as Wisconsin's Living Room. "It represents what government was when the building was built," he says "It was a temple of democracy. The building said, 'This is what we are, which is government.' We are an important state."

Quagliana's work with the Capitol finished in 2002. These days he ventures into the area on Saturdays to visit the farmer's market. However, he hasn't been inside the building in nearly a year. In the future he would like to see the instatement of several curators to educate the public, workers and legislators on how best to maintain the building's balance, a balance that will preserve the Capitol in the years to come. WE

Written by: Jacob Peterson

Photography by: Evan Verploegh

Design by: Jason Wan

Student Organization Spotlight

WISCONSIN

CONCRETE CANOE

Looking to sink the rest of the competition with a sixth national championship in June.

Row, row, row your…concrete boat? While this phrase may seem oxymoronic, the UW—Madison Concrete Canoe Team goes against the grain and is tasked each year with fabricating and racing a new canoe made of concrete. To say that they have been successful in their efforts would be an understatement, as the UW—Madison-based team has won a record-tying five national championships thus far, placed fifth at the national competition last year and is looking to add more hardware to their collection this year. In order to learn more about this organization, I sought out some individuals that have previously led or are currently in charge of the student organization – and making sure that the canoe floats.

The competition the organization participates in is unique to say the least. The student-based group is responsible for conducting their own research and development of various concrete batches, the "marketing" behind the theme of their canoe and fabrication of the canoe itself. All of these components are then brought together by a final technical report. According to Benjamin Kranner, former co-chair of the organization, the competition covers "every phase of an engineering project…touches on all disciplines of engineering…[and is] run by students," with roughly half of the members coming from departments outside of civil engineering. The practicality of the competition does not go unnoticed by employers; current co-chairs Megan Long, Rhett Skrober and Eric Hartig were all in unanimous agreement that participation in the organization was helpful with their respective job searches.

At the beginning of each year, the UW—Madison Concrete Canoe team picks a theme and team name to market the canoe around, with previous themes being Egypt, Forward (Wisconsin's state motto), and Buckingham. Unfortunately, the co-chairs asked to keep this year's theme a secret, but current UW—Madison students are encouraged to join the student organization if they don't wish to wait to find out. As for everyone else, you'll just have to wait and see.

After a name and theme are decided upon, the canoe itself must be fabricated. The mold is rec-

"[Concrete Canoe covers] every phase of an engineering project… [and is] run by students."
- Benjamin Kranner

Members of the concrete canoe team lay strips off wood onto a frame of the canoe they plan to build.

➢Nails are used to hold wooden strips together as the glue dries on a test canoe.

reated each year, and the concrete batches used to create the canoe are blended differently as well. Mixing the concrete is the most essential phase to ensuring that the canoe will actually be able to float on water. One of the safety tests at competition actually requires the canoe to resurface after being entirely submerged. With countless calculations and the help of science, the right mix is decided upon and used to create the canoe. In fact, last year's UW—Madison team placed first in the innovation category at nationals for using heat-reading probes to best determine the correct ratio in which to mix the concrete.

After the mix ratio is determined, the concrete is molded and left over winter break to set properly. Then, the canoe is ready to begin its journey across the nation, being dragged around in what is dubbed "the coffin;" a 26-foot trailer that stores the canoe for safe travel. This year, hopefully, the canoe will be brought to Clemson University in South Carolina for the national competition. However, a lot of time, teamwork and preparation are required to get to the national competition, especially after the boat is set. After the students return from winter break, the concrete canoe lab has members flowing in and out almost every single night of spring semester. "There's pretty much more canoe stuff than homework," the organization co-chairs say, as the rowers begin their training by holding indoor pool sessions with a replica wooden canoe, in preparation for the five races spread across three divisions at competition. These extra practice sessions have been paying dividends, with the women's distance team placing first at nationals last year. Meanwhile, the other members begin preparing a technical report to present in front of a panel of judges, subject to "intense questions and drilling," according to the co-chairs.

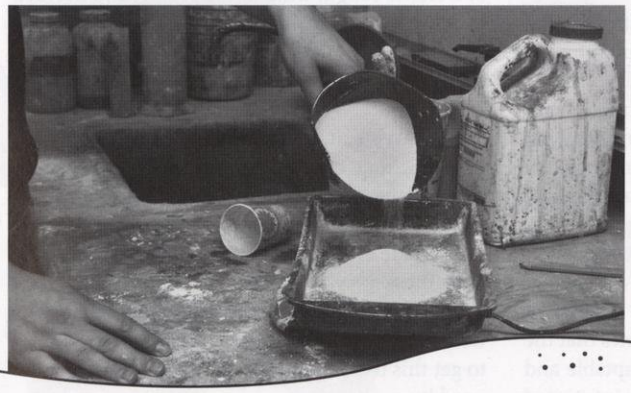
After these key areas are rehearsed and edited thoroughly, the team is ready for the Great Lakes regional, where the team placed first overall to qualify for national competition last year. Hopefully, this year, the streak of overall first place finishes will continue and result in a record-breaking sixth national championship in South Carolina. Best of luck to the UW—Madison Concrete Canoe team and On Wisconsin!

Anyone interested in learning more about the UW-Madison Concrete Canoe team can visit their website at http://canoe.slc.engr.wisc.edu/index.html or e-mail them at canoe@cae.wisc.edu. WE

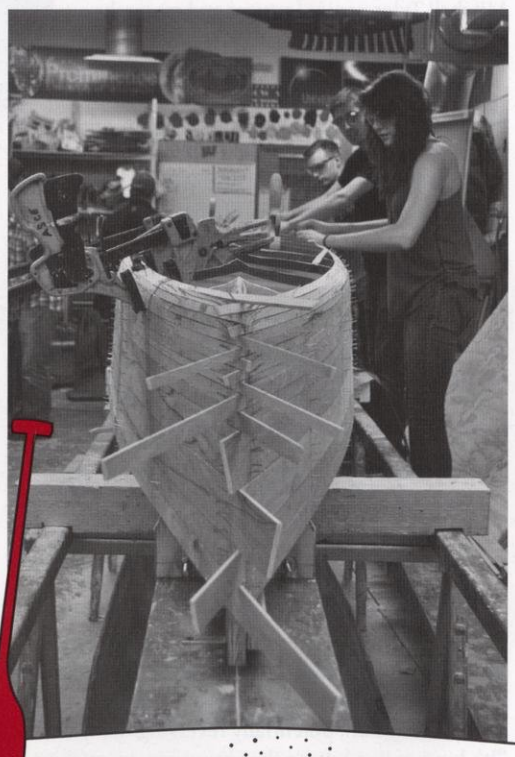
Written by: Brian Zhou

Photography by: Ciara Lotzer

Design by: Tom McAdams



➢A wooden test canoe is made and used as a mold for the final concrete canoe.

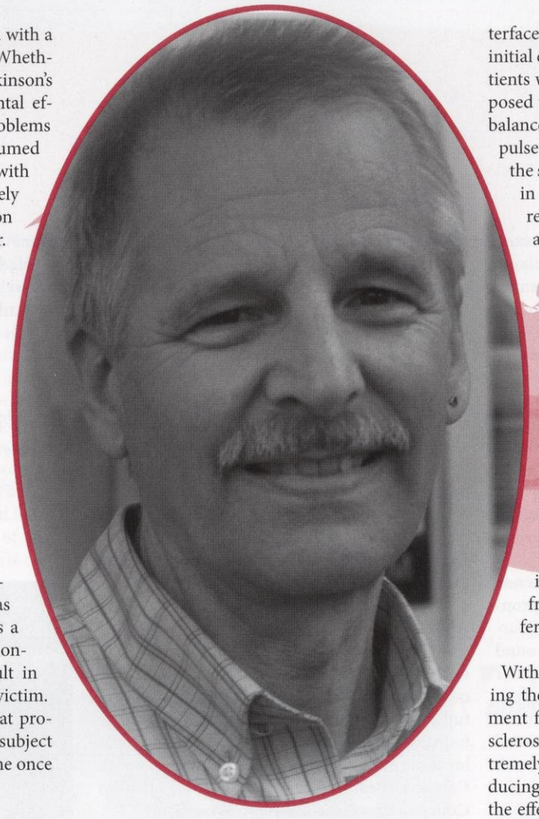


➢A member measures chemicals before mixing a sample of concrete for testing.

A Revolutionary Treatment for Brain Damage

A breakthrough technology developed by a UW-Madison laboratory has the potential to revolutionize brain damage treatment.

Over a million adults are diagnosed with a brain disorder every single year. Whether it is due to a stroke or Parkinson's disease, people are subjected to detrimental effects such as cognitive and emotional problems or depression. Historically, it was assumed that while brain damage could be treated with medication and various therapies, ultimately there was no cure; once the brain function was lost, there was no way for it to recover. Recent advances by UW-Madison's Tactile Communication and Neurorehabiliation Laboratory (TCNL), however, challenge this conventional wisdom and provide hope for the future of neurodegenerative disease treatment. Centered around the idea of brain plasticity, the ability for the brain to recover normal function by passing information via external stimulation, the TCNL has made remarkable breakthroughs that can have far reaching implications for a broad segment of the population.



Professor Mitchell Tyler.

Mitchell Tyler, senior lecturer and researcher at UW–Madison, now leads the TCNL as Project Director. Once the brain sustains a serious injury, the damaged portion no longer functions properly, which could result in physical or emotional problems for the victim. For example, if the region of the brain that processes visual information is damaged, the subject may become visually impaired or blind. The once healthy brain tissue is essentially "offline", but by using the techniques developed at the TCNL, information can be transmitted to the damaged portions of the brain, potentially reversing the effects. "It's kind of like hitting the restart button on your computer," says Tyler, "if you stimulate the brain in some way, working around the functional deficits, the brain will recover its normal function."

"There's a lot to be done, but we are one part of that promising future. Things that were considered impossible are now starting to look not just viable, but indeed possible!" – Mitchell Tyler

In the early years of the lab, much effort was spent on trying to figure out how to pass information into the brain via electrical stimulation in such a way that was not only meaningful, but comfortable for the subject as well. After many unsatisfactory attempts to accomplish this through stimulation of the fingertips, abdomen and back, founder of the lab, Dr. Bach-y-Rita came up with the idea of passing it through the tongue. Tyler notes that the tongue happens to be a "massively adaptable and sensitive organ which is also intimately integrated into the brain," and so it seemed like a natural interface with which to conduct the research. While initial experiments attempted to provide blind patients with limited visual information, Tyler soon posed the idea of using the technology to combat balance instability. Providing a simple electrical pulse on the tongue which would correspond to the subject's current spatial orientation resulted in near-instantaneous success with subjects reporting significant improvement after only a few minutes with the device.

The real breakthrough, however, occurred one day in 2003 after a balance-impaired subject's normal 20-minute training session. After removing the device, the subject noted that she still felt relatively stable; that it was almost as if the device was still providing feedback. At the time, this was a revolutionary discovery. "We're not just providing feedback in the classic sense of replacing the lost sensory input, we're actually changing the way your brain is functioning. We're actually inducing neuroplasticity," Tyler says. This has huge implications, not just for people suffering from balance problems, but for patients suffering from all types of neurological diseases.

With this in mind, the TCNL began investigating the use of tactile communication as a treatment for patients with diseases such as multiple sclerosis, and once again, the results were extremely promising. The treatment ended up producing significant improvement for slowing down the effects of MS and these results were so favorable that eventually the United States Department of Defense caught wind of the project and decided to actively invest in the science. The military has an enormous problem with soldiers returning from overseas deployment suffering from post-traumatic stress disorder and traumatic brain injury. As a result, these veterans experience many life-impeding effects such as sleep deprivation or cognitive and emotional regulation problems. Sadly, it is estimated that around 22 veterans commit suicide every day due to their inability to cope with these very real and very destructive issues. As a veteran himself, Tyler recognizes the importance of his research and will do whatever it takes to get this technology into the hands of those who need it.

With the Department of Defense backing the research, its development can be fast-tracked and passed by the Food and Drug Administration with minimal setbacks. This doesn't mean the lab can bypass regulations as it still must adhere to proper scientific standards, but given that the military has such a high demand for this technology, it will do everything in its power to speed up its implementation. In addition to providing the technology for military personnel treatment, the general public will also benefit. Millions of people sustain traumatic brain injuries or are living with neurodegenerative diseases, and once this technology is made available, anyone with a need for it will be able to take advantage of it. "There's a lot to be done, but we are one part of that promising future," says Tyler, "Things that were considered impossible are now starting to look not just viable, but indeed possible."

Written by: Stephen Schwartz

Photography by: Nicholas LePar

Design by: Brent Grimm

Pictured here is Professor Tyler's functioning prototype of the PoNS device.

The DIY Satellite

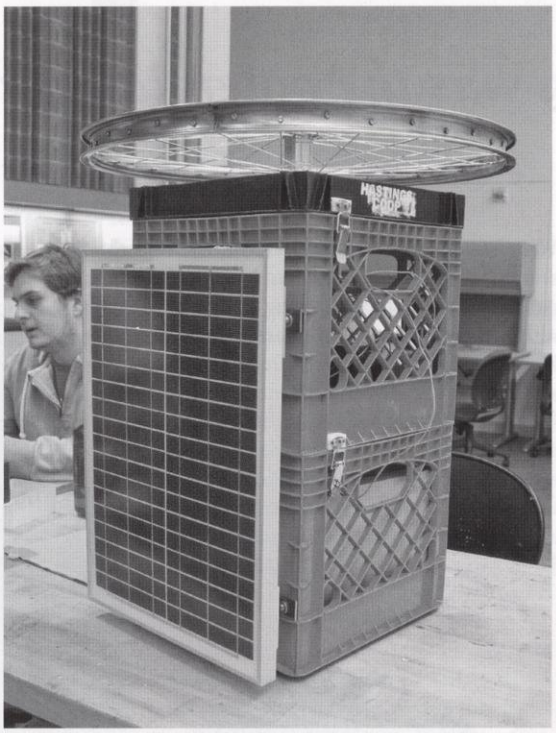
Not a rocket scientist? No problem. Explore the creation of miniature satellites with Scott Munsen.

Space exploration has always been a human fixation: Galileo's first glimpse at the moon's surface inspired Neil Armstrong's first steps for mankind on the moon, which lead to the development of the current international space station. All people have pondered the conquest of the realm outside Earth's atmospheric boundaries. However, few can say they have experienced space firsthand. The notion of the common man reaching such heights has only appeared in science fiction novels — that is, until now. Today, you can forget about stamp collecting or knitting, and make room for a more modern hobby; space exploration via homemade satellites.

One may think constructing a functioning satellite is too difficult for the average person — a hobby requiring much expertise and experience. However, the freshmen of Introduction to Engineering Design 160 at UW-Madison also have little to no experience with astronautical engineering either, yet Scott Munsen, teacher of the design course, has continuously proposed design projects pertaining to the creation of satellites and rockets, which the freshmen successfully create in a semester. Some of these projects include the design of propellant transfer devices, altitude control devices and solar panel deployment devices; all of which simulate a small part of a real astronautical engineer's challenges.

Munsen's 2014 fall semester group is currently working on creating a semi-functional satellite, whose parts have been divided into three groups: scientific payload, power collection storage and distribution and spatial orientation. "I think the biggest challenge is actually the interface between the three groups," Munsen says, "You've got one group working with solar energy and turning that into electricity at 12 volts, so the payload needs to be at 12 volts … This project really looks into how the different engineering disciplines intermingle in order to create a product that meets specifications." The disclaimer to this project is that it will not actually be able to function in space. With a $600 budget, this satellite loses satellite functionality with its inexpensive parts like its milk crate skeleton, $30 solar panel, and Styrofoam insulation. However, the point of this project is simply to learn how to successfully interface the different parts on the inside of the machine.

If college freshmen can make a satellite, anyone can. But there's a slight caveat: cost. Satellite-making is not a cheap hobby. $600 can pay for a satellite simulation in the 160 design class, while the real deal costs quite a bit more. One option available to create a personal satellite is called CubeSat, which is a prefabricated satellite kit available to beginner enthusiasts and classrooms alike for $7,500. The CubeSat Project's mission is to provide an efficient and reliable deployment system that allows a team to fabricate and experiment with this educational toy. The CubeSat satellite is similar to other picosatellites (the term for miniature satellites) in that it cannot get into space on its own, although according to the CubeSat Project website, finding a way to launch this satellite in to space isn't too complicated. For $40,000, the CubeSat can reserve a place on the brig of a rocket launching into space and be released from there. Naturally, the price of the launch is the biggest obstacle, so these satellites are normally used by schools that use fundraisers to finance the launch of their satellite. "You can get to space relatively cheaply, and sending a satellite into space provides a great learning experience by teaching students how to use specific measurements to create a satellite and then take data," says Munsen. "The students learn how to make something survive space which is really hard on its own."



Freshmen engineering students work together to build DIY satellite.

Beyond providing benefits from an educational perspective, the picosatellites are being made by hobbyists so that they can capitalize on the data they collect with their satellite. Previously, most of the images of the earth's surface came from larger satellites and were owned by the government. However, because there is a larger market for the data provided by satellites, companies can buy data from hobbyists with their own satellite. Companies benefit from this data by getting almost real-time imaging of the earth's surface. For example, in order to study the growth of a business, a company can analyze the number of cars in the parking lot, or the traffic in a commercial district. Even the government can find these satellites advantageous because its small size makes the satellite relatively inexpensive and almost undetectable, so the government can get real-time pictures of the Earth's surface in an easier and less resource exhaustive way. So armed with a picosatellite, the common hobbyist becomes an entrepreneur overnight.

Satellite making may not be for everyone, but now it's clear that more than just the Galileo's of our time can benefit from space. For students, enthusiasts and businessmen alike, picosatellites can yield a wealth of information. WE

Written by: Anastasia Montgomery

Photography by: Margo Labik

Design by: Tanae Swenson

Not Your Average Summer Camp

A look into the summer camp the inspires and prepares incoming UW Madison engineers.

As students of all ages advance through school, they grow eager with curiosity about their future. Naturally, a large part of their future is expanding and applying their education in a way that aligns with their interests and ambitions. With an infinite number of opportunities, it is important to start exploring as soon as possible. Camp Badger organizers embrace this philosophy as they strive to spark the interest of young, inspired engineers through their summer camp program.

Camp Badger is a week-long summer camp for 8th graders with a passion for math and science. The camp is offered throughout the UW system in Madison, River Falls and Oshkosh providing incredible experiences that would inspire any engineer. While the camp is intended to be a fun opportunity for kids to spend a week away from home, the ultimate goal of Camp Badger is to show kids that college is within reach and that engineering is a great degree option.

This past summer, participants were given the opportunity to tour the Trek Bicycle headquarters, get a behind-the-scenes look at the Kohl Center and explore the Children's Museum in downtown Madison. However, that is only a small part of all that the camp includes. Paul Daniels, a third-year UW–Madison engineering student who worked as a camp counselor this past summer, recalls the tour through the facilities of the Columbia Power Plant ending with a scenic stop on the roof that overlooked the plant. Daniels remarks that while the tours and site visits were exciting, "the best part about this camp is helping to pass on the knowledge and skills learned here at UW–Madison to the kids and watching them learn how to become the next generation of engineers."

Along with the introduction to the engineering world, participants also have opportunities to make new friends, whether they are other campers or current UW–Madison students. There are over eight counselors working the camp each week who do their best to connect with each participant. Daniels says, "There is nothing more exciting than when one of the campers explains something they learned that day with excitement in their eyes and a desire to experience more."

"One of the best moments of the camp is when the kids express their excitement to attend UW–Madison in the future." -Johnnie Wagman

There is frequent talk of the bond shared between current students and alumni, but the connection between current students and their younger peers is often be overlooked. Camp Badger provides an excellent opportunity to show kids the beauty of the UW–Madison engineering program and gives them a glimpse of what it would be like to be full time student here. Johnnie Wagman is a third-year Mechanical Engineering student at UW—Madison who plays a significant role in organizing and running the camp. "One of the best moments of the camp is when the kids express their excitement to attend UW–Madison in the future," says Wagman. Camp Badger is a chance for two generations to learn about their passions and what they want to accomplish together.

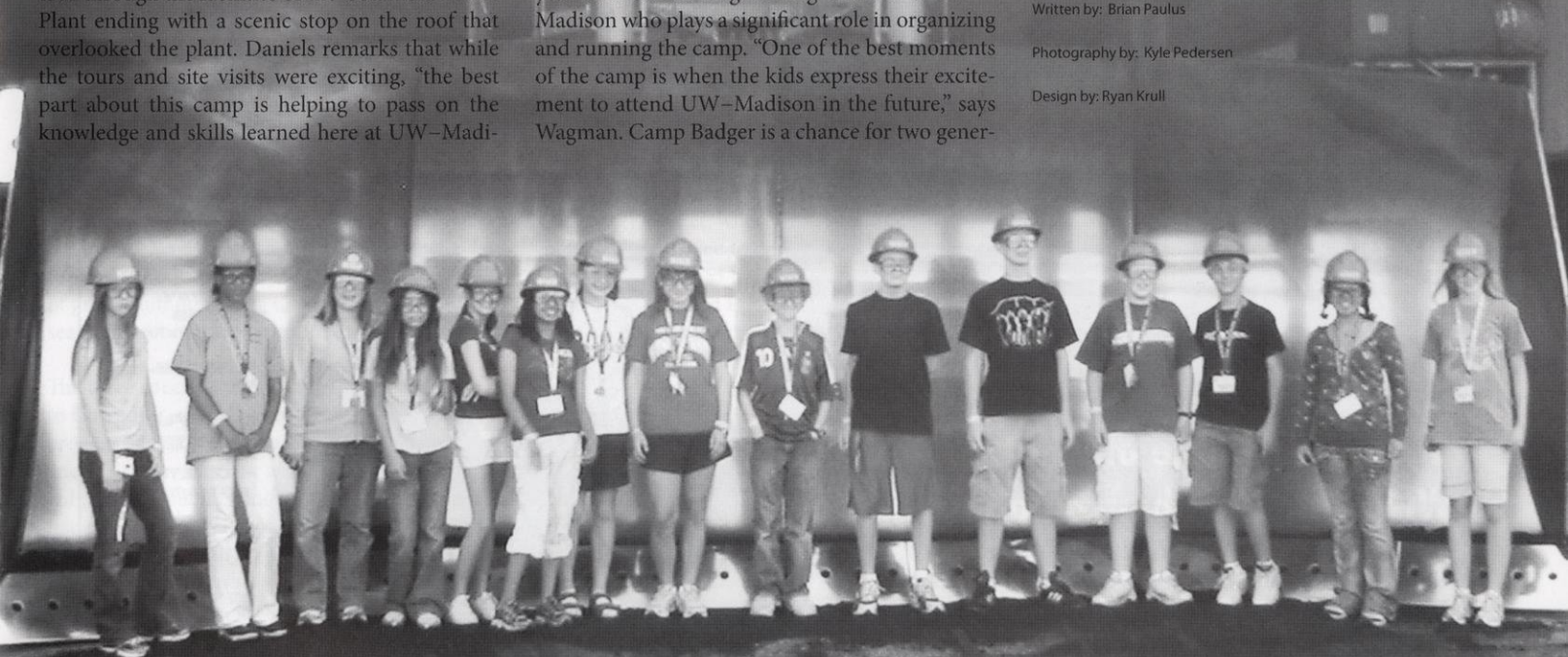
While it is clear how much the 8th grade participants experience during this camp, it is important to realize the growth of the staff members as well. A vast majority of the camp is organized and supervised by engineering students here at UW–Madison. Wagman spends the entire year preparing materials, designing projects and scheduling site visits for Camp Badger. Wagman also mentions, "It was interesting to work with local teachers and see the public education system from a different perspective." The camp is always reaching out to current UW-Madison students to be involved and contribute fresh ideas for upcoming sessions. It provides a good leadership opportunity for UW-Madison students to be a part of something larger than themselves.

Camp Badger plans to continue running these successful programs at full capacity in future summers. Wagman explains that since the summer of 2014 has ended, the staff has been evaluating the activities of the previous summer and identifying which were the most engaging in preparation for the next round of sessions. New site visits, new design projects and even offering the camp in yet another city could all be seen in the future. The plans for Camp Badger summer 2015 are already in the works and are looking better than ever.

Written by: Brian Paulus

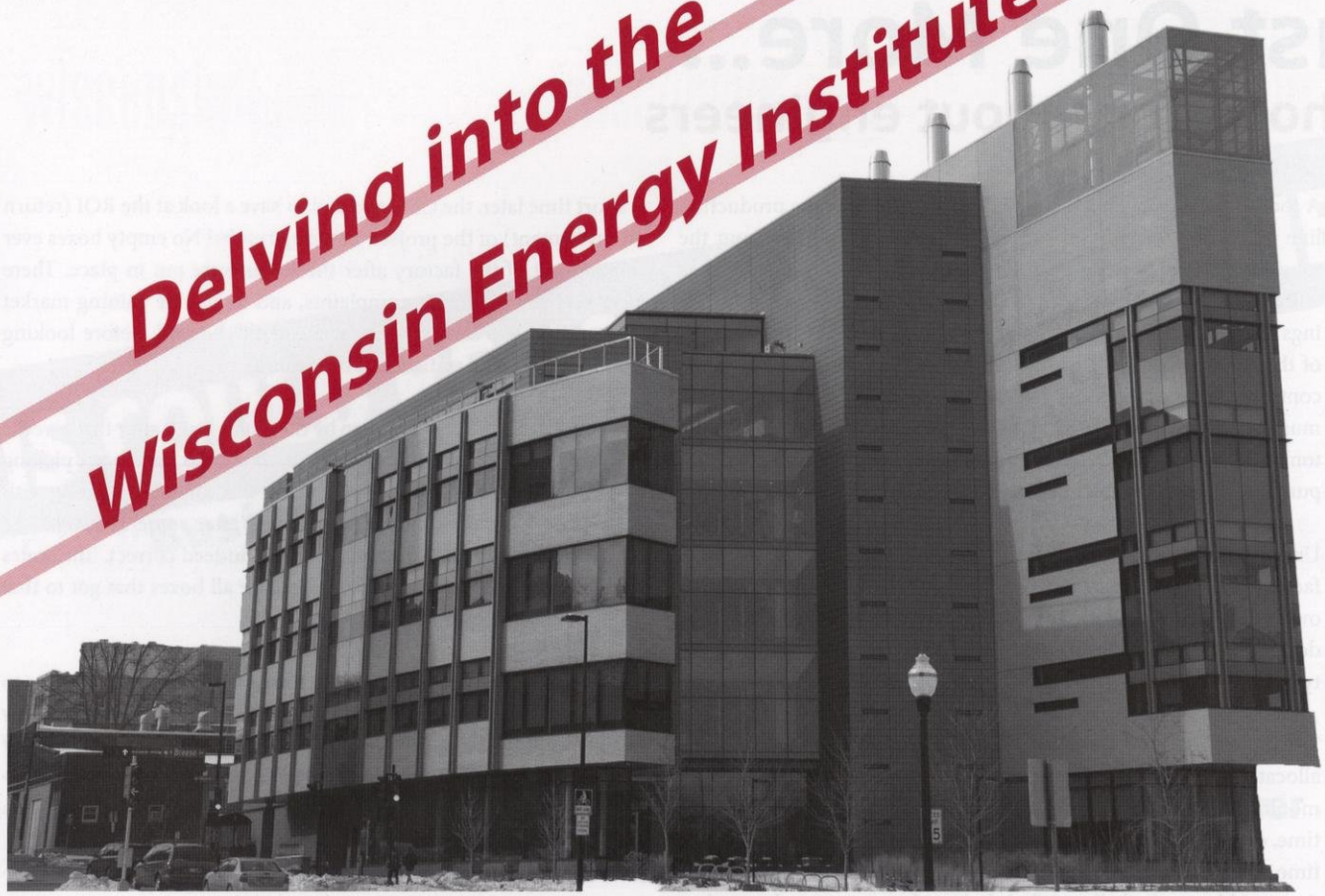
Photography by: Kyle Pedersen

Design by: Ryan Krull



Students get to experience engineering in the real world: photo courtesy Camp Badger Exploring Engineering.™

Delving into the Wisconsin Energy Institute



Learn more about the Wisconsin Energy Institute and the many opportunities for careers in the energy industry.

UW–Madison is home to numerous institutions and organizations that work to benefit students, faculty and alumni. The Wisconsin Energy Institute (WEI), for example, is one of these institutes. Headed by director Michael Corradini, an engineering physics professor at UW-Madison, and associate director Mary Blanchard, this institute provides a forum to exchange ideas about energy issues and to share knowledge to solve the challenges in energy. Blanchard, who joined the institute early in 2014, had previously worked for Virent, a bioenergy company. Now at the Institute, she runs the day-to-day operations, which include the distribution of grants and managing of staff. She also helps researchers connect with funding opportunities.

The three specific objectives of WEI, according to Corradini, are to "foster collaborative energy projects across sectors and disciplines, prepare energy leaders of today and tomorrow and to enhance the public's understanding of energy issues." The institute got started when a group of faculty interested in furthering energy education and outreach began to work together. The Institute focuses on making research breakthroughs in several key areas such as feedstock, liquid fuels, energy storage, carbon-neutral electricity and electricity policy.

Not only does the WEI focus on research, but also works to inform the community about energy issues. Corradini describes it as a place where faculty can go to receive assistance when doing research or outreach in energy, and conversely, a place where external entities go to learn about research and outreach that takes place at UW–Madison. For outreach, the Institute coordinates a series of presentations for student organizations about issues related to energy. Another project of the Institute takes place in the Great Lakes Bioenergy Center, where the unused portions of biomass are used to create biofuel and other biochemicals. WEI has also established a student organization called EnergyHub, where students can learn about energy issues. WEI's involvement in education has led to the creation of a certificate program for undergraduate students that focuses the studies of those interested in energy related courses.

According to Corradini, this certificate is beneficial to students because there are many possibilities for careers with a focus on energy. Jobs range from the financial and policy side of the energy industry for those with an energy policy degree, to the implementation of new power plants for those with an engineering physics degree. Energy policy jobs will hire those who understand energy technologies well enough to advise policies that should be made with respect to the use of energy. In the engineering physics field, the jobs for nuclear engineers are very plentiful; however, many of these jobs are overseas in countries such as China and India, as the energy companies are multinational. An example of this is the company TerraPower, which is a company funded by Bill Gates, where the goal is to create an advanced nuclear reactor design in China. At individual companies, certain employees will study the energy policies that impact that specific company. Corradini also encouraged interested students to join startup companies such as Virent that have intellectual property that can be turned into products that many larger companies would want.

The Wisconsin Energy Institute is an excellent resource for companies, students and faculty at UW-Madison to get involved in energy research and outreach. It is also an excellent time for students to get involved in energy due to the variety of jobs that are offered in this field. For a student interested in a career in energy, interactions with both the WEI and EnergyHub would help to learn about the ins and outs of the industry. WE

Written By: Alex Chay

Photography by: Catie Qi

Design by: Brent Grimm

Just One More...

A short story about engineers

A toothpaste factory had a problem: Due to the way the production line was set up, sometimes empty boxes were shipped without the tube inside. People with experience in designing production lines will tell you how difficult it is to have everything happen with timings so precise that every single unit coming off of it is perfect 100% of the time. Small variations in the environment (which cannot be controlled in a cost-effective fashion) mean quality assurance checks must be smartly distributed across the production line so that customers all the way down to the supermarket won't get frustrated and purchase another product instead.

Understanding how important that was, the CEO of the toothpaste factory gathered the top people in the company together. Since their own engineering department was already stretched too thin, they decided to hire an external engineering company to solve their empty boxes problem.

The project followed the usual process: budget and project sponsor allocated, RFP (request for proposal), third-parties selected, and six months (and $8 million) later a fantastic solution was delivered — on time, on budget, high quality and everyone in the project had a great time. The problem was solved by using high-tech precision scales that would sound a bell and flash lights whenever a toothpaste box would weigh less than it should. The line would stop, and someone had to walk over and yank the defective box off the line, then press another button to re-start the line.

A short time later, the CEO decided to have a look at the ROI (return on investment) of the project: amazing results! No empty boxes ever shipped out of the factory after the scales were put in place. There were very few customer complaints, and they were gaining market share. "That was some money well spent!" he said, before looking closely at the other statistics in the report.

The number of defects picked up by the scales was 0 after three weeks of production use. How could that be? It should have been picking up at least a dozen a day, so maybe there was something wrong with the report. He filed a bug against it, and after some investigation, the engineers indicated the statistics were indeed correct. The scales were NOT picking up any defects, because all boxes that got to that point in the conveyor belt were good.

Perplexed, the CEO traveled down to the factory and walked up to the part of the line where the precision scales were installed. A few feet before the scale, a $20 desk fan was blowing any empty boxes off the belt and into a bin. Puzzled, the CEO turned to one of the workers who stated, "Oh, that…One of the guys put it there 'cause he was tired of walking over every time the bell rang!"

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