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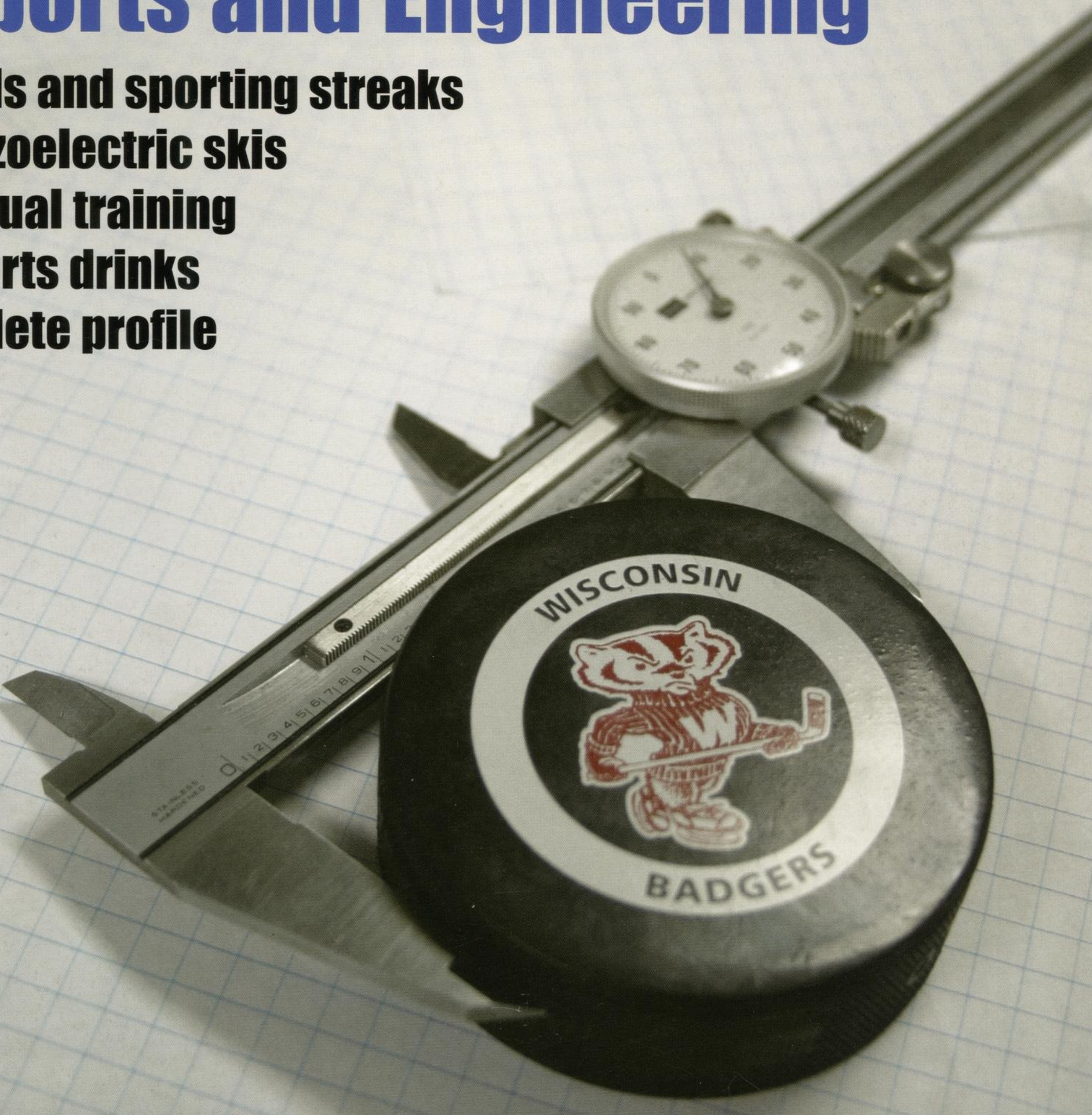
Wisconsin engineer

April 2005
VOLUME 109, NUMBER 3

Sports and Engineering

Odds and sporting streaks
Piezoelectric skis
Virtual training
Sports drinks
Athlete profile



wisconsin engineer

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COVER PHOTO

Special Edition: Sports and Engineering

An official UW-Madison hockey puck is 72.6 mm in diameter. This is an example of how engineering specifications are used in sports.

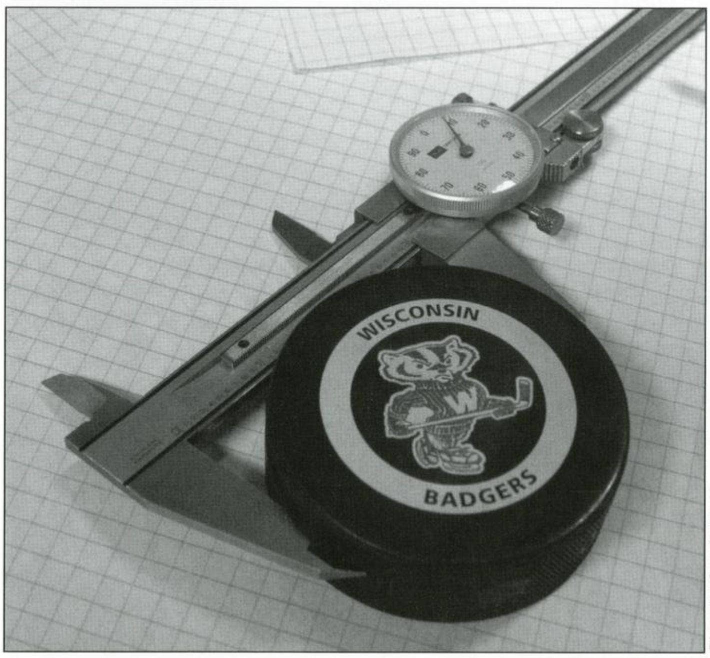
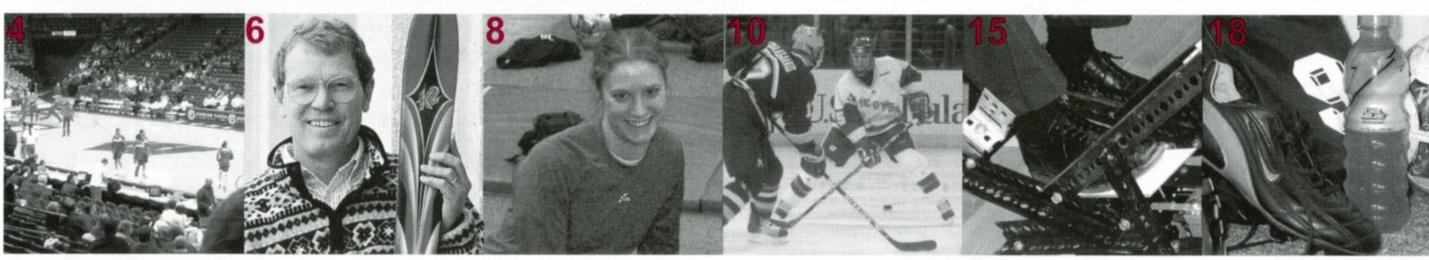


Photo by Carl Calhoun

FEATURES



COMMENTARY

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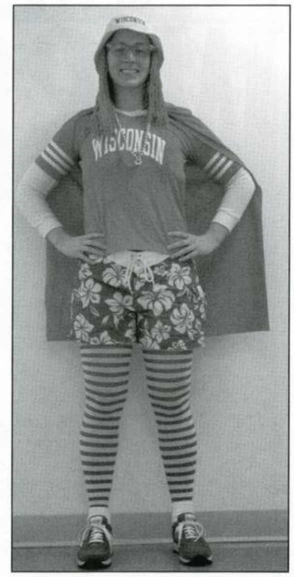
Karen Mandl
Editor-in-Chief

Geeks, jocks and UW-Madison



People often look at a map of campus and chuckle at the fact that the engineering campus is right next to the athletic facilities; there is just something ironic about pairing the stereotypical geeks and jocks. But perhaps our school's planners knew the strong connections between these two and placed them there on purpose.

Engineering, whether it be for safety, speed, or strength, plays a large part in athletics. There are the materials designed for safe football helmets or water-repellant swimsuits, the statics and dynamics behind wrestling moves, and the resistance and hydrodynamics of a crew boat. Just like there are specifications for how to build a distillation column, there are specifications for the layout of a basketball court, basketball size, hoop size and hoop height. And before this year's Super Bowl, Fox subjected everyone to a rocky, yet humorous, explanation of how Newton's Laws apply to football.

But just the fact that engineering can be used in sports is not the only connection the two neighbors have. Competition is an obvious aspect of athletics, but is hidden in engineering to those not involved. UW-Madison supports its nationally ranked football, basketball, hockey, crew, cross county, track and many other teams. But it also supports its twice-national champion Future Truck team, concrete canoe team, steel bridge team and quarter scale tractor team. Badger fans are known for being some of the loudest, most ruckus fans in the nation. The College of Engineering is known for having the greatest E-week celebration in the Midwest and the largest student-run engineering exhibition in the county (EXPO).

On a more personal note, both the College of Engineering and Badger Athletics have been important parts of my seven years as a student here (both BS and MS). As one of those crazy Badger fans who wears red-and-white-striped tights and a red cape to each sporting event, I have had football season tickets for the last seven years, made the trek to Pasadena back in 2000, lost my voice at hockey games and partied on State Street to celebrate the basketball team's Final Four berth. All things every UW-Madison student should experience. I have even proudly and successfully defended our beloved Badgers many times in debates with those silly Gopher fans in my home state of Minnesota to prove that we are in fact so much better than they are.

In addition to being a supportive Badger fan, I have been a proud engineering student. Becoming involved in the college has opened up more doors to me than I can even count and introduced me to some of the most intelligent, creative and supportive people I have ever met. Not only have the college's courses taught me about problem solving (how can 10 hours worth of homework get done in 5?), but it is really the small things that have made me fall in love with the engineering college. Where else can you pick gummy worms out of a pie tin of tapioca pudding with your teeth while blindfolded or get free pizza at a student organization meeting at least two or three times a week?

So after seven years of school in the surreal world that is UW-Madison, I finally say good-bye to taunting Section O and racing chairs around ECB and everything in between. And after four and a half years (yes, longer than most people are in school) of serving the great Wisconsin Engineer magazine, I say good-bye to a phenomenal staff and let someone else be slave to the task. I will miss my time as a student fan, engineering student, and magazine staffer, but as they say: you can take the girl out of Wisconsin, but you can't take the Wisconsin out of the girl. So while I may not be living in Wisconsin or Madison anymore, it will always be a part of me. Thanks for all the great times and memories and *On Wisconsin*.

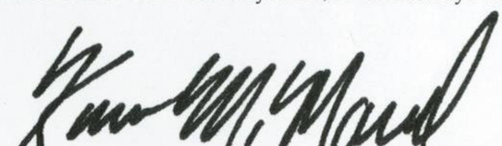


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Photo by Mason Cutsforth

Engineered for tradition

By Robert Beets

The Kohl Center, a vibrant centerpiece to the UW-Madison campus, shines brilliantly after another stellar winter sports season. Numerous sellouts and win-streaks for basketball and hockey teams continue to embolden traditions and exemplify how great design and engineering enhance our lives and the sports we love.

Photo by Andrew Raimer

The colossal $76.4 million Kohl Center towers over the southeast corner of the UW-Madison campus. This facility holds almost 17,000 seats for sporting events, concerts, and graduations. In addition, the Kohl Center also contains enough concrete to build a sidewalk from Madison to Chicago.

Each experience at the world-class facility reminds students, fans and the community that an arena can not only fulfill its purpose to hold events, but also enrich those events for all in attendance. With glass, steel and concrete, the Kohl Center warmly embraces its occupants and hosts athletes, graduates and musicians for the UW-Madison community.

The main entrance entices visitors inside by displaying its wide, open concourses buzzing with people on gameday. The motoring fans and etched figures on the northwestern wall bring the arena to life even before the event begins.

"I like the intensity of the atmosphere. Regardless of the event that I've been to, it's always been high energy," Robert Van Wyhe, undergraduate student and basketball fan at UW-Madison, says.

Once inside the Kohl Center, tradition and school pride run prevalent with championship banners, W's everywhere and fans creating a sea of red. Few other places pack so much pride into one space.

"The Kohl Center provides UW-Madison a chance to continue sporting tradition, which many people, young and old, can relate to their entire lives," Jessica Zowghi, UW-Madison undergraduate, says. "There is a really great atmosphere at the basketball games. Everyone is excited and into the game, bright lights, loud sounds-so it really grabs your attention."

The draw of the arena is undeniable for sports fans and part of that comes from their love for the university. Another way the Kohl Center builds tradition for this campus is its commitment to fans through good architecture. The two overhanging balconies, emulating the old field house, bring fans closer to the action and create a tight-knit atmosphere.

"The Kohl Center provides UW-Madison a chance to continue sporting tradition, which many people, young and old, can relate to their entire lives."
- Jessica Zowghi

"I like that it's a smaller venue, as compared say to the Metrodome, where people seem far away from the action. At the Kohl Center people seem right on top of the court, which I think is good for the fans-because then they get great seats-and good for the players-for homecourt advantage," Zowghi says.

The setup for a great atmosphere at the Kohl Center is no mistake, and great developmental effort preceded the results spectators enjoy today. Architecturally and aesthetically the building is effective, but it's not until realizing the unique nature of the Kohl Center that its greatness can truly be appreciated.

" At the Kohl Center people seem right on top of the court, which I think is good for the fans because then they get great seats, and good for the players for homecourt advantage," - Jessica Zowghi

In the developmental stages of the stadium, architects, engineers and planners worked in partnership to bring a vision into shape. It's impressive the facility was completed ahead of schedule when considering the cooperation needed for such a massive undertaking.

"[The architect] is the leader of the project so we follow them," Bob Jeffers, project engineer and electrical systems coordinator for the Kohl Center, says. "On a project that's this big, it's hard to keep tabs on everybody. So we have to have a team that doesn't need to be told exactly what to do. They have to be self-starters."

Not only was the sheer size of the project somewhat daunting, but so was the demand for a versatile venue, one that can host basketball, hockey and other assorted events like concerts and graduation ceremonies. The logistics of this problem keep the team working on unique and often unexplored problems.

Photo by Mason Cutsforth

Etchings of basketball players welcome fans and athletes alike into the Nicholas-Johnson Pavillion. The Pavillion houses three full size basketball courts and is used as a practice gym when the main arena is booked for other events.

"Anytime you have a space that is kind of a multi-use space, it always creates conflict. It'd be a lot easier if we could just design for one function, but having a design for multiple functions challenges us to come up with some creative solutions," Jeffers says.

One such creative solution allows for changing between sporting events. During a change from hockey to basketball, the hockey ice rink is covered to insulate the cold medium underneath and create a base for the basketball court.

"It's called 'Polar Floor' and it's [made of] four by four sheets of insulation. Basically it's a good, hard plastic. These [sheets] just fit together kind of like a puzzle," Larry Johns, a Kohl Center worker, says.

Because of the differences in size of the basketball court and hockey rink, seats must be mobile horizontally to fit tighter around the court and vertically to accommodate its different height. The Kohl Center staff meets this challenge with a system of inner risers that includes sliding trays and a lift system at both endlines. This lift raises 750 seats a total of seven feet. The result is an arena that feels dedicated to just the sport that is out on the floor.

With creative solutions, engineers, designers and workers constructed a truly unique home for UW-Madison sports. And even though they don't realize it, Kohl Center fans reap the benefits of this hard work. WE

Author Bio: Robert is writing toward a career in environmental journalism. His goal is to instill public and corporate awareness of environmental issues crucial for the sustainability of our planet.

Photo by Mason Cutsforth

The lowest section of seats in the Kohl Center can be withdrawn to make room for a first class hockey rink. The conversion process takes roughly three hours and occurs as often as three times a week during the basketball/hockey season.

Good vibrations

Applying Piezoelectric materials to the world of sports

By Anita Boor and Jamie Tabaka

Imagine how different fishing would be without graphite rods or how archaic golf would be without liquid metal club heads. Modern technology has done much to advance the world of sports equipment. Among the most recent advances is the use of piezoelectric materials-"smart technology" that can dampen unwanted vibrations in sports equipment such as skis, tennis rackets and mountain bikes.

> **"As a materials scientist, I just had to have a pair of these skis."**
> **-Eric Hellstrom**

Piezoelectric materials have unique properties that allow them to convert mechanical energy into electrical energy and vice versa. When a piezoelectric material experiences a mechanical force, it produces an electric field. This electric field induces a change in the material's structure. Piezoelectric materials detect mechanical forces through changes in their structure and respond to electromagnetic fields by changing their structure. Their ability to both detect mechanical forces and respond to electromagnetic fields means piezoelectric materials can be used as both sensors and actuators.

These properties are due to the arrangement of atoms in piezoelectric materials. They are composed of a lattice of atoms, which can be deformed by an applied force or change in electric field.

Picture a cube with one negatively charged atom at each corner and a single positively charged atom in the center. When the positive atom is exactly at the center of the cube, the material is not piezoelectric. However, if it is moved slightly off-center, the material becomes piezoelectric, because the distance between the positive and negative charges is different at the top of the cube than it is at the bottom. This causes a net electric dipole (a dipole consists of two equal and opposite charges separated by some small distance).

If the cube is deformed by a mechanical force, the atoms are shifted and the strength of the dipole is changed. Conversely, if the cube is subjected to an electric field, the charged atoms can be pulled apart or pushed together, causing the material to change shape.

Piezoelectric materials have been applied to a wide range of industries. You are probably wearing a piece of piezoelectric material right now: quartz. A naturally occurring piezoelectric material, it can be found keeping time in simple everyday devices like wrist watches.

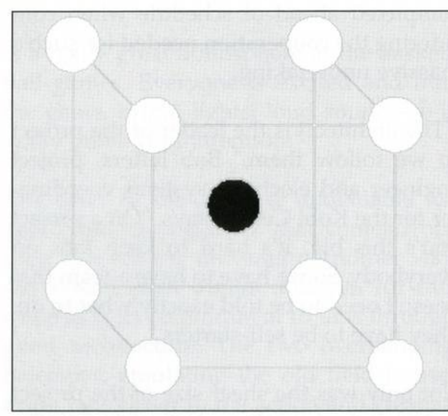


Photo by Jamie Tabaka

This configuration of centered positive atom surrounded by negitve atoms is not piezoelectric due to balanced charges.

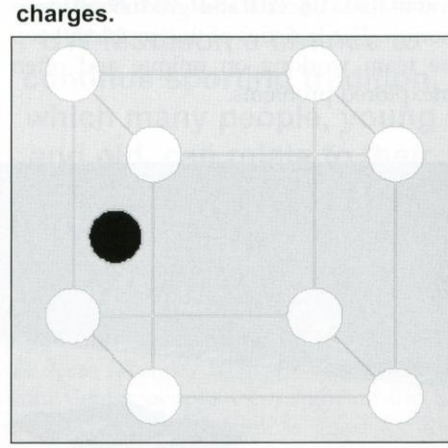


Photo by Jamie Tabaka

The positive atom has now been moved off-center, making the structure piezoelectric.

Synthesized piezoelectric materials prevent flutters in the rudders of extraordinary machines like the U.S. Navy's F/A-18 Tomcat fighter. The applications of piezoelectric materials seem ubiquitous and have recently made their way into the realm of sports, finding particular success in ski technology.

For skiers who have been plagued by vibrating skis, also known as "chattering skis," piezoelectric materials provide welcome relief. The possibility of eliminating unwanted vibrations while skiing over bumpy terrain has many skiers smiling, including professor Eric Hellstrom. "As a material scientist, I just had to have a pair of these piezoelectric skis," Hellstrom says.

By stiffening these "smart skis" when needed, piezoelectric materials reduce vibrations and keep more of the ski in contact with the snow. This provides the skier with more control when turning.

The first smart ski, the K2 Four, was produced by alpine ski manufacturer K2 in 1995. Engineers placed a piezoelectric ceramic plate on the ski directly in front of the binding-the area that experiences the most vibrations. Originally, the piezoelectric material was simply used to absorb energy and dissipate it in the form of heat or through the light of an LED.

Later the design was enhanced to return the energy to the piezoelectric material. When these later systems experience vibrations, they generate a voltage that is sent to an electrical control circuit. The circuit sends an electrical signal back to the piezoelectric material a few milliseconds later. This signal changes the stiffness of the piezoelectric material, dampening the vibrations.

Most recently, Head, another alpine ski manufacturer, developed piezoelectric polymers that are directly embedded in the skies.

"I think [piezoelectric polymers have] a good chance of being widely used, because it is easier to manufacture polymer fibers than ceramic plates, and fibers can be woven into a wide variety of shapes," Hellstrom says.

In addition to skis, piezoelectric materials have been used in the hydraulic systems of mountain bikes and the frames of tennis rackets. They are potentially beneficial whenever trying to dampen vibrations.

"One could think of incorporating piezoelectric fibers in arrows to keep them straighter as they are shot from a bow [or] woven into support stockings for hospital patients to have a rhythmic compression that pushes blood from patients legs towards their heart," Hellstrom speculates.

Indeed, the possibilities for applying piezoelectric materials seem endless. WE

Author Bios:

Anita is a sophomore with an undetermined major.

Jamie is a sophomore majoring in electrical engineering.

Photo by Jamie Tabaka

According to materials science professor and skier Eric Hellstrom, piezoelectric materials have a promising future.

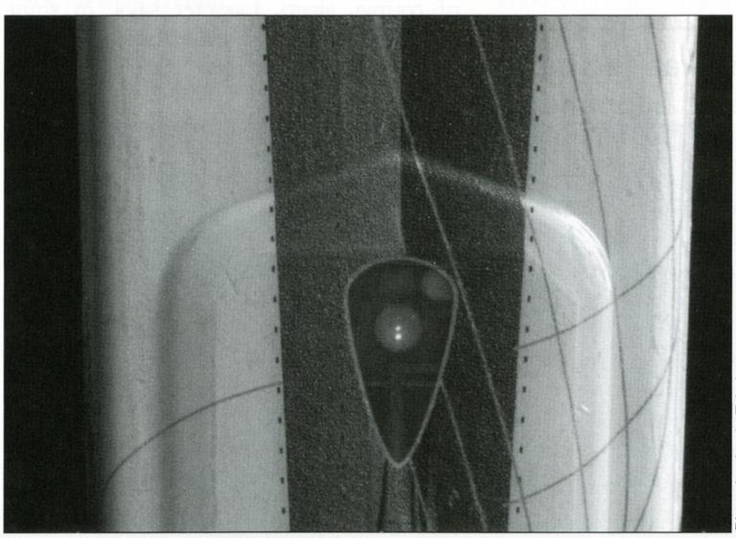
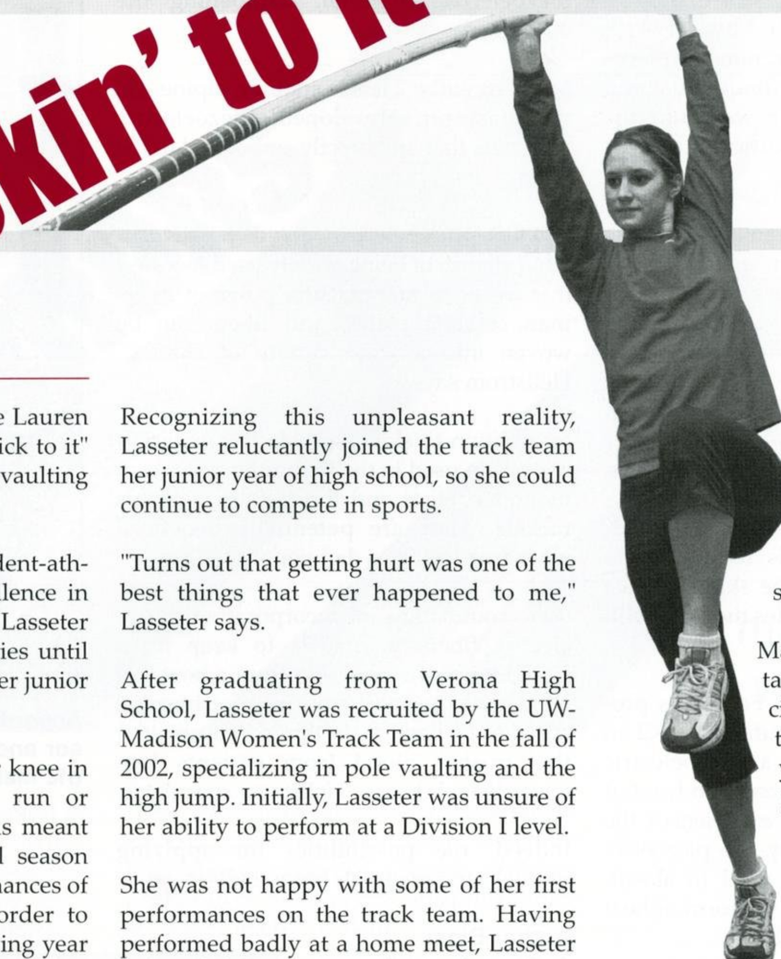


Photo by Jamie Tabaka

The LED lights on this K2 ski are powered by the current generated by the piezoelectric plate on top of the ski and show that the ski is being actively dampened.

Stickin' to it

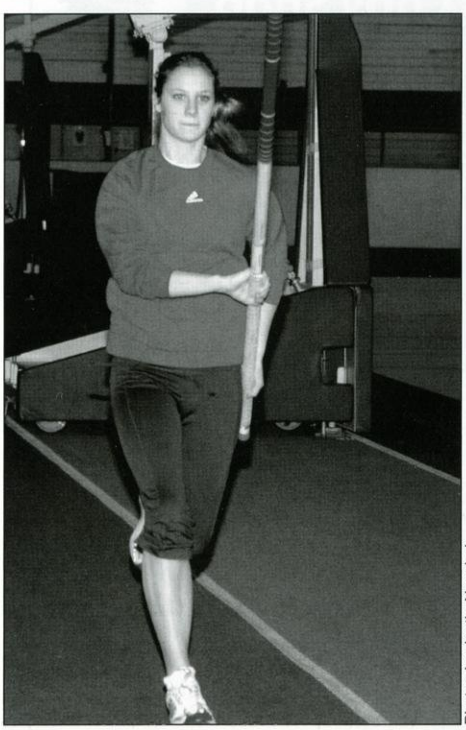


By Sarah Michaels

UW-Madison student-athlete Lauren Lasseter knows how to "stick to it" when it comes to both pole vaulting and engineering.

Many accomplished collegiate student-athletes begin to develop their excellence in athletics early in life. However, Lasseter did not realize her jumping abilities until she joined the track team during her junior year of high school.

When she tore the cartilage in her knee in high school, Lasseter could not run or jump for a lengthy 22 weeks. This meant that her sophomore year softball season would immediately end and her chances of regaining her prior strength in order to play at the varsity level the following year would be slight.



Photos by Justin Novshek

Lasseter sprints, pole in hand, in the Shell.

Recognizing this unpleasant reality, Lasseter reluctantly joined the track team her junior year of high school, so she could continue to compete in sports.

"Turns out that getting hurt was one of the best things that ever happened to me," Lasseter says.

After graduating from Verona High School, Lasseter was recruited by the UW-Madison Women's Track Team in the fall of 2002, specializing in pole vaulting and the high jump. Initially, Lasseter was unsure of her ability to perform at a Division I level.

She was not happy with some of her first performances on the track team. Having performed badly at a home meet, Lasseter believed her chances of traveling to an away event would be unlikely. On the contrary, Lasseter traveled with the team to a meet in Seattle, Wash., where she beat her personal best jump by 11 inches. This performance placed her fourth on the all-time list for UW-Madison women pole vaulters.

> **"Getting hurt was the best thing that ever happened to me"**
> **-Lauren Lasseter**

While traveling across the country can be a great team bonding experience as well as an ideal means of seeing new places and meeting new people, it does not come without costs. Traveling to competitions during the season requires a significant amount of focus and diligence in order to complete coursework while mentally preparing for the meet. Track meets take Lasseter all around the country including to New York, California and, frequently, Iowa. These Thursday to Sunday trips leave little time for studies and sometimes impede upon exams.

"[You] have to have a professor who is understanding," Lasseter says.

Many times the most important meets of the year coincide with the most important academic period of the year: final exams. Every year, the track team's Big Ten competition falls on final exam week. The conflict of interests between school and athletics imposes additional stress and requires some negotiation between Lasseter and her professors. This rescheduling can cause clusters of exams within a two- to three-day period. This requires an enormous ability to organize and allot an appropriate amount of study time for each class as well as maintain track practice schedules and, of course, sleep. Lasseter says, in some cases, athletes must multi-task by taking exams while on the road to a meet.

If the academic half of being a student-athlete was not challenging enough, the athletic side is often taxing as well. Lasseter says she has pole vaulted in many difficult conditions. Some of these circumstances include rain, sleet, wind and extreme heat. At one meet the rain was extremely heavy, yet the officials decided not to delay the event, and Lasseter had to compete. After every vault, helpers had to sweep puddles off the runway.

This year is Lasseter's third season as a student-athlete at UW-Madison and her third year in the College of Engineering. Despite the rigorous athletic schedule, she has still maintained a high level of academic achievement. Majoring in electrical engineering, a typical semester's course load consists of 12-13 credits. Lasseter's natural ability in the realm of mathematics and the sciences shines through when asked her feelings in regards to the difficulty and amount of course work required for her major. Lasseter feels she is "at a good pace and is learning a lot."

Lasseter's abilities have earned her not only the satisfaction of knowing she is an up-and-coming female engineer but also several awards for her talents both on and off the track. She has received several scholarships for her distinguished academic performance through the College of Engineering. Lasseter also received the prestigious Academic All-Big Ten honor.

"Track is a team sport just as much as an individual sport" -Lauren Lasseter

Unfortunately, Lasseter is injured once again, forcing her to red-shirt this year's track season due to a back injury. In an effort to maintain her physical strength and recover from the injury, Lasseter continues to cross-train four days a week by lifting weights and biking. She is still very much a part of the team.

"Track is a team sport just as much as an individual sport," Lasseter says.

Dedicated to this mentality, she often finds herself assisting her fellow teammates by videotaping jumps. Coaches can watch these videos and offer the athletes feedback on their technique.

Through times of difficulty, Lasseter says that what she enjoys most about being a part of the UW Women's Track Team is "a good sense of unity" between teammates. Indeed, it is the combination of common goals and support for each other that ensures a close-knit and successful team.

Her busy life doesn't stop there; she is currently gaining first-hand engineering experience. Outside of training, attending class and studying, Lasseter works part-time at Pegasus Lab, which specializes in nuclear fusion research. The lab performs controlled plasma experiments in hopes of learning how to use plasmas as an energy source. Her role at Pegasus Lab includes working directly with machinery in addition to using her knowledge of circuitry in designing circuits on the computer.

Clearly, being an engineering student and a collegiate athlete poses both physical and intellectual demands. Lasseter has no complaints. In fact, she thrives on a busy schedule. "If I'm less busy, I'm less productive," she says.

Lasseter believes her work ethic is a major contributing factor to her success as a student-athlete and will most likely have a positive influence in her future endeavors. She claims that track "teaches discipline, team work and [how to] balance time."

In the near future, Lasseter hopes to gain more experience in the engineering field by doing a co-op or internship. She later hopes to use her engineering degree to start her career in an engineering firm. A mix of innate talent, intelligence and discipline, Lasseter knows how to "stick to it." WE

Photo by Justin Novshek

Lasseter is an electrical engineering student, pole vaulter, and Academic All-Big Ten Honor recipient.

Author Bio: Sarah Michaels is a junior majoring in English literature and hopes to earn a certificate in technical communications. This is her first semester writing for the *Wisconsin Engineer*.

Photo by Justin Novshek

Lasseter was a gymnast before she started pole vaulting in high school.

Hot Shot or Not?

A look into streaks in sports

By Emily Niebuhr and Brad Groh

Few would argue with the statement that Joe DiMaggio was a phenomenal baseball player, especially in light of his 56 game hitting streak in 1941. But is it possible that one of the pinnacle achievements in all of sports history was no more unusual than flipping heads 56 times in a row? Or are there some moments in time when an athlete leaves the realm of statistics to play at a phenomenal level, commonly known as having a "hot hand"? Because of the strong feelings on both sides of the argument, the "hot hand" debate is the source of a fire all its own.

UW-Madison sophmore guard Kammron Taylor takes the ball inside vs. Indana on March 1st, 2005. Taylor scored an average of 8.5 points per game for the 2004-05 season.

Photo by Carl Calhoun

Robert Wardrop, sports enthusiast and professor of statistics at UW-Madison, helps to shed some light on this issue.

"One school of thought, the one that's dominant, is that everything's just random. And the other school of thought, which I believe, is that perhaps for much of the time in the world things are random but occasionally players become either very, very good or very, very bad."

For most people who believe in the hot hand, the phenomenon is more adequately expressed on the court or field as opposed to pure calculations using paper and pencil.

"We [past and present athletes] all believe in the hot hand," Wardrop says, reflecting on his own high school basketball experience. "We know because we experienced it. We've had days where you just throw up anything and it goes in. And other days you can't hit the rim from six feet away. That is not random; that is something happening."

"I think it's obvious, even as a statistician, that players occasionally become a whole lot better than they would be otherwise. And that can be the joy of watching sports." - Robert Wardrop

Indeed, some psychologists have found evidence that player thoughts and actions are influenced by streaks. In other words, players that have been playing "above their normal potential" tend to recognize the shift and adjust their actions despite the fact that the odds of scoring a basket or hitting a pitch remain the same. According to this research, recognition of the "hot hand" is a product of cognitive interpretation rather than enhanced physical ability.

"Recent fMRI [Functional Magnetic Resonance Imaging] evidence has found that specific areas of the brain have increased activation when people experience events producing a streak of the same outcome," Bruce Burns, professor of psychology at Michigan State University, writes on his website. "This is consistent with what has long been observed that people's future choices can be influenced by a streak of events."

From left: UW-Madison Hockey teammates Matt Auffrey, Jeff Likens, Bernd Brückler,and Joe Pavelski defend their goal in a 2004-05 season game against the Minnesota Gophers. Was the Badgers' triumph over the Gophers due to the skill of their team, or because of statistical luck?

Those opposing the "hot hand" theory suggest that every event has some discrete and completely independent probability of occurring. For example, opponents of the "hot hand" theory might suggest that every time Michael Jordan stepped up to the free throw line, he may have had an 83% chance of making the basket, regardless of the game situation.

Similarly, many psychologists and statisticians argue that a streak is merely a reflection of unusual statistics. To determine whether streaks in sports can be attributed to luck or to changes in a player's psyche, player performance has been analyzed from a physiological and statistical perspective.

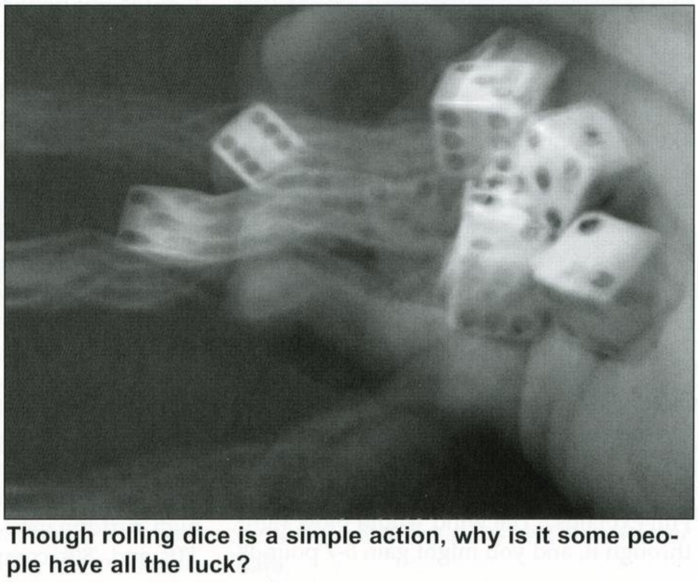
In the case of basketball, statisticians have found little to no correlation between a given shot and the results of the prior attempt. This evidence gives support to the notion that events such as shooting a basket or hitting a baseball are independent of previous successes or failures. To these researchers, the "hot hand" is little more than a vague interpretation of an extremely unusual statistical phenomenon.

To illustrate this belief, Alan Reifman, professor of human development and family studies at Texas Tech University, writes on his website, "Even random processes with inanimate objects, such as coin-flipping, can yield occasional long steaks. "Supporters of the hot hand, however question the comparison between a human player and an inanimate object.

"That's an unfair argument," claims Wardrop. "Roulette [wheels] are mechanical, dice are mechanical. And few people would argue there's much skill in throwing dice. And the thought of comparing dice with shooting baskets is silly."

Regardless of whether athletic performance is driven by pure statistical probability or by external forces unexplained by science, the fact remains that extraordinary streaks and efforts do occur in sports. In the face of statistical reasoning and probability estimates, athletes continue to reach beyond their normal potential. The "hot hand" may or may not exist from a scientific standpoint. What makes sports so interesting, however, is the fact that on any given night, in any given location, a seemingly "hot hand" may develop.

"I think it's obvious, even as a statistician, that players occasionally become a whole lot better than they would be otherwise. And that can be the joy of watching sports. But Michael Jordan goes out with the flu and he wins the game. That's incredible, not just random," Wardrop says. **WE**



Though rolling dice is a simple action, why is it some people have all the luck?

Photo by Aaron Arnold

Author Bios:

Brad Groh is a senior in the civil and environmental engineering department. He is an active member on the American Society of Civil Engineers' concrete canoe team. Brad is also pursuing a technical communication certificate.

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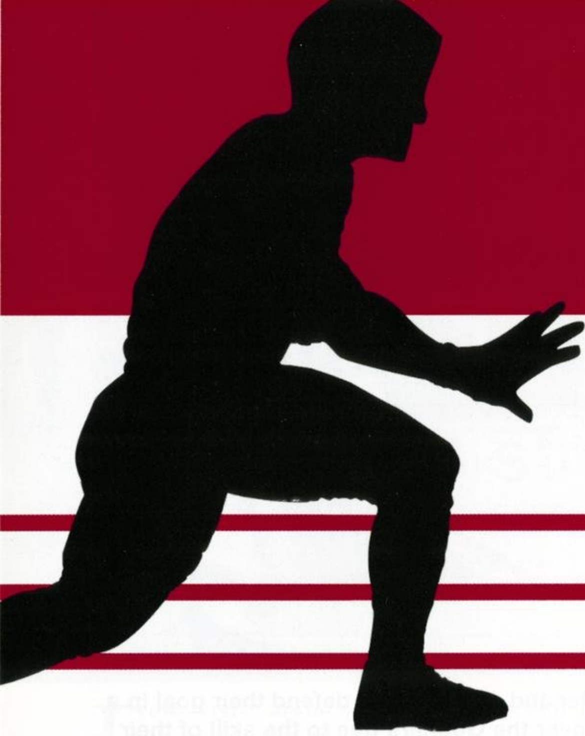

It Keeps You RUNNIN'

By Mike Verner

In the first Olympic Games, held sometime in the 9th century B.C., none of the athletes were dressed in colors representing where they were from. In fact, they all wore the same thing: their birthday suits. A few millennia later, humans still enjoy running, the most basic form of sport, yet for us running naked isn't an option.

Humans are now spread all over the globe, rather than being confined to the temperate regions where our species first learned to run. Wind, cold, rain, snow, heat and humidity all challenge lovers of this sport. To continue to run in the far corners of the earth, we had to develop some protection from the elements.

For most of the 20th century, cotton was not only the dominate fabric in our casual clothes, but of athletic apparel as well. The invention of Nylon in 1938 offered runners a new more durable material to use, but it was really only practical for shorts. As far as shirts and pants were concerned, runners were stuck with cotton.

In the late 1970s, a man named Jim Hill ran cross country and track for the University of Oregon. He spent his high school days in Virginia, so getting used to the constant rain of the Pacific Northwest was a challenge. However he felt that he shouldn't have to just "get used to it."

"In the winter we'd wear lots of cotton" Hill explains. "The wind would blow right through it, and you might gain 5-7 pounds of water if it were raining. This made it extremely difficult to layer." This wasn't just a problem for him; it was a problem for many runners across America.

A few years later, the fabric industry started to listen to the complaints of runners. New materials started to spin out of textile plants, and in the early '80s, tights became popular. They kept runners warm, didn't absorb much water and seemed like the perfect solution. Hill disagreed. Since he couldn't get over the idea of running in something that was "painted on," he decided to form his own business for runners who shared this opinion.

The inspiration for this company, Sporthill, came from a pair of European soccer pants that his old high school coach had picked up for him while in Ireland. Hill knew that the cut and the fabric were more appropriate for running than anything the United States had to offer, but they weren't quite there yet. That is until he discovered 3SP.

"It's probably the best fabric in the world," Hill claims. "No fiber, handmade or natural, has the hydrophobic qualities of 3SP." He goes on to say that in addition to its amazing resistance to wind and water, it doesn't pick up odor.

However, Sporthill was not the only startup company to produce running gear. Many others felt the same as Hill, wanting apparel that catered to the needs of the high performance athlete. Throughout the '70s and '80s companies like Hind, Craft and Sugoi began to pop up all across the globe. These companies would work with elite athletes to design products that fit their needs. And what's good enough for the Olympic athlete is good enough for the rest of us.

Athletes needed things that would repel water, not absorb it. They needed materials that would get rid of their sweat, not retain it. They needed clothes that would keep them warm without being bulky. They needed apparel that blocked the wind, yet allowed their bodies to breathe. Companies were fixated on addressing these issues and worked with the fabric mills to do so.

The concept of layering had been around for a while, but it began to take on a new meaning. Instead of peeling off layers as they heated up, athletes have endorsed the idea of each layer having a specific function.

Start with the outer shell. This is what protects a runner from wind, rain and sleet. Fabrics like Gore-Tex and now Epic have specialized in keeping athletes dry while allowing their skin to "breathe" so that they don't overheat during strenuous activity.

The middle layer provides warmth. This layer hasn't changed as much as the others, except for getting lighter.

The last layer is the base layer, the one that touches the skin. This is where the biggest changes have been made lately. The pur-

"It's probably the best fabric in the world. No fiber, handmade or natural, has the hydrophobic qualities of 3SP."

- Jim Hill, founder of Sporthill

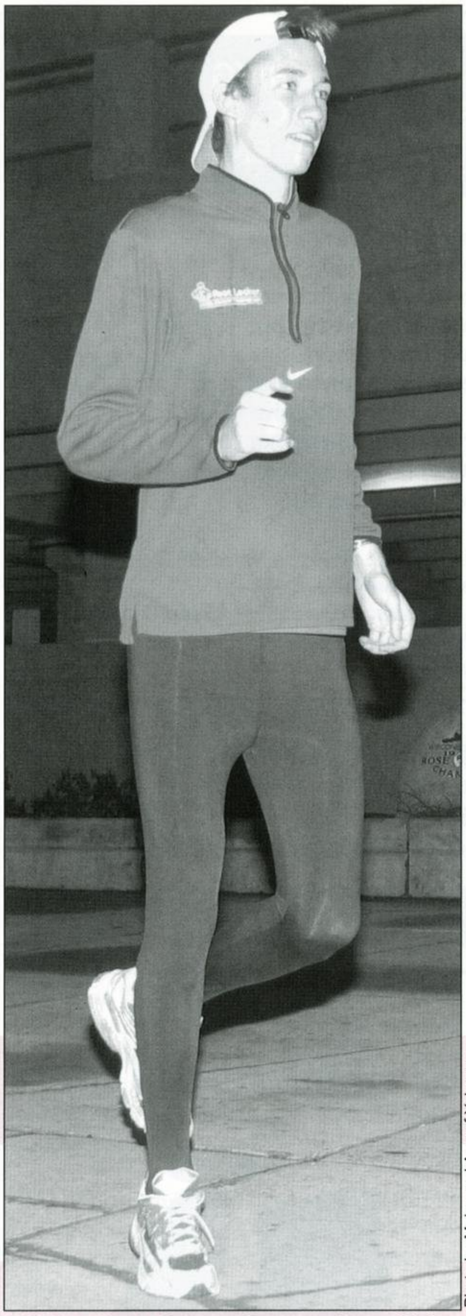

Photo by Muhamad Asyraf Yahaya

UW student Stuart Eagon dons lightweight running gear, shielding him from wind, water, and even odor.

pose of this layer is to keep your skin dry. If clothing soaks up an athlete's sweat and keeps it close to the body, he or she will get cold. Runners needed a material that could "wick" this moisture away from the body, keeping them dry and warm. All sorts of polyesters and man-made fabrics are being designed today to wick better.

Amazingly, some companies use a person's sweat to their advantage. A new fabric developed by the Japanese company Mizuno actually heats up noticeably when it absorbs perspiration. This material, known as "Breath Thermo" retains a person's sweat rather than wicking it away from the body. It turns the sweat into heat, keeping the body warm.

Other companies like Sugoi have tried to combine layers, resulting in a less bulky more streamlined fit for the runner. Sugoi's "Mid-Zero" and "Sub-Zero" product lines specialize in materials that feature a soft and fuzzy interior with a smooth and durable exterior. Not only does this keep the user warm while partially blocking wind, but it has a second feature as well. The inside has a much greater surface area than the outside, thereby allowing the material to wick perspiration away faster. When the sweat reaches the outer part of the fabric, it beads up and either brushes off or evaporates.

But these new materials are only one aspect of a good product. According to Sugoi's marketing manager, Stan Wong, three elements are necessary to make a great product. The first is obviously the fabric. This determines the function and ability of the product. The next are manufacturing details, such as the sewing or the knitting. For instance, how will seams still keep out the elements? The last part is the design-utilizing the material in a way that will best suit the athlete's needs.

The success of these smaller companies has spurred the larger ones to follow suit. Shoe giants Nike and Adidas have jumped into the game. Nike's "Dri-Fit" and Adidas' "Clima-cool" shirts have been enormously successful with athletes. These products have changed the life of the college athlete who might not have been able to afford them if it weren't for university sponsorships with these big companies.

UW-Madison cross country runner Bobby Lockhart agrees. Like Hill, he too grew up in Virginia, and spent his high school days wearing cotton T-shirts and nylon shorts.

"Since switching to a polyester like Climacool, my body has been much drier and my clothing much lighter on runs" says Lockhart. "I would never go back to cotton."

Clothing is continuing to change with runners' needs, and what the future has in store is very exciting for runners everywhere. A recent trade show in Salt Lake City unveiled new fibers and technologies. One of these was called Holofiber, which claims to modify light waves, interacting with particular wavelengths and turning them into energy. This energy is supposedly sent to the body to oxygenate a person's cells. Holofiber Inc. claims the body takes much less time to recover after working out while wearing this fabric.

It's obvious that what the future holds is much more then just protection from the elements. Modern textile engineering and design has made our "second skin" more efficient than our first, and it is perhaps even beginning to enhance athletes' abilities. Elite runners constantly strive for perfection - and modern technology is helping them attain it. WE

Author Bio: Mike Verner is a sophomore majoring in electrical engineering and enjoys running in his free time. This is his third article for *Wisconsin Engineer*.

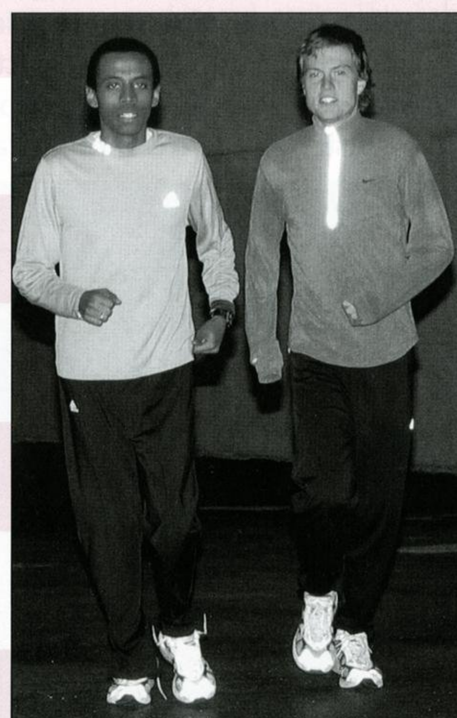

Photo by Muhamad Asyraf Yahaya

Reflective elements help keep night joggers Simon Bairu (left) and Ben Porter safe.

Walk this way

By Michelle Desnoyer

"To invent, you need a good imagination and a pile of junk," says Kreg Gruben, UW-Madison professor of kinesiology, quoting Thomas Edison and standing amidst his own "junk" pile. "Just getting your hands dirty and actually building stuff is critical."

This philosophy sums up the work ethic of two engineers in the UW-Madison kinesiology department researching different aspects of motor coordination in humans. Gruben, who holds a B.S. in agricultural engineering and a Ph.D. in biomedical engineering, studies coordination in lower limbs, while Professor Andrea Mason, who holds a Ph.D. in kinesiology, concentrates on the upper body.

Although they work separately, both Gruben and Mason use methods of engineering to answer critical questions about the human body. Gruben currently studies how the human nervous system causes the lower limbs to produce force and allow people to walk.

"My engineering degrees gave me a set of tools to use for problem solving," Gruben says. "They taught me how to look at the human body as one giant system, just like any machine."

Gruben uses these tools to approach motor coordination research from a different direction.

"For years, kinesiology research has focused on measuring muscle activation to see how the control system puts muscles into motion to walk. They didn't learn the secret to motor control, however, so what we wonder is-maybe the control system doesn't particularly care what the individual muscles are doing. Maybe the control system-like the director of a large factory-is more interested in the global product, not the small variables involved in putting it together," Gruben says.

So Gruben and his team look at the end result-the application of force by the foot, which is the mechanism that allows walking. In his research, Gruben designs and builds his own equipment to isolate the muscle component of foot force over which the nervous system has the most control. His research subjects consist of healthy adults, adults who have recently suffered a stroke and adults who have torn their Anterior Cruciate Ligament (ACL).

"What our research has found so far is that the nervous system has a preference of how to coordinate force, and even though the pedal is moving in various ways, there's still the same control strategy-one highly tuned for balance during walking," Gruben describes. "In stroke patients, the force applied by the foot increases in a linear fashion just as in neurologically intact individuals, but those with stroke don't push in the same direction."

Gruben goes on to say that this finding indicates the strategy for walking resides in the spinal cord, but the higher levels in the brain somehow get confused after a stroke and interfere with the coordination pattern in a specific manner: altering the force direction.

He compares a stroke patient to a baby learning to walk, since infants may direct force in a similar way. Both tend to fall backwards and may bend at the hip to compensate, which means learning to walk might involve correcting the direction of foot force. Stroke patients essentially have to relearn how to walk by reorganizing the control system to retain balance by redirecting the force or overcompensating in any way they can.

"The [physical] therapists work with stroke patients to correct all the things that look funny in gait. The compensating behaviors the patients do to accommodate for the misdirected force should not be viewed as the problem, but rather as appropriate responses to an altered system. Maybe the most important thing to teach is how to correctly direct the foot force," Gruben says.

Gruben hopes his research will provide insight into how humans learn, or relearn, to walk. This way, stroke victims can recover more quickly and easily. This basic understanding of motor coordination could launch advanced research, such as how to improve coordination in athletes and other adults.

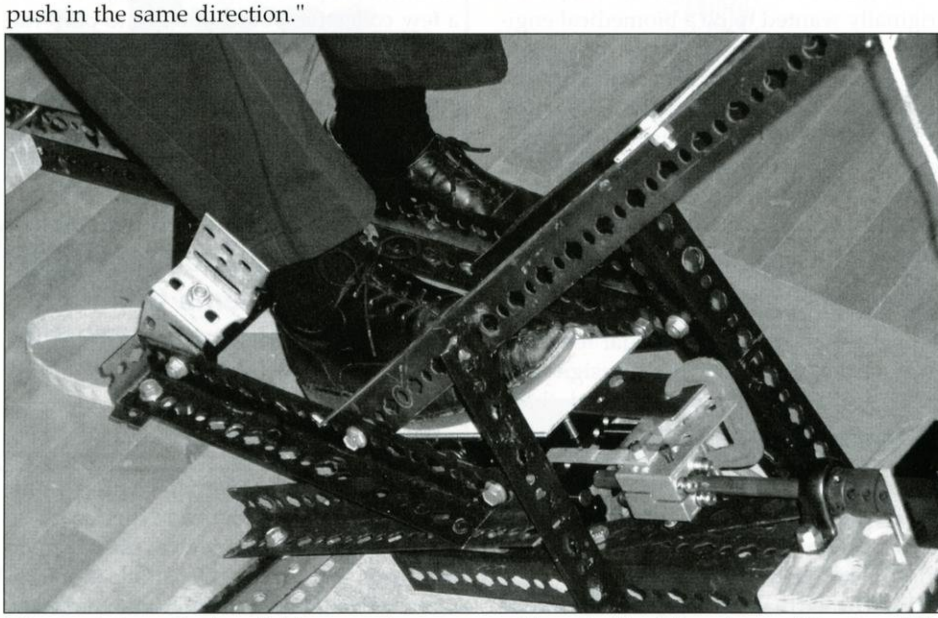

Photo by Adam Dahlen

The prototype foot pedal is one of many machines in the laboratory of Gruben. The prototypes allow Gruben to study the forces a body experiences when walking.

"My main research involves understanding how sensory information, such as visual and haptic [sense of active touch] feedback is used to control simple, bimanual and collaborative movements made in both natural and virtual environments," Mason starts.

"The results of our studies will give us insight into motor control in humans. For practical applications, such as virtual environments for training or sports applications, we will know the minimum amount of sensory information needed to perform the skill effectively."
- Andrea Mason

Mason's first study involves the coordination between two people passing an object. Research subjects pass an instrument over a square taped onto a table. The silver instrument is about the size of a cell phone but has the ability to record grasping forces when the passer lets go and the receiver takes full possession.

Designing experiments like this involves using skills from both parts of Mason's educational background.

"My undergraduate engineering degree mostly helped me with problem solving and logical thinking," says Mason, who originally wanted to be a biomedical engineer, but her undergraduate university didn't offer it as a major. Consequently, she decided to conducted her graduate study in kinesiology. She discovered it was really the area she wanted to work in. "[Engineering] helps me to come up with logical solutions others may have more difficulty with."

And how does one solve the problem of testing the importance of visual feedback in a virtual environment? Design and build a virtual environment. And that's exactly what Mason did.

Mason tests how much sensory feedback the average person needs in order to perform tasks with her creation, the Wisconsin Virtual Environment (WISCVE). The virtual environment functions as follows: Motion information, for example, movement of the subject's hand, is monitored by a PTI, Phoenix's Visualeyez motion analysis system.

This motion information is used to generate a graphic image of the user's hand and objects within the environment. The image is displayed on a downward facing monitor, placed parallel to a work surface. A mirror is placed parallel to the computer monitor, midway between the screen and the work surface. The mirror reflects the image on the computer monitor which subjects perceive, wearing stereoscopic goggles, as if it were a three-dimensional object located on the work surface below the mirror. In a typical experiment, test subjects are asked to grasp and handle augmented objects, real objects with graphic images overlaid.

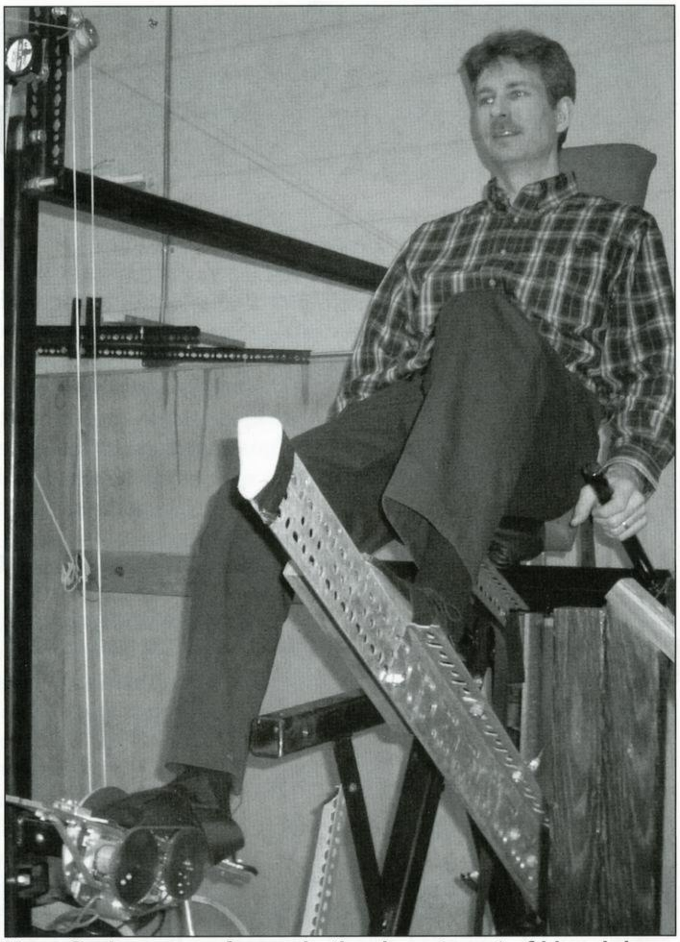

Photo by Adam Dahlen

Kreg Gruben, a professor in the department of kinesiology, demonstrates how patients use a machine designed to measure the forces produced in the lower limbs.

Through her research, Mason tries to answer some important questions. Do we need to see our limbs to better perform in a virtual environment? Do we have to see an entire graphic image of the object or are a few collective points enough to perform effectively?

"Engineers should know they don't have to just go out and start designing products. They can use their experience to solve complex biological problems that have resisted explanation, such as how we walk."
- Kreg Gruben

"These results of our studies will give us insight into motor control in humans. For practical applications, such as virtual environments for training or sports applications, we will know the minimum amount of sensory information needed to perform the skill effectively," Mason says. "This is important because the amount of computer memory and power required to mimic a real environment is unfeasible. But if we can reduce what needs to be reproduced in a virtual environment, it can be made more cheaply, but still effectively enough to be of value."

With the combined research of these two engineers, the basic elements of human locomotion can be uncovered. This knowledge will enable future generations to be better coordinated or even help them overcome typically debilitating illnesses like stroke.

"Engineers should know they don't have to just go out and start designing products," Gruben says. "They can use their experience to solve complex biological problems that have resisted explanation, such as how we walk." WE

Author Bio: Michelle is a senior graduating with a double major in English and political science, with a technical communications certificate.

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Sports drinks:

Photo by Erin Jacobs

the fuel of athletes

By Nate Holton

If an athlete in training were a high performance sports car, then a sports drink would be super-premium gasoline. Indeed, since the invention of Gatorade in 1965 by Robert Cade, a University of Florida kidney specialist, the sports drink industry has taken off, and athletes have reaped the benefits.

If sports drinks are like a super-premium fuel, then water could be described as regular unleaded gasoline.

Sports drinks work by combining carbohydrates and electrolytes with liquids to create a drink to help keep athletes' bodies hydrated and functional. Electrolytes, such as potassium and sodium, are lost when an athlete sweats during training. These are important because they help with muscle movement and ensure that the water in the body is transferred effectively. Furthermore, the presence of electrolytes makes the body desire more liquid, encouraging proper hydration.

Like electrolytes, carbohydrates such as glucose work to keep an athlete in top condition during crunch time. Once consumed, carbohydrates rapidly enter the blood stream through the small intestine.

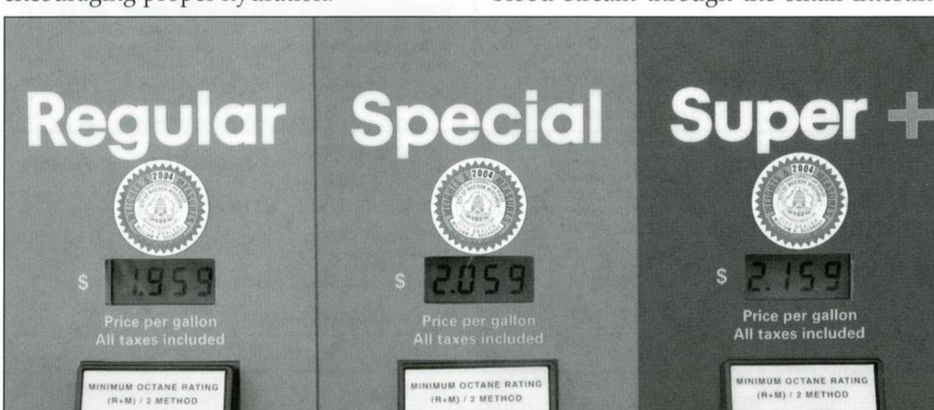

Photo by Erin Jacobs

Sports drinks are much like super+ fuel; both are specially formulated to give high performance machines the extra boost they need.

From there, they can travel to the muscles, where they serve as fuel. Carbs are enormously beneficial to anyone engaged in physical activity.

UW-Madison sports nutritionist Jeremy Isensee says that carbs are "used by the muscles as a primary fuel source. It's the most effective fuel source and as you're working out you deplete those, so immediately afterwards you want to get as many back in."

In addition to working as a fuel, carbohydrates also speed up the hydration process.

In addition to working as a fuel, carbohydrates also speed up the hydration process. While water alone will rehydrate the body, water and carbohydrates rehydrate the body faster, which is an obvious advantage to athletes who cannot afford to lose a step.

To optimize their products, sports drink makers, particularly Gatorade, have done extensive peer-reviewed research on their products' effectiveness. Numerous studies have concluded that certain ratios of carbohydrates and electrolytes to fluid can give a hard working athlete a noticeable boost in performance. There have even been studies done to determine what flavors athletes prefer when they're in the heat of the battle, since these preferences are different from when the body is resting.

Photo by Erin Jacobs

Gatorade has done special research to make their combination of carbohydrates and electrolytes give a noticeable boost to an athlete's performance.

"When you're not working out, an ice cream sundae will taste really good, but when you're done working out it won't taste the same, so they've studied taste a lot to make sure that their drinks are tasty," Isensee says.

Gatorade currently dominates the market and is the most well known sports drink available, in part because of the "Gatorade showers" that were first made famous by the New York Giants and their head coach Bill Parcells in 1987. However, sports drinks in general, including Powerade, All Sport, Everlast and Hydrafuel offer the same advantages to athletes.

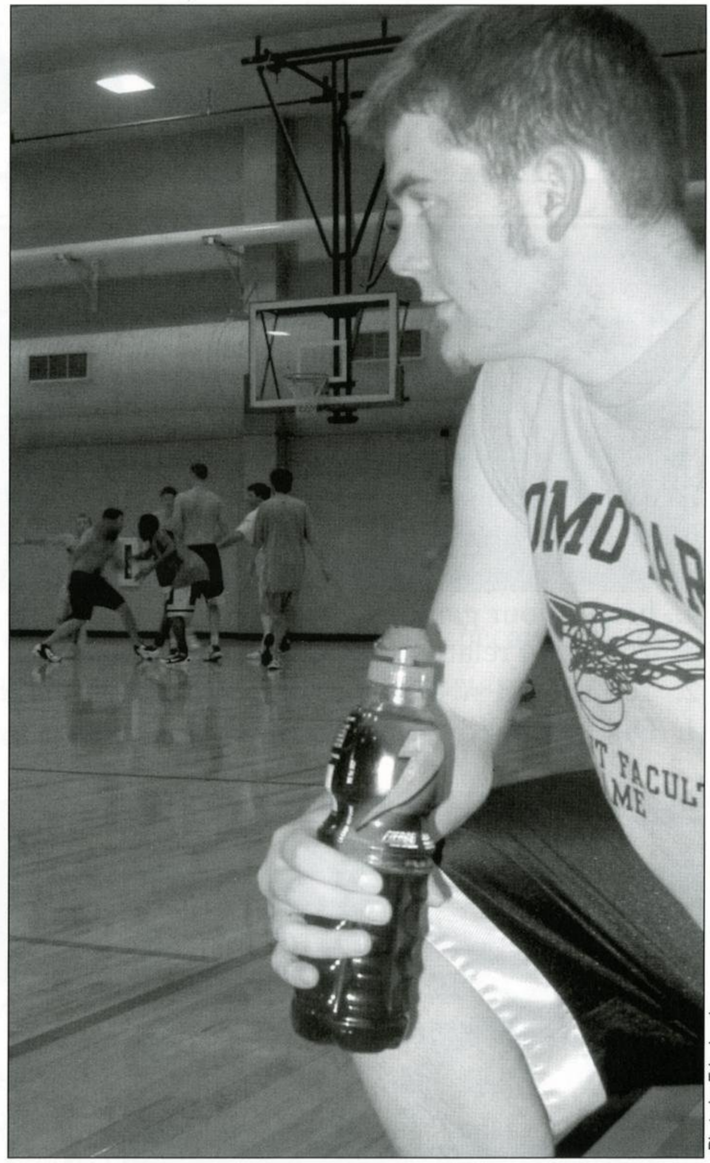

Photo by Erin Jacobs

Dan Countryman has Gatorade on hand to give him energy to play basketball.

Is there a downside to sports drinks? So long as you're an athlete engaging in strenuous activity, the answer would appear to be no. Any possible disadvantage of sports drinks occurs when people who are not engaging in rigorous physical activity feel that they need a boost.

"If it's 80 degrees out and you're playing golf, you should drink water. Now, if you're in Arizona, and it's 98 degrees out, and you're walking through 18 holes, then it's okay to have a sports drink," Dale Schoeller, UW-Madison nutritional science professor, says.

Sports drinks contain calories and a large amount of sugar, which can be unhealthy, particularly for those who do not need or will not use the advantages that sports drinks provide. In this case, drinking water is perfectly fine and would be considered the right option for hydration. If sports drinks are like a super-premium fuel, then water could be described as regular unleaded gasoline; if one is driving a typical sedan and not a high performance sports car, then the unleaded gas would be the more logical choice. WE

Author Bio: Nate Holton is a senior majoring in philosophy and mechanical engineering. Upon graduation, he plans to attend law school. Though originally from Milwaukee, he is an avid 49ers fan.

Just One More

The Finest in Eclectic Humor

By Skye McAllister

Top 7 Engineering Trash Talking Phrases and Excuses

Trash Talk

7. First I'm gonna break down your game, and then I'm gonna break Newton's 1st Law.
6. Your turbulent game can't match my laminar skills.
5. My skills are so complex they can only be described in 4 dimensions.
4. Just so your game doesn't completely collapse, I will multiply your score by a safety factor of 2.5.
3. Theory of relativity? HA! Try deriving this...
2. You should switch to structural engineering and build a house with all of those bricks.
1. Did you fail dynamics? Because your game is static.

Trash Excuse

7. It's not my fault, the coefficient of restitution of the ball is insufficient.
6. Sure you can beat me, but what about my robot, Dunk-a-tron?
5. It's not my fault, I'm big brained.
4. My backpack got in the way.
3. I'm much better at the Playstation version.
2. I didn't have time to compute the proper arc of my shot.
1. The ball and the rim must both be negatively charged.

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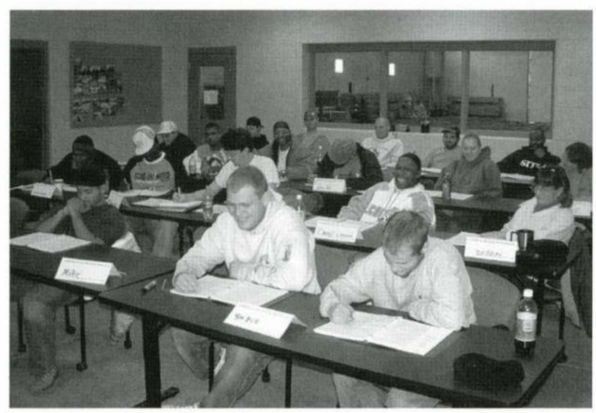

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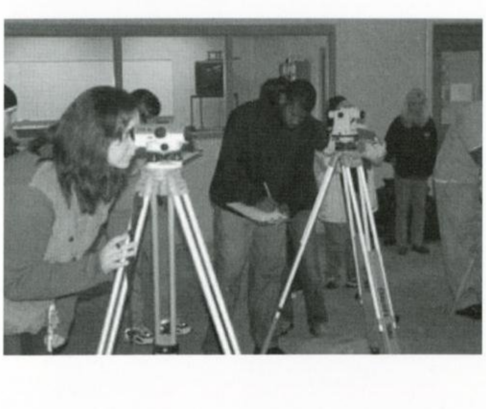

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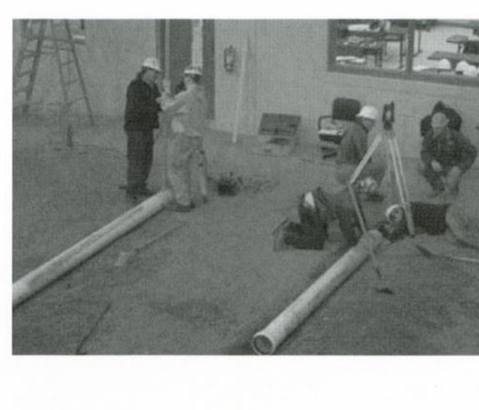

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