Columbians are breaking ground in areas spanning health, science, education and the arts
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Very spring, the Missourian produces a Progress Edition to report on new developments around Columbia.

This year, the Progress Edition highlights people who are using their expertise and resources in original ways to break new ground.

Columbia has three higher education campuses, including a prominent public research institution that is a leader in innovation. Since 2008, MU has filed 465 U.S. patents and signed 257 options and licenses for new technologies.

Annually, university faculty submit more than 2,000 new proposals to secure grants and contracts. Their discoveries in medicine, health and nutrition, education, agriculture and the social sciences are evidence that MU research makes a global difference.

Groundbreaking work extends across all campuses in other areas — political science, criminal justice, music, art, technology and more.

Examples of these projects include:

- A team in physics and astronomy that has developed a 3-D microscope to observe membrane proteins in new ways;
- A medical bacteriologist testing a new method to speed anthrax detection.

In other pockets of the community, individuals are pioneering new ways to live and learn.

- Research is underway that could lead to the creation of a ‘solar farm’ on the site of a city utility station on West Ash Street north of Shelter Gardens.
- In the public schools, a class known as criminalistics gives students an opportunity to use scientific techniques to analyze physical evidence of crimes with hands-on experience and real-life situations.
- A local business is giving Columbia the distinction as the only place in the country where cosmetics made from camel’s milk are for sale.

These efforts are collaborations among many in the city who are working to solve problems and improve lives. This section is a snapshot of their innovative ideas.
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MU lab uses lasers to detect metastasized skin cancer faster

By TAYLOR FOX | news@ColumbiaMissourian.com

The Viator Lab at MU is researching how to detect melanoma cancer with lasers, which can not only detect the presence of cancer in the blood but also how much cancer.

Skin cancer is the most common form of cancer, killing more than 12,000 people in the U.S. each year. According to the American Cancer Society, 9,000 of those deaths are caused by melanoma.

Once melanoma spreads, or metastasizes, only 15 percent of patients survive, according to the Skin Cancer Society. So early detection is the key to survival.

John Viator and MU’s Viator Lab have developed a technology, the Viator Technologies Inc. Circulating Tumor Cell System 3.0 (VTI CTCS 3.0), which they say detects metastasized cancer cells faster than current methods in use.

“We’ve built the machine, we’ve convinced people that it does what it does, and now they can buy it,” Viator said.

Viator, Viator Technologies Inc. chief scientific officer, has been applying photoaoustic technology to the detection of circulating tumor cells since 2005. At the International Molecular Medicine Tri-Conference in San Francisco in February, he announced the market launch of the new technology.

“We have launched as a product for research use,” Viator said. “Although the market is small, there are a lot of researchers who want to use it to study melanoma for scientific use.”

Viator is working to take the technology to a Clinical Laboratory Improvement Amendments laboratory within the next two years and to the FDA in the future for diagnostic use.

“We want to make sure that no one has to die from (skin cancer) because they know soon enough that the treatment can be introduced before it gets really bad,” said Ben Goldschmidt, graduate researcher in the Viator Lab.
Currently, detecting metastasized skin cancer is expensive and can take months as it cannot be detected until a tumor has formed. The Viator Lab technology will allow doctors to determine whether cancer has spread to a patient’s bloodstream within a matter of seconds, adding significantly to a patient’s treatment time and chance for survival.

“We are focused on creating an actual solution to a problem,” said Mark Messler, undergraduate researcher. “It’s a very broad problem and we get to design a solution to it — you really get to use your creativity.”

The device, which Goldschmidt nicknamed the “Viatron,” works by flowing cells through a small tube, directing a laser at the tube and monitoring the reaction.

“The tool itself is cool to look at,” said Amanda Kappele, a Hughes Research Fellow who works with the Viator Lab. “I also really liked what they were applying it to.”

As the laser hits the cells, an ultrasonic microphone detects the dark, cancerous cells and emits a sound wave while clear, non-cancerous cells will produce little to no sound.

“It’s really kind of a game changer in cancer detection,” Goldschmidt said. “If you know even a single week in advance, that’s an extra week you can be getting treated.”

Because the Viator technology is much cheaper than MRI tests, patients will be able to monitor their risk for cancerous tumors more frequently.

“No one should have to wake up every day for six months and wonder if they have cancer,” Goldschmidt said.

In June, Viator Labs is planning to relocate to Duquesne University in Pittsburgh where Viator is currently creating a biomedical engineering department for the university. They will continue to further develop the laser technology to detect all types of cancers.

“The better we get at detecting skin cancer, the better (we will be able) to detect other types of cancers in the future,” Messler said.

Sources: VIATOR LAB, MISSOURIAN REPORTING

RAY HOWZE/Missourian

KEY
Melanoma cell
Healthy white blood cell

SIGNAL STRENGTH
Melanoma cell signal | Healthy cell signal

FINDING THE INFECTED CELLS
As cells pass by the laser, the sensor records the laser’s signal strength. If the sensor records a weak signal, the cell is healthy. If the sensor records a stronger signal, it means there are melanoma cells present.

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Most college freshmen are more worried about their grade in an introductory biology class than the state of health care in India.

While Rock Bridge alumni Nahush Katti and Vikram Arun certainly still worry about their classes, they are more concerned about their pet project: DoctorOn.

DoctorOn isn’t a game. It’s an app that Katti and Arun believe has the potential to improve access to eye check ups.

Although Katti, 19, is studying at Purdue University and Arun, 18, at Washington University in St. Louis, they are also long-time friends and the teenage CEOs of the telemedicine company that is developing the app for smartphones.

The DoctorOn app uses a smartphone and a special attachment, called iOn, to take a photo of the eye. The photo is uploaded to an online database where doctors can access and diagnose a patient from anywhere. The app would be geared more to health care providers, making it easier for them to screen patients in rural areas.

DoctorOn uses a wireless or 3G Internet service to transmit photos. Katti and Arun are banking on improvements in Internet access in rural India.

“In the U.S., 3G is all over the place, but in India now it’s kind of spotty, but it’s improving,” Arun said. “So we’re thinking that by the time we actually deploy it, the data signals there would equal that of the U.S. right now.”

The iOn attachment and DoctorOn app has a 92 percent accuracy rate.

iOn uses slit lamp technology, a large, bulky piece of ophthalmic equipment that is used to take photos of the front of the eye. It is most commonly used to diagnose cataracts, which cause 80 percent of all blindness in India, according to the International Development Association.

Although the app would still require patients to interact with a nurse or some sort of para-professional, training to use DoctorOn would take only a couple of days and would not require a medical degree to use. The app would also make slit lamps much smaller and easier for aid workers, nongovernmental organization workers or other health care workers to carry into rural communities.

Katti and Arun used a 3-D printer to build iOn, first using a machine at the Columbia Area Career Center and then in the MU 3-D Prototype Lab.

With new slit lamps costing thousands of dollars, Katti and Arun estimate that they would sell iOn to ophthalmic hospitals for about $100, or in a package with a smartphone for about $500. If health care providers would like to use their own smartphone, it needs to have at least an 8-megapixel camera.

“Initially we want to start with big hospitals because they have the manpower to distribute it to the masses,” Katti said. Eventually he wants to bring smaller city nurses and family practice doctors into the network to serve as checkup points in smaller villages.

Arun said the app is a win-win situation. Because doctors in India are usually paid based on the number of patients they see, doctors will make more money and patients will no longer have to travel long distances for a short visit.

“We are essentially increasing their field of access,” Arun said via email.
Too far for help

Much of the problem in India isn’t that the people can’t afford care but that care is too far away to conveniently access, according to the National Center for Biotechnology Information. Hospitals are located in large cities, several hours away from India’s many rural villages. Many of India’s rural roads are also not paved, making travel difficult, according to a report by the International Labor Organization.

Katti knows about this problem first hand.

Katti and Arun’s journey started almost four years ago, when Katti’s grandfather was diagnosed with Alzheimer’s disease. Because he lived in rural India, Katti’s grandfather had to commute two hours each way from his village to the hospital for his hour-long treatment. This seemed like an excessive amount of time to his grandson living in Columbia.

“I just thought that was ridiculous,” Katti said in a TEDxCoMo talk given in April 2013. “So I heard about this and I started talking to my friend Vikram Arun about it, and a couple of months later, and after some more discussion, we started DoctorOn, a telemedicine company.”

Katti and Arun had been friends for years, playing tennis against each other and joining their first tennis team together in middle school. It was not a surprise then when Katti decided to pair up with Arun to work on the idea of DoctorOn.

The pair pitched the idea to the Reynolds Journalism Institute’s Innovate!2010 Pitch Slam competition in August 2010. First place winners got the chance to compete in a global contest to find the 100 most innovative ideas in the world. Katti and Arun placed second. They weren’t discouraged, though, and went right back to work to improve their idea.

The project received $25,000 in funding from the United States-India Science and Technology Endowment Fund last summer, Katti said.

The partners don’t have a strict timeline for rolling out their first product, but they estimate DoctorOn will be available in India in about two years.

BY THE NUMBERS

$25,000

Funding the project received from the United States-India Science and Technology Endowment Fund last summer

92%

The accuracy rate of the iOn attachment and DoctorOn app

$100–$500

Katti and Arun estimate that they would sell iOn to ophthalmic hospitals for about $100, or in a package with a smartphone for about $500

Concept to prototype

Initially the pair wanted to create an app that would work in any and all types of medicine, with the ability to video conference between patient and doctor. After deciding that plan was a little ambitious for a first project, they focused on eyes and ophthalmology.

It’s one thing to build an application, though, and another to see if it actually works.

Katti and Arun paired up with Sankara Nethralaya, a charitable eye hospital in Chennai, India, to field test their program. Katti and Arun met the founder of the eye hospital, Sengamedu Srinivasa Badrinath, in the winter of 2010 when he visited MU to receive an honorary degree. The pair pitched their idea to Badrinath, and a partnership was born.

Katti and Arun were allowed to work on DoctorOn when they were students at Rock Bridge High School, as a part of an internship class for the Gifted and Talented Program. During that hour and a half every other day, they did research, designed in engineering software and 3-D printed their prototype of the camera attachment.

Looking forward

Although they’ve come a long way in almost four years, there’s more work to do. Sitting in their rooms nearly 300 miles apart, the biomedical-engineers-to-be continue to develop the app.

“We try to dedicate at least some time every week or, if we can’t do it one week, then make sure we do a little bit extra the next week,” Katti said. “Just to make sure our mind is on it and we’re working on it as much as we can without compromising our studies.”

The partners don’t have a strict timeline for rolling out their first product, but they estimate DoctorOn will be available in India in about two years. More field testing in India and approval by the Food and Drug Administration means that DoctorOn could be available in the U.S. as soon as a year after its rollout in India.

They won’t stop with just ophthalmology, or with the estimated 845 million people who live in rural India — they want to diagnose the world.

“One thing that both of us have decided is that we don’t want to be a one-product company,” Katti said. “That means we have to be able to design other things, and so we have to have an emphasis on our college education in order to be able to do that for the long run. Obviously the sooner the better, but we also want to be able to roll out something that will help the masses.”

Supervising editor is Katherine Reed: reedkath@missouri.edu, 882-1792.
Although anthrax scares are more common than actual threats in the U.S., anthrax detection demands speed. It’s costly and panic-inducing to contain and decontaminate when anthrax exposure is suspected. If gone untreated, those infected can die within a day or two of showing initial symptoms, according to the Anthrax Vaccine Immunization Program.

An MU researcher played a key role in testing a new method that reduces the time it takes to identify anthrax from 24 to 48 hours to about five hours. The new method, developed by David Schofield, chief scientist at Guild Biosciences in Charleston, S.C., was tested by MU medical bacteriologist George Stewart in the Laboratory for Infectious Diseases Research.

“David had tested his virus against non-virulent strains, but in order to make sure they would work in a real-world situation, he needed to test them against highly virulent strains,” Stewart said. “And we were able to do those experiments for him ... and we showed that his system works quite well.”

The bacteria

Anthrax is caused by the bacteria Bacillus anthracis. It can hibernate in the form of spores, sitting in the soil for years at a time, Stewart said. When the spores are introduced to warm, nutrient-rich environments — like mammalian blood and tissue — the spores revert to their bacterial form and infect the host. Like cows, or humans. But it’s a much bigger problem among cows.

Anthrax is detected through a procedure called polymerase chain reaction, or PCR, which involves growing more of the material in a controlled environment called a culture, extracting its DNA and copying it until there are millions of copies. Once the DNA has been copied, scientists compare the material's DNA sequence to the known recorded sequence of Bacillus anthracis, according to the Occupational Safety and Health Administration.

“All of those steps take more time, especially the culture steps in order to get enough bacterial cells to actually do the PCR reactions,” Stewart said.

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Those steps could take one to two days to complete, meaning the government has to spend time and money on decontamination. Cleanup from a real anthrax attack takes anywhere from 24 hours to two months, according to a 2012 report in the journal Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science. The 2001 anthrax attacks, which targeted the postal service, cost the government about $3.2 million. Being able to determine more quickly that a substance is not anthrax could save on unneeded decontamination.

**Shedding light on anthrax**

Schofield applied for a U.S. Department of Agriculture grant in 2007 to develop a sensor to detect anthrax in contaminated food.

Because of that grant, researchers will now be able to use the new detection method to find anthrax.

The new key to anthrax detection lies in a virus that infects the bacteria called a luminescent reporter phage. The virus, engineered by Schofield, contains a light-producing gene that normally stays inactive within the virus. When the virus enters the anthrax bacteria, however, the gene activates and glows. By measuring the amount of light produced with a luminometer, a sensory device used to measure low levels of light,
scientists can determine whether anthrax is present. If scientists see enough light, anthrax is present.

Schofield was able to develop and test this method, but only with non-disease-causing strains of the bacteria. There are only 12 regional biocontainment laboratories in the U.S. that are capable of handling highly toxic strains of anthrax — MU has one of them. Schofield sent his project to Stewart, who found that the virus made the more dangerous strains light up as well.

So well, in fact, that the system separates strains of the bacteria that are extremely similar to the strain that causes anthrax.

“Part of the problem we also have in terms of trying to identify this (anthrax) quickly is that there are other organisms in soil that look a heck of a lot like Bacillus anthracis but are not disease-causing,” Stewart said. Luckily, the virus is able to tell the difference.

“It’s highly specific and highly sensitive,” Stewart said. “Dr. Schofield tested in his system in South Carolina a whole variety of other organisms that are similar to Bacillus anthracis, and there were only a few odd strains that gave a positive reaction. So the false-positive rate is very low, and it’s a very sensitive virus so the false negatives are very low as well.”

Infection

Anthrax bacteria can enter the body in three ways: inhalation, cuts and ingestion, according to the Centers for Disease Control and Prevention. Once inside, it can take anywhere from a day to several months before symptoms of anthrax disease appear. Symptoms are similar to those of the flu, including fever and chills, vomiting, diarrhea, body ache, headaches and shortness of breath. Although anthrax is deadly if left untreated, it is not contagious.

Before you rush off to check your symptoms on WebMD.com, know this: Naturally occurring anthrax disease is rare in humans in the U.S., and is treatable with antibiotics.

The most recent anthrax threats to occur in the U.S. were the postal mailings in 2001. Since then, there have been several scares that were ultimately nonthreatening, including the 2007 threat at the Missouri University of in Science and Technology in Rolla that was later deemed a hoax.

Although the bacteria can be found almost anywhere in the world, its victims are generally bovine.

“It’s more of a threat if you’re a cow,” Stewart said. “Cows are killed by anthrax when they pick up the spores when they’re grazing in grass or drinking water out of ponds and that sort of thing.”

The next step is more research. Schofield has acquired more funding, this time from the Department of the Army, to develop sensors that can detect anthrax in environmental samples like dirt and water. He has also received funding from the National Institute of Health to develop clinical diagnostic sensors that would be able to detect traces of anthrax in blood samples if anthrax were ever used as a weapon, Schofield said.

Stewart and his team published their study in The Journal of Microbiological Methods in August 2013.

Supervising editor is Katherine Reed: reedkath@missouri.edu, 882-1792.
New 3-D knee implant technology shows promise

By BRANDON WEISS | news@ColumbiaMissourian.com

Irene Sackreiter already had her right knee replaced when her left started giving her trouble.

An avid biker and hiker, Sackreiter wanted her knees in shape for outdoor activities. She’s “no mountain goat,” but she likes walking along mountain trails, she said. “Obviously, I need my knees.”

Her doctors advised her to undergo arthroscopic surgery to clean the joint out and see if that helped, just as she’d done before her right knee was replaced five years earlier. Or, they said, she could always just get a second opinion.

Sackreiter, 61, had been down the arthroscopic surgery road before, and it seemed to only delay the inevitable — forcing her to lug a bad knee around for another 18 weeks before getting her right knee replaced. Her own research had persuaded her that results from arthroscopic surgery aren't good for people her age.

“It was terribly painful and uncomfortable,” she said. “There was no way I was going to do that again.”

So she sought a second opinion. She'd worked in exercise physiology and outpatient physical therapy at the now-defunct Health Connection through MU. So she decided to see Sonny Bal of the Missouri Orthopaedic Institute.

“Anyone who has been around here and has been in the exercise world knows about Dr. Bal,” Sackreiter said.

Bal told her about a custom knee implant from a 3-D printer designed specifically to fit her knee's anatomy. Sackreiter thought she'd give it a shot.

“A custom joint that was made just specifically to fit my anatomy had to be the way to go,” she said. “In theory, of course it makes sense.”

So Sackreiter met with Bal in early September at the Missouri Orthopaedic Institute to begin the process. She had a CT scan of her knee so the doctors could send the data to a company called ConforMIS and have the implant made, a process that took about six weeks. When it was finally time for surgery on Dec. 2, she felt no hesitation, she said.

The need for knees

Knee replacement surgery is trending up in the United States, and aging baby boomers are part of the reason. One study from the Journal of The American Medical Association found that the demand for total knee replacement increased 161.5 percent between 1991 and 2010. That demand has triggered research into methods of improving the surgery and outcomes, Bal said.

The research brought about what Bal considers the first meaningful advancement since the creation of gender-specific knee implants, a necessity since male and female knees do not perform tasks in the same way. Perhaps more importantly, Bal said the technology gives patients a better fit than knees developed from research on cadavers.

“This is probably where the world is going,” he said. “It makes perfect sense for a patient to have an implant that fits their body.”

The only reason the new technique hasn't grown as much as it might have is that surgeons have to be retrained in the surgery to be able to use the custom implants, he said.

Despite its relative newness, Bal said the custom implants cost roughly as much as traditional knee replacements, and he expects the price to eventually drop below that of their traditional counterparts.

“None of the up-front costs are different,” he said. “[The new technique] uses a lot less equipment because you only have to put in that one customized knee implant. Because the overall risk is less, the overall cost will be less.”

Sackreiter said her cost was the same with her first and second surgeries. A 2011 AARP study found the price to be $45,783 in 2008.

There was an early glitch for patients: Early on, some insurance companies questioned the
3D PRINTING IMPROVES KNEE IMPLANT PROCESS

Irene Sackreiter of Columbia got her left knee replacement in part thanks to 3D printing technology.

SCAN AND DESIGN PROCESS

A CT scan of Irene Sackreiter’s left knee, done at Missouri Orthopaedic Institute by Sonny Bal, a surgeon at the institute, feeds exact measurements to ConforMIS, a Boston-based company. ConforMIS uses a computer program that creates a 3D model of the parts of Sackreiter’s knee that need to be replaced.

PRINTING PROCESS

The computer program divides the model into a series of very thin wax layers, which the 3D printer creates and stacks on top of one another. The layers add up to a mold, which is used to create the metal implant that will eventually replace Sackreiter’s left knee.

FINISHED KNEE PRODUCT

The finished metal product is the exact shape and size of Sackreiter’s natural left knee. ConforMIS ships the implant to the hospital a few days before the surgery.

Sackreiter’s knee-replacement surgery took less time and required less bone cutting than a standard implant surgery. After nine weeks, she was able to go up and down stairs, which patients who undergo traditional knee-replacement surgery are not able to do for nine months.

SOURCE: 3DERS.ORG, CONFORMIS INC.

benefits of the 3-D knees over traditional knees, Bal said. Even for Sackreiter, her insurance company did not want to pay for the CT scan required to map the knee for the custom fit because she had already had a MRI and X-Ray with her previous doctor.

“The insurance company balked at that procedure,” she said. “Dr. Bal had to intervene with them, but they did agree it was necessary.”

But the positive results have eliminated problems with insurance providers, he said.

Reducing the risks

Bal has been doing custom knee replacements since early 2013. He said he won’t go back to “off-the-rack” knee replacements that come in standard sizes, built on the flawed notion that everyone’s knee is built or moves in exactly the same way.

He has performed about 250 custom knee implants since switching and says that the results are distinctly better for the patient.

“What patients say is there is much less pain, much less need for therapy and much less struggle in getting knee mobility,” he said.

The benefits aren’t only felt by those going under the knife, though. Bal said that he prefers performing surgery with the newer technology because it reduces the risk of error. These can relate to fit, rotation, alignment and positioning of the new knee.

“This technology comes up with this ideal position, and the ideal size and helps [surgeons] put it in that ideal position,” he said. “There’s a lot less surgical guesswork.”

Bal found out about the knee replacement technology through his work as a consultant for ConforMIS, though he did not and does not consult with the company on knee replacements in any way. He helps in other areas of the body and provides legal consultation to the Boston-based company when he can.

Generally, Bal said that patients have returned positive feedback, noting that they have experienced less pain and have regained mobility more easily.

The outlook

Bal said that subjective and objective data collected on 3-D knee replacements have all been positive, but more study on the procedure is needed.

A study by the Henry Ford Hospital indicated that much of the success of the surgery relies on the surgeon’s skill, rather than the implant going in the knee.

Another study available through the National Center for Biotechnology Information found that the procedure was absolutely safe and yielded positive outcomes, including reducing the time in surgery by 14 percent. The study also concluded that the variation from the natural knee axis was 1.4 degrees less in the custom replacement.

University Hospital is one of only a handful of universities offering this type of procedure at the moment. But Bal said he expects the procedure to grow rapidly in the coming years.

Sackreiter was even happier with the results than she expected to be. The post-operative recovery was about the same as with her right knee, as was the physical therapy plan.

Doctors have told her that a year after the surgery, the knee will be as good as it’s going to get. With that in mind, she’s withholding her final judgment.

There is one distinct difference in the early going, though, that suggests great promise for hiking mountain trails. It took her nine months to go up and down stairs after her previous replacement. It took her nine weeks this time.

“Descending the stairs is a huge difference,” she said. “Nine weeks as opposed to nine months — that’s huge.”

Supervising editor is Katherine Reed: reedkath@missouri.edu, 882-1792.
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classroom but never said aloud.

Tangible or intangible, barriers to educa-
tion for students with disabilities abound and are
often invisible to professors on a university campus.

But for Gina Ceylan, a graduate student at MU,
the barriers are apparent. Ceylan has a progressive
retinal condition and had almost completely lost
her vision by early 2009. She came to MU with an
interest in improving inclusion in classrooms and a
determination to help educators change how they
work with students of diverse abilities.

She’s witnessed the effects of a lack of accessibil-
ity throughout her education. Once she saw several
students register with disability services for a geol-
ogy class and then drop the class within the first
two weeks, already discouraged that they wouldn’t
be able to do the coursework.

“In my experience, inaccessible materials
and physical spaces are concrete barriers, but I
emphasize the underlying for a reason,” she said. “And that is because it’s the source of these other problems, and it’s what we need to focus on changing the most.”

**Classroom teaching**

In the fall semester of 2012, Ceylan designed the inclusive design for learning class, funded by the graduate school, which she has taught for the past year. The class helps faculty and graduate students recognize the variety of abilities of their students and how to best teach everyone. Her students learn teaching methodology and how to design classrooms that are inclusive for all students, whether they have hearing loss, visual impairment, neurological differences, psychological differences or mobility impairments.

“We don’t design students’ brains,” Ceylan said. “We design our instruction. That’s where we have the power to make a difference.”

Ceylan teaches her students how to recognize unnecessary restraints in learning environments, such as the stairs in the auditorium or even a video without captions. She also provides them with a set of guidelines for designing instruction and helps them to develop an awareness and appreciation for students with diverse abilities.

The students also work on projects using the tools and technologies learned in Ceylan’s class to create something they believe will help improve learning in their particular field.

For her project, graduate student Christina Thebeau built a 3-D molecular modeling kit. Usually these kits have objects that are all the same size, leaving someone with a visual impairment unable to discern one molecule from the next. Thebeau re-created the kit for the visually impaired, shaping the molecules in various ways so a student could feel the differences. The element carbon became a cube with four holes in it, representing its ability to make four bonds, while oxygen became a sphere with two holes.

Thebeau plans to teach science education in the future and hopes to use tools such as her kit to make science accessible to all of her students.

But she’s not waiting to implement the skills she picked up in Ceylan’s class. As a teaching assistant, she’s found herself tweaking her teaching to be more inclusive by representing material in multiple ways.

“We all have different learning styles,” Thebeau said. “When you teach on the fringes of the continuum of ability, you end up benefiting everyone, regardless of their ability or any type of impairment they have.”

**A larger network**

The course is MU’s contribution to the Center for the Integration of Research, Teaching and Learning, a network that connects 22 U.S. universities to promote the teaching of STEM disciplines, which MU joined in fall 2012. The network promotes learning through diversity, and though many universities focus on racial, ethnic and gender diversity, Ceylan said no one was
thinking about students' diverse abilities. Angela Speck, MU’s coordinator for the Center for the Integration of Research, Teaching and Learning and director of astronomy, sat in on Ceylan's class in spring 2013 and ended up taking away some valuable ideas for her own classroom.

Speck realized that teachers shouldn’t assume that everyone communicates or learns as they do, she said. For example, she was taught not to read everything on the PowerPoint presentation, but for some students, it’s critical that the information be read aloud. She also learned to make sure all the documents she posts online for her own course can be understood by the reading software that people with visual impairments use.

“I shouldn’t assume that every student is like me. I shouldn’t assume that everyone is comfortable with everything I’m comfortable with,” Speck said.

While Speck’s classes are among those influenced by Ceylan’s teaching of inclusive learning, Ceylan is reaching a much larger audience through an online video series for the Center for the Integration of Research, Teaching and Learning based on her course.

Every month, Ceylan and a guest record a lecture related to inclusive design. Each lecture is followed by a discussion panel on the same topic, where audience members are invited to join the conversation on the Center for the Integration of Research, Teaching and Learning’s website.

A broader impact

Besides having a new online presence, Ceylan has also begun to raise awareness of inclusive design on campus, said Barbara Hammer, director of the Office of Disability Services.

Hammer said the office recently conducted a survey of faculty on campus and discovered interest in learning about inclusive design, which the office had not seen in past years. People are realizing the benefits of the class, Hammer said.

For Ceylan, the benefits were always clear. She wants people to understand the big picture and use inclusive design to combine their different teaching perspectives to work toward the goal of education: learning.

Supervising editor is Katherine Reed: reedkath@missouri.edu, 882-1792. [ ]

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Criminalistics classes grow STEM
presence in Columbia Public Schools

By KEVIN MODELSKI | news@ColumbiaMissourian.com

When Mike Szydlowski used to teach chemistry, he was often approached with the same question from students:

“When are we ever going to use this?”

Now that he is coordinator of the science department for Columbia Public Schools, Szydlowski has been searching for new ways to spike student interest in science, technology, engineering and mathematics (STEM) related courses.

One of those courses is a high school-level criminalistics class, also known as forensic science, which gives students an opportunity to use scientific techniques to analyze evidence of crimes with hands-on experience and real-life situations.

“We’re not trying to really train a new crop of forensic scientists,” Szydlowski said. “It’s really just to show them things like crime-solving uses all this science. While it is a forensics science class, they’re learning to use equipment that could be used in many labs.”

Battle and Hickman high schools are offering the criminalistics class.

“We talk about anything you can imagine a detective would do,” Battle forensic science teacher Misty Brawner said.

The program will tackle crime-related topics, including analysis of blood, fingerprints, DNA and handwriting.

Brawner said she and Anne Hoylman, another forensic science teacher at Battle, plan real-world scenarios to study the primary topics in criminalistics. For instance, when it gets warmer outside, Hoylman, Brawner and their students will bury dead pigs and use their bodies to teach students about tissue decay.

“This is something hands-on they can apply to the workforce,” Brawner said.

Szydlowski said this new program will give students the opportunity to branch out scientifically.

“The teachers have said that we don’t really have many electives for the physical sciences,” Szydlowski said. “This is one where it’s not just physical science, it’s also life. ... If you really like the physical sciences, you could take this course and go beyond the normal studies.”

Mike Himmel said he sees a similar advantage to teaching forensic science at the high school level because of his work at the college level.

Himmel, a retired Columbia Police Department detective and an adjunct professor of forensic science at Columbia College, said the advancement in technology has created a growing demand in STEM-related fields.

Columbia College’s Broader Science Center, which was finished in 2013, has a forensic science classroom specifically designed for the subject. One of the walls of this classroom opens, allowing access to the Crime Scene Lab Simulation room.

“This room is designed for experiments, reconstructions and practical applications of forensic disciplines,” Himmel said.

Himmel said a main priority of the program is to spark passion for STEM-related subjects in students.

“As an educator, one of the weaknesses I’ve noticed is getting students more interested in math and science,” Himmel said.

“If we can work with area high schools to draw attention to practical applications of math and the sciences, with attention of how they can apply to forensic applications when working crime scenes, we may be able to perk interest of students to greater levels.”

Technology is changing so rapidly that the tools in your toolbox have not been invented yet, Himmel said. “AFIS, CODIS, DNA profiling, digital cameras are all examples of tools we now have in our toolbox that I didn’t have in ’75,” he said.

Criminalistics programs in the area have also shifted gears toward a younger crop of science students.

Brawner, who teaches a summer “CSI”-based class at the Columbia Area Career Center for 11- to 15-year-olds, has integrated hands-on application with forensic science.

The class, “CSI: Following the Evidence Trail,” looks at topics that the high schools are implementing into their curriculum, including fingerprint analysis and bite mark analysis. On the last day of the class, the kids gather evidence at a simulated crime scene to find a culprit.

The Columbia School Board approved submitting a grant last month from 3M Co., which would give the school district $20,000 toward the installation of criminalistics-related topics into required science classes at Rock Bridge High School.

Szydlowski said biology classes will learn DNA analysis, physics students will learn accident reconstruction and chemistry students will learn toxicology as part of their curriculum.

“The whole point is to not just learn content to learn content,” Szydlowski said. “There should be some relevance to the content.”
MU experiments with online tutoring program

By THOMAS DIXON | news@ColumbiaMissourian.com

Ever wish you had someone to answer your questions as you cram in the middle of the night before an exam? Through a pilot program, MU is trying to do just that.

As educational institutions continue to toy with the idea of online learning, MU’s Learning Center is testing online tutoring through NetTutor.

“For some people, it’s going to be effective,” director Phil Deming said. “For others, they’re going to have a hard time learning (online) and will want to interact with a person face to face. I think it gives students options based on what they’re comfortable doing.”

NetTutor is an online tutoring program launched in 1996 with student flexibility in mind. It offers one-on-one tutoring seven days a week out of Tampa, Fla. For math and English, tutoring is available 24 hours a day.

This covers the late night and weekend hours when the Learning Center doesn’t have in-person tutors available. Most of its on-campus tutoring sessions are between 5 and 8 p.m. on weekdays and between 1 and 7 p.m. on Sundays, Deming said.

If a student needs help outside of the Learning Center’s operating hours, he or she can log on to NetTutor via Blackboard and work one-on-one with a tutor, submit a question or a paper for review or access NetTutor’s archives of previous tutoring sessions. For one-on-one tutoring sessions, NetTutor uses Worldwide Whiteboard, a blank tablet interface that students can type questions or problems on and chat with their tutor.

Deming said NetTutor’s services will also help students who can’t get to the Learning Center for in-person tutoring.

“We had somebody contact us last semester who’s living in North Carolina and needed to finish a course, but at that time we didn’t have this online tutoring available for her,” he said.

The Learning Center does have online tutoring for writing, which covers about 20 percent to 30 percent of overall tutoring support, Deming said. However, it’s not viable for the Learning Center to extend online tutoring to more subjects in the way NetTutor does.

“NetTutor works for several schools, so they can have the staff available 24 hours a day,” Deming said. “If we were to do that, we would be paying someone to sit there for 20 hours a day for nothing.”

NetTutor is being piloted for 26 classes as of now, 19 of which are self-paced, online courses. The courses were chosen largely by faculty who showed interest in trying NetTutor after demonstrations by the Learning Center, Deming said.

Most of the courses using NetTutor right now are those with large enrollments, such as Mathematics 1100, Statistics 1200 and Spanish 1100.

The pilot was launched at the beginning of the semester, but there were some technical issues trying to set it up, Deming said.

It took awhile to make sure student information wasn’t being passed insecurely upon login and to get the link set up for the online courses, which don’t use Blackboard. Deming said the Learning Center is still having difficulty setting up a link through its website because of security issues.

The program is funded through instructional technology fee money paid by MU students, Jim Spain, vice provost for undergraduate studies, said.

The cost of NetTutor is based on how often students use it; MU pays $25 for each hour that students are engaged with a tutor, but the university is not charged if students just look up questions in NetTutor’s archives, for example.

NetTutor has been active only long enough in MU math courses to have usage reports, Deming said. As of March 25, 13 students engaged with tutors in 46 sessions for an average of 17 minutes. Most students log on, ask a couple of questions, log off and then come back for a new session when they have another question, he said.

Students’ use of NetTutor’s archives isn’t being tracked since MU isn’t charged for that time.

Spain is confident that NetTutor usage rates will grow over the course of the year, especially in the fall.

“We can talk to incoming freshmen about it over Summer Welcome and the fall and begin to help them understand this is available,” Spain said. “They’re already paying for it, so they might as well use it.”

Deming said the Learning Center may open the program up to more courses later on, depending on how well the program works.

“It’s going to take awhile to build and for people to have experiences with it and share those with their friends,” Deming said. “It’ll be interesting to learn how much students really want to do things online.”

Supervising editor is Elizabeth Brixey: brixeye@missouri.edu, 882-7884.
A large-scale initiative being considered by the city would make solar energy more accessible. As soon as the end of this year, Columbia could be offering electricity generated by the sun. Research is underway that could lead to the creation of a ‘solar farm’ on the site of a city utility station on West Ash Street north of Shelter Gardens.

The solar arrays would take up about 25,000 square feet and be able to sustain about 100 energy efficient homes, or 30 average American households, Tom O’Connor, a member of the city’s Water and Light Advisory Board, said in an email.

Although the project is in the research phase, the solar panel farm could be established sometime in the next year, Connie Kacprowicz, Water and Light communications marketing supervisor, said.

One factor driving the idea, largely based on a guide to community solar by the U.S. Department of Energy and the National Renewable Energy Labs, is the declining cost of solar electricity.

There would be a large upfront cost, about $432,000, to create the solar farm, but it would have almost no maintenance costs and could continue producing for a couple hundred years because the panels are so resilient, O’Connor said.
Solar power is cheaper than other forms of electricity, O’Connor said, with solar power costing about 5 cents per kilowatt hour, while residential lots and small businesses spend about 10 cents a kilowatt per hour.

“If we were to invest in large-scale solar projects, we would be making our own clean, local, renewable energy, and it would be cheaper than every single one of our existing coal contracts,” O’Connor said.

Water and Light is looking into finalizing the program parameters. Kacprowicz said decisions will need to be made about how to sell the electricity, whether the city would sell or lease panels or sell the electricity directly.

Utility customers could opt to buy as few or as many units of solar electricity as they want, O’Connor said. Customers would sign a contract or make an arrangement to pay the community solar program for electricity.

The electricity would be provided on a first-come, first-served basis, O’Connor said, and it would be sold at a slightly higher price than electricity from other sources to make up for the upfront cost to the city.

After the model is developed, the Water and Light Advisory Board will review it and then it will go to the City Council for approval.

Supervising editor is John Schneller: schnellerj@missouri.edu, 884-2103.

BY THE NUMBERS

100

The number of energy efficient homes the solar arrays would be able to sustain, or about 30 average American households

$432,000

The upfront cost to create the solar farm, but it would have almost no maintenance costs and could continue producing for a couple hundred years

5 cents

The amount solar power costs per kilowatt hour, while residential lots and small businesses spend about 10 cents a kilowatt per hour.
Camel’s milk cosmetics company finds oasis in Columbia

By ELIAN PELTIER | news@ColumbiaMissourian.com

The skin cream looks ordinary — white and velvety. Its packaging looks typical — small pastel-colored tubes.

But Elly Bethune, the owner of Elly’s Couture on Broadway, doesn’t stock ordinary cosmetics. In fact, she normally doesn’t sell cosmetics at all. But there’s an exotic ingredient in the Skinue products that caught her attention: whey from camel’s milk.

She’s been using it herself for about a month — a dab is enough to make her whole face feel “like a baby’s butt,” and it helps her clear up blemishes, she said.

If the products’ potency and far-flung ingredients weren’t enough to convince Bethune to stock them, there’s also this: Columbia is the only place in the country where camel’s milk cosmetics are for sale.

From Dubai to Missouri

It’s a long journey from camel udders to the shelves of Elly’s Couture.

It starts in a place called Camelicious, a camel farm in Dubai owned by the United Arab Emirates’ royal family. The farm exports powdered camel milk to a Jordanian pharmaceutical company called MONOJO Biotech. The company has one to two weeks to mix the powder with conventional cosmetic compounds, such as mineral oil and cetearyl alcohol, before it degrades.

The nickname for camel’s milk in the Middle East is “magic drink,” MONOJO Biotech CEO Penelope Shihab said, because people in the Gulf States drink it daily. In Jordan it’s a popular remedy for infections such as gastroenteritis and hepatitis. MONOJO’s scientists have been working since 2005 to apply those
therapeutic properties to skin care. In 2012, the formulas were ready.

Luay Abu-Qatouseh, the head of MONOJO's microbiology section, said camel's milk improves cosmetics in several ways:

- Its proteins contain antibodies that remain stable under harsh conditions, including strong sunlight, heat and skin's natural acidity.
- Camel's milk contains more vitamins and minerals than milk from other animals. These vitamins promote soft skin.
- Common allergy-causing bacteria do not grow in camel's milk.

Each Skinue product for acne contains 3 percent camel whey, Abu-Qatouseh said. The whey supplements a general cosmetic formula.

Columbia as a launchpad

After eight years of research and development on the Skinue line, Shihab knew her company was sitting on some good products. But she wanted to launch her line outside the Middle East.

Jordan is a small market, she explained, and expanding to each country in the region would've been more complicated than staying within one large market, like the U.S.

Besides, she said, “Jordan customers love U.S. products.”

She dreamed of launching her product in New York or Chicago, but she changed her mind when she met Samih Darwazah, a Jordanian graduate of St. Louis College of Pharmacy. He told her Missouri was the ideal place to understand the American market culture.

She considered St. Louis, but when she visited the MU Life Sciences Business Incubator, the incubator’s CEO Jake Halliday convinced her Columbia was the place for a fledgling business to start.

She settled in at the business incubator in 2012, and things finally seemed to come together. She could talk to MU scientists about tweaking her product to fit U.S. regulations. She could consult entrepreneurs about expanding her line in an American marketplace. She had access to free legal consultation to set up her U.S. subsidiary company, Columbia Biotech. She could tap the incubator's contact network to find retailers to sell Skinue products.

She was also able to work with journalism students to develop a marketing and communication plan. With that team of students, Shihab decided her containers would showcase the camel's milk aspect of the product while maintaining a traditional, upmarket design.

A toehold

In March, MONOJO shipped thousands of Skinue products to Columbia. Camel's milk products can be found in World Harvest International and Gourmet Foods, Concannon Plastic Surgery and Elly's Couture, and they're for sale at 9thelm.com.

Shihab is already thinking of bigger markets and more countries. But for now, Columbia Biotech's brand manager Patti Butera said the company wants to strengthen its presence in Columbia. MONOJO's scientists are working to diversify their products, and they might expand into stomach medicines.

The company is looking to expand into New York soon, Butera said, and they plan to sell Skinue products across the country by 2015.

After that, Shihab said, the Middle East and Brazil should follow.

Supervising editor is Adam Aton: news@ColumbiaMissourian.com, 882-7884.
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Every year, thousands of cows die from heat stroke, costing the cattle industry billions of dollars.

Don Spiers wants to save their lives.

With the help of MU postdoctoral researcher Brad Scharf, he has created an app called ThermalAid that allows farmers to monitor the heat stress levels in cows.

The app became available to iPhone users in 2013 and has had about 1,000 downloads. It can alert farmers when cows are in danger and gives them advice about ways to improve the situation.

“It’s a little ahead of its time, but we’ve got to get it out there,” said Spiers, an MU professor of environmental physiology in the Department of Animal Sciences.

“And we want to be the first to do it.”

An expert in the field of stress physiology, Spiers had grown frustrated with the challenge of bridging the gap between researchers and farmers. Realizing how much people rely on their cellphones, he created the only app on the market that features a live weather feed, he said. An iPad version also is available.

It helps farmers monitor their cows no matter where they are. They input data about each cow, and the app monitors its temperature humidity stress index. The index displays a spectrum of colors coded for normal, alert, danger or emergency conditions.

The app lets farmers select specific characteristics for each member of the herd, such as age, general health and breed.

“Each characteristic factors into the animal’s overall threshold for environmental stress,” Spiers said. “No two cows are alike.”

ThermalAid also has a feature that measures respiration rate. Traditionally, farmers have had to rely on intuition and direct monitoring of their herd to keep their animals safe.

“One limitation is that we can’t take into consideration the conditions inside a barn,” Spiers said.

He and Scharf would like to build a portable module that could be placed inside a barn and provide a direct feed to the user. The two are in the process of applying for a grant in order to build the module.

Eventually, they want to expand the application to pigs and other animals and to have an international reach as well.

“The key is to create this network between the animals, the researchers and the producers,” Spiers said.

Farmers need to be in more direct contact with their herd, which is why technology needs to be integrated into farms, the researchers say.

“Food production is going to be around forever,” Spiers said. “We have to make farming more efficient in order to make income.”

In the long run, Spiers said, better farming practices will yield more access to meat and dairy for the world’s growing population.

“The challenge is getting the app into their hands,” he said.

Supervising editor is Jeanne Abbott: abbottjm@missouri.edu, 882-5741.
Men and women ages 50 to 75 hold dumbbells in each hand with blue weights strapped to their ankles.

For 60 minutes, they perform repetitive arm lifts, forward and backward lunges, wide-legged squats and straight-leg dead lifts.

Some are breathing easily; others gasp for precious oxygen. All are increasing body composition and reducing the risk of falling.

They are in the Advanced Stay Strong, Stay Healthy program in MU’s McKee Gymnasium, conducted every Tuesday and Thursday for 10 weeks.

The strength-training program was designed by MU Extension professionals and state specialists to increase mobility in older adults.

The instructor is Emily Crowe, 24, an MU graduate student and teaching assistant in the Department of Nutrition and Exercise Physiology.

Crowe has been teaching the class since August. She is the first to offer the program at MU, and she will also be the first to document the results.

Musculoskeletal diseases affect more than 1.7 billion people worldwide and are currently one of the biggest causes of disability, according to an article published in the “Journal of Aging and Health,” primarily authored by Stephen Ball, MU associate professor of nutritional science and exercise physiology.
Sarcopenia is common among older adults, an ailment that leads to declining muscle mass — 4 percent to 5 percent per decade, resulting in falls, death and, generally, a lower quality of life.

In a pilot study conducted during fall semester, Crowe found that the strength training class successfully reduced body fat, increased lean muscle mass and reduced the risk of falls in men and women aged 50 and older.

Crowe leads a study in which older adults perform exercises to improve their strength and decrease their risk of falling at MU's McKee Gym.

In a pilot study conducted during the fall semester, Emily Crowe found that the strength training class successfully reduced body fat, increased lean muscle mass and reduced the risk of falls in men and women aged 50 and older.

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Now, think of something 1,000 times smaller. A molecule.

Even though molecules cannot be seen individually by the human eye, they make up most of the oceans and the atmosphere.

Two MU researchers have developed a 3-D microscope that looks at proteins in cell membranes on a molecular level. The information gathered from the observations could potentially advance drug development, giving scientists more effective medical applications.

Gavin King, assistant professor of physics and astronomy at the College of Arts & Science at MU and Krishna Sigdel, a postdoctoral fellow in the Department of Physics worked together to create the 3-D atomic force microscope.

In a traditional atomic force microscope, a silicon nitride tip pokes at the surface of the molecule. The tip, which is one-thousandth the thickness of a hair, is connected to a cantilever that moves up and down like a diving board in response to the force applied by both scientists and the protein.

To create the 3-D microscope, King and Sigdel added a laser that hits the tip and scatters, to tell researchers where the tip is located in space. The results show how the membrane proteins move and interact.

“The importance is potentially long-term in terms of developing new tools to allow us to understand nature ... and potentially map complex dynamics of biological molecules,” King said.

The idea came from a technological development in King’s initial doctoral research. He found that the problem with a traditional force microscope is that results are incomplete and one-dimensional.

King’s improved microscope, however, allows sample membranes to be in a near-natural state of salt water or saline solution. Previously, samples were either crystallized or frozen, which made the results less realistic.

When observing membrane proteins through the microscope, the structure of the protein might change depending on the
environment, such as changes in voltage or adding chemicals to the proteins being studied.

The microscope measures these changes in 3-D and shows exactly how the membrane protein responds to its surroundings.

“We could potentially monitor structural change in three dimensions, in real time and with high precision in near-native conditions,” King said.

Pioneering new ways to observe the world is both challenging and exhilarating, the researchers said.

“When you’re at the frontier it is hard to predict what the next step is going to be,” King said. “So when you have something with a new capability, one can dream about the applications, but it is really going to be speculative. That’s what makes it exciting.”

Supervising editor is Jeanne Abbott: abbottjm@missouri.edu, 882-5741.
A n innovative stagecraft technique combining traditional methods and modern technology might arrive at MU shortly. It’s a combination of traditional shadow puppets with large-scale image projection to create scenes that appear to be floating or soaring. The technique evolved from the work of Czech designer Josef Svoboda, an early pioneer in theater projection work,
and Julie Taymor ("The Lion King"), an innovator with masks and puppets.

Brad Carlson, an MU theater professor, has had personal experience with the method and hopes to incorporate it into MU productions.

The technique was used in the opening ceremony of the Sochi Winter Olympics to create the illusion of depth by projecting symbolic images among live performers. In one scene, a series of projectors produced a team of horses, which appeared to pull a ring across the sky.

Carlson saw firsthand how shadow puppets could be integrated with video and still-image projection at The Rose, a performing arts theater in Omaha. He spent the winter at The Rose as a designer on the production of "The Grocer’s Goblin & The Little Mermaid," a story based on two tales by Hans Christian Andersen.

The children’s play explores “intertwined tales of loving, longing and growing up,” according to rosetheater.org.

The little mermaid sacrifices her life for a friend and is thus transformed into an air spirit who scatters happiness around the world. Images projected onto a screen during the performance appeared to be water, while puppets behind the screen seemed to float on the waves.

Projection was also able to create twinkling stars, rolling clouds and a moon that changes colors.

“There were some really effective moments,” Carlson said. “What the video brings to the table creates an interesting environment.”

Supervising editor is Jeanne Abbott: abbottjm@missouri.edu, 882-5741.
Jonathan Kuuskoski never saw a division between being a pianist and making a living.

Coming from a family of artists, he understood what it took to be a performer and put food on the table.

Kuuskoski brought his understanding of business and music to Columbia in 2011 when he accepted the job of coordinator of outreach and community programs at the MU School of Music.

While he was initially hired to coordinate local music programs, he soon spearheaded the task of building a new curriculum that would teach students how to self-start their careers.

The result is the Music Entrepreneurship Certificate, a program that will become available to both undergraduate and graduate students. The program is designed to help students market their talent to potential employers in the music industry.

Classes for the certificate are already being offered. Topics include learning how to budget, event promoting and branding.

In a course called Career Development for Musicians, Kuuskoski engages eight students in conversations about music lesson pricing, taxes and student loans.

He encourages students not to undervalue what they do. He even had them fill out an algebraic worksheet to determine how much to charge for their time, whether it be teaching or consulting.

“If you are undercharging people, they will start thinking that is what you’re worth,” Kuuskoski told them.

He knows that the circumstances of full-time musicians have changed in the past 10 years, and the way music is being taught should change as well. Although the certificate is not meant to replace the rigorous course work of a music student, understanding the music business can be as important as sustained music practice.

According to the Strategic National Arts Alumni Project, 76 percent of music majors are self employed at one point in their lives, but many have no formal business education.

“The goal of the certificate is to prepare students to take the next step,” Kuuskoski said, “They need to know how to collaborate with someone else and develop a network.”

Students who aspire to work in the music industry but are not music majors can also benefit from the certificate.

Communications major Erica Whyman is interested in the business side of music and belongs to the Mizzou Music Management Club. Her favorite course is Art Marketing, she said, because of its creative approach to entrepreneurship.

“The certificate would show employers that you are self-motivated and you are willing to take risks,” Whyman said. “Also that you have an appreciation for the arts.”

While the courses let Whyman visualize her goals, Kuuskoski also teaches her how to execute them. He motivates students to be persistent when contacting people and identifying resources.

Whyman and the Mizzou Music Management Club recently put together a Battle-of-the-Bands-style benefit concert called Battle for Benefit to be held in May. The project was fostered through the music entrepreneurship courses.

“He is always telling us to dream big,” Whyman said.

Supervising editor is Jeanne Abbott: abottjm@missouri.edu, 882-5741.
At the City Garden School near downtown Columbia, a lesson on multiplication is demonstrated with carrots that magically reproduce.

A classroom garden becomes a wonderland of seeds that sprout, then bloom and continue to grow.

This type of imaginative storytelling is part of the Waldorf-based school that Nicole Knapp-Weber helped establish in Columbia last year.

Waldorf schooling was championed by Austrian educator Rudolf Steiner in the early 20th century, and focuses on developing children through a combination of hands-on play, environment exposure and artistic expression.

Today, there are more than 1,000 independent Waldorf schools in 60 countries. The City Garden School in Calvary Episcopal Church on Ninth Street is modeled on the Waldorf philosophy, although it has not yet been certified.

Nicole Knapp-Weber helps bring Waldorf education to Columbia

By VERONICA DESTEFANO | news@ColumbiaMissourian.com
Nicole Knapp-Weber, director and teacher at City Garden School, lines up her students as they prepare to change out of their winter wear on March 12. One of the areas the City Garden School focuses on is environmental involvement, which is a key principle of the Waldorf philosophy.

Nicole Knapp-Weber, leads her students in an art activity on March 12. The classroom houses three grades with each doing a different activity.

City Garden School students come to Peace Park for recess on March 12. Nicole Knapp-Weber, director at City Garden School, teaches students in first, second and third grades. The school emphasizes a Waldorf education, which focuses on developing children through a combination of hands-on play, environment exposure and artistic expression.
third grades. Next year it will expand to fourth grade, with Maeve Pickus, Knapp-Weber’s assistant as the school’s future third and fourth grade teacher.

Knapp-Weber will teach first and second grade and hand over ownership of the school to a board when the school becomes a non-profit organization by summer.

**How children learn**

A typical day starts with circle time, a warm-up for the brain and body through physical exercise, singing, juggling and other creative play.

Knapp-Weber teaches first and second graders a lesson block — math, language arts or science — while third graders finish their work from the previous day. After snack and recess in Peace Park in mid-morning, the roles switch.

“Before they start learning all the scientific facts, they need to love being outside,” Knapp-Weber said. “Just letting them play instills that love.”

Being close to nature is one of the tenets of the Waldorf philosophy, along with other experiential and sensory-based learning.

So, the group heads outside every Friday, weather permitting, to Rock Bridge Memorial State Park, Three Creeks Conservation Area, Mark Twain National Park or other natural or rural areas.

The school partners with the Columbia Center for Urban Agriculture to give children an opportunity to experience an urban farm where they study plants and animals.

City Garden School also teams up with the MU Confucius Institute for Chinese lessons and the Columbia Art League for art classes.

Starting the school

In 2005, Knapp-Weber and her husband came to Columbia to start a family. After her daughter Opal was born, she attended Columbia College at night to pursue a master’s degree in teaching.

She enrolled Opal in Garden Gate School, a Waldorf-style preschool off South Garth Avenue started by Deborah Kallman. When Opal was ready for first grade, she joined Kallman’s homeschooling co-op and Knapp-Weber became a first- and second-grade teacher.

City Garden School was started when the co-op parents needed a larger space to continue teaching. Kallman’s leadership, Waldorf principles and Knapp-Weber’s background laid the foundation for the new school.

Each child spends much of the year creating a large, personal workbook and records of the lessons, conversations and adventures they have had. The books might include drawings, collections, reflections, math homework and data from science experiments.

“It gives them an opportunity to discover who they are,” Knapp-Weber said. “Something reminiscent of the Renaissance man and woman.”

Clementine Penrose, 6, at far left, Bella Berry, 8, and Nicole Knapp-Weber walk back to school after their recess on March 12. Knapp-Weber is the director and teacher at the City Garden School.

**More information**

OPEN ENROLLMENT: March 1-Sept. 1. Families must fill out an application by April 1 to secure a spot. Once a family is accepted, a $225 materials fee is due May 1 and first month’s tuition of $520 is due July 1. If there are any open spots after the application period closes, families are able to enroll until Sept. 1.

TUITION: $520/month August-December, February-May. It is $260 for January because of the long winter break.

WEBSITE: citygardencolumbia.org

will draw people to this alternative education.

“We live in a fast-paced world and children learn slowly — you can’t rush a child,” Knapp-Weber said. “That has drawn me to this because once you explore the curriculum you realize how intentional it is.”

*Supervising editor is Jeanne Abbott: abottjm@missouri.edu, 882-5741.*
Kevin Keegan looks at a tiny black cube-shaped gadget with pride. It has helped horses all over the world.

More than six years ago, Keegan launched Equinosis, a company that creates devices to detect and measure lameness in horses.

Today, Equinosis may be the leading company worldwide in making and selling products to veterinarians that address equine lameness. The driving force is Keegan, professor and director of the E. Paige Laurie Endowed Program in Equine Lameness at MU.

According to Keegan, lameness is the most common clinical condition in horses. He and a team of colleagues developed the lameness locator as an objective method of detection.

Using small body-mounted inertial sensors, Keegan can measure lameness among horses in a field. This method gives veterinarians more specific information about the condition, instead of the standard subjective method of watching the movement and performance of a horse.

The sensors are sold through Equinosis, which has been licensed by MU to market and further develop the technology.
“I really had no intention on making a product to sell,” Keegan said. “I just wanted to use it.”

Equinosis products have been used on more than 1,000 horses since the company was launched in 2007, according to Keegan.

“There are 140 systems in use,” he said. “Each system perhaps has been used a few hundred times on horses.”

Keegan said the system is now used in about half of the veterinary schools in the country and in every continent except Antarctica.

“We now offer online and on-site training sessions for which veterinarians can get continuing education credit,” Keegan said.

Currently, Equinosis is routinely selling third-generation small body-mounted inertial sensors that can be placed on the horse’s head, pelvis and right front leg.

Fourth-generation sensors are being manufactured and pre-sold, and a fifth-generation sensor with additional improvements is being tested. According to Keegan, the fifth-generation sensors will be smaller and more robust, as well as waterproof.

Additional research is taking the device in new directions.

“We’re also now measuring the rider, and we use that to adjust the signals because we know the rider affects the exhibition of lameness,” Keegan said.

The average price for the system is $15,000 to $18,000, which includes two sets of wireless sensors, two sensor charging stations, a tablet PC pre-loaded with the necessary software and a hard-shell travel case.

According to Keegan, the primary engine now funding the development of the products is the National Science Foundation. Additional funds have been raised from private investors.

*Supervising editor is Jeanne Abbott: abbottjm@missouri.edu, 882-5741.*
Breastfeeding research aims to eliminate stigma, decrease infant deaths

By WENDY PENNINGTON | news@ColumbiaMissourian.com

Urmeka Jefferson remembers the first time she lost an infant patient. “It was a newborn, critically ill. The parents were trying to decide whether to continue with extraordinary measures,” she recalled.

It was in 1996, and Jefferson had just begun working in the neonatal intensive care unit at a hospital in Memphis, Tenn.

A senior nurse took charge, removing the tubes and wires that had been keeping the newborn alive. She swaddled the infant and allowed the parents to hold him one last time.

“It happens all the time,” Jefferson said. “But it’s not something you ever get used to.”

Infant mortality propelled Jefferson into research at MU’s Sinclair School of Nursing after nearly a decade of working in neonatal intensive care units. She is currently working to find ways to improve rates of breastfeeding, particularly among African-American mothers.

“I got to a point where I wanted to find out ways that we could improve care,” she said. “I wanted to do more.”

Jefferson began studying the causes of infant deaths and found a strong correlation between high mortality rates and low breastfeeding rates.

“I began to see that in communities with higher rates of sudden-infant death and illnesses that lead to death, breastfeeding rates were very low,” she said.

Although it is still in its early phases, Jefferson’s research is the first of its kind.

“No other study has focused on the intentions of future mothers and the actual rates of those who do breastfeed,” she said.

The problem isn’t that mothers aren’t informed, Jefferson said, it’s that a social stigma exists that causes women to shy away from breastfeeding.

Her studies have shown that college-age African-American women, despite knowing the health benefits, are unlikely to breastfeed their babies.

“These were college-aged, educated men and women,” Jefferson said. “But there was still a disparity, and it couldn’t be explained away by education.”

Jefferson said she hopes to isolate specific factors that contribute to the social stigma surrounding breastfeeding.

So far, her research has mostly been based on observing conversations and analyzing data collected from surveys. Participants were asked questions to determine their comfort level with women breastfeeding in public.

“Overwhelmingly, both men and women said that they do not want to see it, that it makes them uncomfortable,” Jefferson said.

She pointed out that in most other cultures, breastfeeding is perfectly natural.

“I think it is an American thing. I think for some reason we are uncomfortable with women feeding their babies in public,” she said. “You wouldn’t take your lunch to the bathroom, would you? So why should a woman not be able to feed her baby in a restaurant?”

Jefferson’s next phase of research will follow women who are currently pregnant through the first few months after their babies are born to analyze their attitudes and intentions before birth and determine what factors affect decisions among women who actually breastfeed and those who do not.

‘No other study has focused on the intentions of future mothers and the actual rates of those who do breastfeed.’

URMEKA JEFFERSON
Breastfeeding researcher

Supervising editor is Jeanne Abbott: abbottjm@missouri.edu, 882-5741.
Heat-transfer research could revolutionize mechanics

By JOEY FENING | news@ColumbiaMissourian.com

Hongbin “Bill” Ma explains the process of creating oscillating heat pipes during a Heat Pipe Lab Presentation at Lafferre Hall on March 13. Ma is a professor in the Department of Mechanical and Aerospace Engineering at MU and has created innovative designs in heat transfer products.

Bill Ma has developed technology that could prevent mechanical systems from overheating.

To the untrained eye, the copper plates in Bill Ma’s engineering lab look like metal scraps. Some are the size of computer chips; others stretch a foot or more across the lab table. The copper plates house Ma’s oscillating heat pipes — fruits of a decade of research and possibly the future of the heat-transfer industry.

Designed to prevent mechanical systems from overheating, heat pipes are a staple of the heat-transfer industry. They have myriad uses — from laptop
computer chips to power cells in nuclear reactors. The pipes run liquid from the hot end of a mechanical system to a cooler area where the pipe “dumps” the liquid as vapor.

As more sophisticated energy and technology systems are developed, overheating becomes an increasing problem, pushing the need for more efficient cooling methods. Ma, a professor in MU’s Mechanical and Aerospace Engineering Department, believes his oscillating heat pipes are the answer.

He is the co-founder of ThermAvant Technologies, a company based in Columbia committed to “assembling a team of heat-transfer experts who are dedicated to making the world a better, more efficient place.”

Ma is partners with Bin Wu, an MU professor of industrial and manufacturing systems engineering, and Joe Boswell, another engineer and the entrepreneurial force behind the company.

The world seems to be recognizing their efforts, as their eight-person team has accrued $5 million in research funding from the Department of Defense, the Office of Naval Research, the Air Force Research Lab, the National Science Foundation, the California Energy Commission, the state of Missouri and others.

ThermAvant’s devices can be embedded in nearly any material as “super thermal conductors” to transfer heat in a microchip as small as a dime or an engine in a commercial jet.

While conventional heat pipes run in simple columns across the material subjected to heat, oscillating heat pipes run in a winding pattern that spans the entire plate as one continuous channel.

The phase — liquid to vapor (when heated) and vapor to water (when cooling) — generate an oscillating motion in the heat pipes that transport heat at a much higher rate than conventional heat pipes, Ma said.

Combined with use of better materials, the ability of the oscillating heat pipes to transfer heat is massive when compared to current methods, he said.

The ability of a material to conduct heat is measured in watts per meter per Kelvin. The more watts of heat transferred over a certain area, the higher the substance’s thermal conductivity.

“For aluminum alloy, the thermal conductivity is about 170 (watts per meter per Kelvin). For copper, like 400. When you use oscillating heat pipes, you can reach more than 20,000,” Ma said.

The ThermAvant team is working to insert their products in military aircraft, computers and even satellite electronics. The prospect might seem daunting, but ThermAvant is confident in its research.

“Our product, it’s very unique,” Ma said. “Other people, other devices, cannot compete.”

Supervising editor is Jeanne Abbott: abbottjm@missouri.edu, 882-5741.
Sometimes, Jeffrey Bryan treats sick dogs whose owners have had their own painful experiences with cancer. Survivors bring their pets to see him hoping the dogs, too, will be cancer survivors.

Bryan said he sees cases where those who have lost family members to cancer are unwilling to give up on their pets.

“One of my favorite things is to be able to keep people and their dogs together,” said Bryan, 46, an associate professor of oncology with the Veterinary Medical Teaching Hospital.

These stories have been a motivation for Bryan to continue his research on cancer in animals.

Bryan was the first to discover Y chromosome DNA in the blood of female dogs. This was surprising, he said, because, in fact, a female should not have the Y chromosome.

His research has found that one-third of female golden retrievers carry male cells in their bodies. The females picked up the cells from their babies during pregnancy. This occurrence has also been found in dachshunds and mixed-breed dogs.

“When I first heard about it, it was just a mind-blowing thing,” Bryan said. “It never occurred to me that more than one person would live inside another person.”

Scientifically, this is known as fetal microchimerism, the persistence of fetal cells in the mother’s body for years after pregnancy.

He said the cells can contribute to autoimmune diseases and some cancers, and they can also be useful in preventing cancer. He is using his results to develop treatment options.

As an illustration, he described a mother diagnosed with lymphoma, a type of blood cancer. If she has cells from her son in her body, those cells could be infused into her blood to provoke an immune response against the cancer.

“I think the dog’s immune system is ideal for testing this strategy to see if this would work in treating cancer,” Bryan said.

He is a graduate of the University of California, Davis, School of Veterinary Medicine. He spent nine years in general veterinary practice in San Francisco before coming to MU in 2002 for a residency in medical oncology.

Bryan earned his master of science in biomedical sciences and a doctorate in pathobiology at MU. In the teaching hospital, his focus is on comparative oncology.

“Of everything I did in practice, treating cancer patients is the most rewarding thing,” he said.

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Jeffrey Bryan, associate professor of veterinary oncology and director of the Comparative Oncology and Epigenetics Laboratory, recently discovered a possible treatment for canine cancer.
The processed food industry may soon be seeing a healthier, soybean-based alternative to trans fats, based on the research of MU plant sciences professor Grover Shannon.

Shannon has developed a method of breeding soybeans with the naturally occurring genes of high oleic acid.

Right now, a partial-hydrogenation process is required to stabilize the oil from soybeans and other plants for use in processed food. Hydrogenation is a chemical reaction that adds hydrogen to a compound.

Last November, the FDA tentatively determined that foods containing partially hydrogenated oils are not safe for consumption, due to the trans fats content that causes heart disease.

The FDA is now going through an additional review process. If the findings are confirmed, food manufacturers will no longer be permitted to sell products containing partially hydrogenated oil.

Enter the high oleic acid soybean. Fat can be extracted from these carefully bred soybeans without hydrogenation, meaning the resulting soybean oil will be free of the unhealthy fat.

Shannon partnered with Kristen Bilyeu, a professor in the plant sciences department and former molecular geneticist, to find the high oleic acid trait in soybeans. The discovery is one that soybean researchers have been searching for since the 1980s.

“We combined two genes with 35 percent and 30 percent respective oleic acid content,” Shannon said. “We got a super increase in oleic acid for 80 percent content.”

Shannon said that oleic acid normally occurs at a rate of about 23 percent in soybeans.

The discovery will not only impact the health of consumers, but also help soybean farmers in Missouri and across the nation who have lost market share due to the growing health concerns about trans fats.

Using off-season nurseries in Costa Rica, the Caribbean and Puerto Rico, Shannon’s team is testing the yield of seeds as quickly as it can. Shannon said that in order for farmers to begin planting the high oleic seeds, they must equal the yield of the existing seeds.

“So far, the yield seems to be looking better every year,” Shannon said.

At 5 billion acres, Missouri has the sixth largest soybean crop in the nation.

Will Spargo, chairman of the Missouri Soybean Merchandising Council, said he expects the repurposed soybeans to sell at a higher price per bushel, so long as they live up to yield expectations.

“We’re thinking that the soybean industry will recapture lost market share,” he said. “This will make soybeans more valuable and provide more profit back to farmers, and provide better food for consumers.” Spargo said the seeds may be distributed to farmers in limited quantities by next year for trials to test their yield.

At present, farmers can choose to grow soybeans with or without the presence of genetically modified organisms, or GMOs, that make the plants more resistant to disease, harsh weather conditions and chemicals.

Non-GMO seeds with naturally occurring genes are in growing demand because of the organic preferences of American and international consumers, especially in European countries where there are strict regulations on genetically modified foods.

Farmers, who grow soybeans with GMOs, purchase their seeds from agriculture companies such as Monsanto and DuPont. With Monsanto’s permission, Shannon said he plans to develop seeds for GMO soybeans like Monsanto’s popular herbicide-resistant Roundup Ready Soybeans.

Monsanto has already spent approximately $100 million developing a high oleic trait that does not occur naturally in its Roundup Ready varieties. The patent for Monsanto’s primary variety, Roundup Ready 1, expires in 2015.

At the end of the year, Shannon’s team will be able to develop a product for Roundup Ready 1 without needing Monsanto’s permission, which he says will likely half the price of the high oleic GMO seeds.

This flexibility means that the soybean industry has high hopes for the new breed. The United Soybean Board recently invested $60 million into research and marketing over the next five years, which Shannon said puts his research team under the gun.

“We’re still in its infancy, we’re still moving forward and still finding out things every day,” Shannon said.

“If it takes off, it’ll be a huge thing. It’ll have a huge impact on not only growers but also consumers.”

Supervising editor is Jeanne Abbott: abbottjm@missouri.edu, 882-5741.
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