Human ECOLOGY

Technology and Innovation

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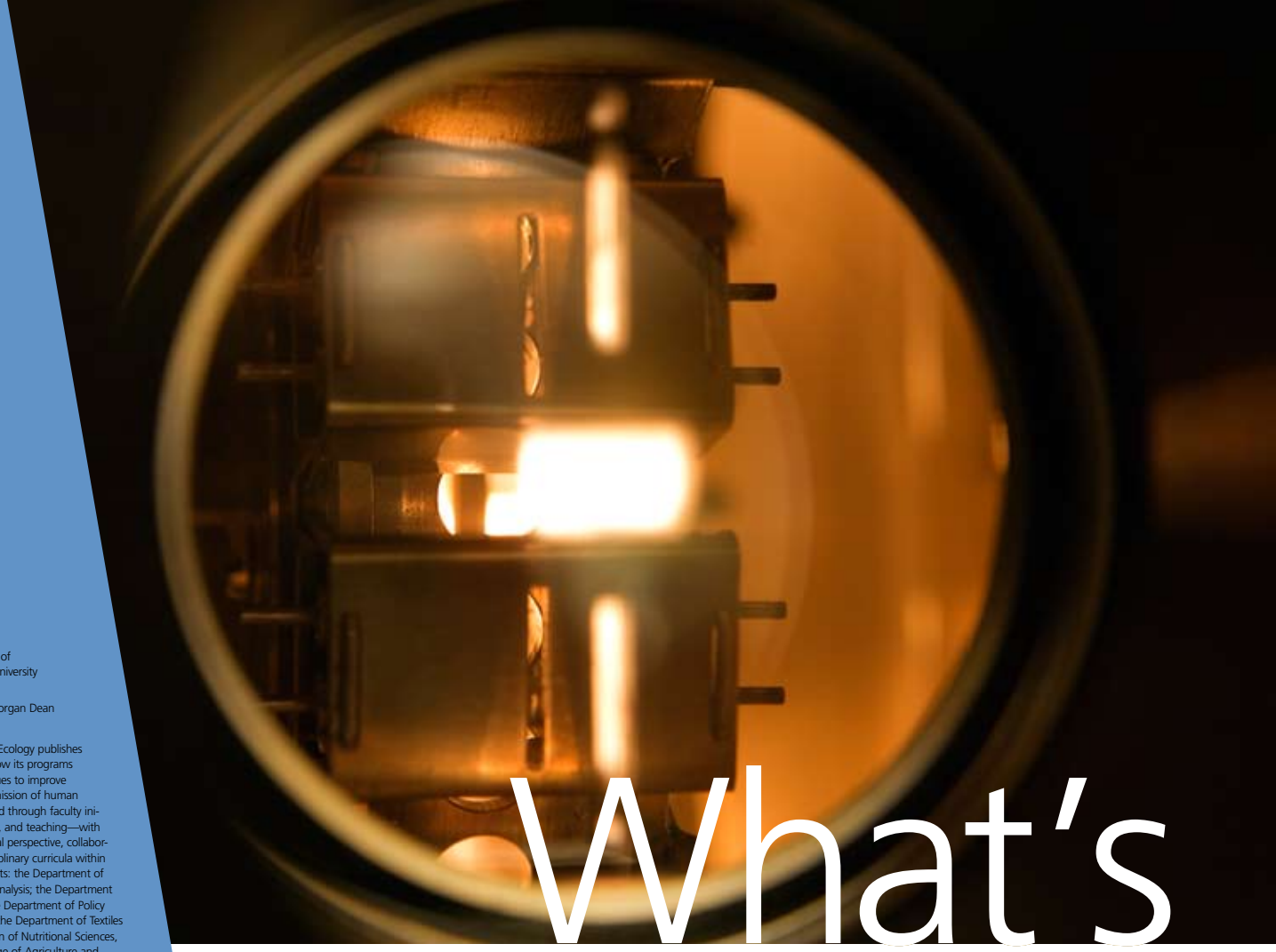

What's

Volume 34, Number 2
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The New York State College of
Human Ecology at Cornell University

Lisa Staiano-Coico, Ph.D.
Rebecca Q. and James C. Morgan Dean

Cornell's College of Human Ecology publishes this magazine to illustrate how its programs address complex societal issues to improve the human condition. This mission of human improvement is accomplished through faculty initiatives in research, outreach, and teaching—with an emphasis on an ecological perspective, collaborative projects, and multidisciplinary curricula within and across five academic units: the Department of Design and Environmental Analysis; the Department of Human Development; the Department of Policy Analysis and Management; the Department of Textiles and Apparel; and the Division of Nutritional Sciences, a unit shared with the College of Agriculture and Life Sciences. The college includes the Family Life Development Center, Bronfenbrenner Life Course Center, and the Cornell Institute for Policy Research.

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Cover photo: Jeremy Inglis, research associate in Nutritional Sciences, pours liquid nitrogen into the magnetic sector thermal ionization mass spectrometer (TIMS) in the college's Human Metabolic Research Unit. Above photo: The source chamber and sample turret of the TIMS is illuminated by a rhenium filament used to ionize samples for isotope analysis. Photos by Jason Koski, Cornell University Photography.

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Dean's Corner

Technology and Innovation Help Us Shape a Better World

Technology and innovation have always been at the heart of academic and scientific exploration. Looking back over 30 years of my own research in medical labs, I see advanced diagnostic tools in use routinely today that we were cobbling together with whatever scraps of glass, metal, and wire that we could find lying around back then. Even though somewhat crude by today's sophisticated standards, those homemade tools moved us along on our journeys of discovery.

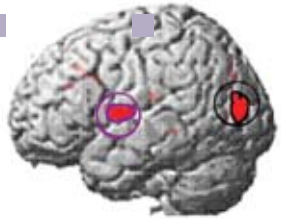
In this issue, you will come across students, faculty, and extension professionals on their own journeys, embracing innovation and pushing technology into new areas of research, instruction, and outreach. You can read about everything from the power of brain scanning to increase our understanding of human behavior and development to the use of mass spectrometry to uncover how our bodies metabolize minerals and nutrients. You will see how technology helps bring research to the real world on an instructional DVD to help people reduce health hazards in their homes, and a new interactive technology in the classroom that is fostering a more robust learning environment for students.

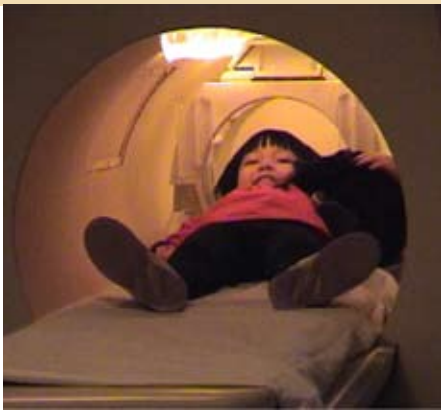
We never really know where the breakthroughs are going to come from, or what is going to propel the biggest leaps forward in knowledge. It is the pursuit of those breakthroughs and leaps that drives the College of Human Ecology. And with a spirit of innovation and a belief in the power of technology along the way, there are no limits on our potential to shape a better world.

Lisa Staiano-Coico

LISA STAIANO-COICO, PH.D.
Rebecca Q. and James C. Morgan Dean

inside. . .





What's New

Juan Hinestroza and Margaret Frey are pushing the textile frontier by developing nanofibers to act as biological sensors and shields against viruses, bacteria, and hazardous particles.

Nano-Textiles Are Engineering a Safer World

BY CLARE ULRICH

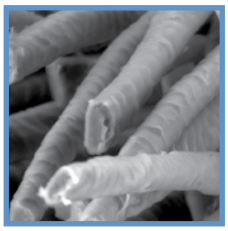
Stone, bronze, and iron have transformed human civilization so dramatically that major time periods are identified with them. Juan Hinestroza, an assistant professor in the Department of Textiles and Apparel (TXA), believes that nanotechnology will revolutionize the near future in much the same way.

Hinestroza and his TXA colleague Margaret Frey, the Lois and Mel Tukman Assistant Professor, are using nanotechnology to create radically new textiles and to enhance conventional textiles with greater functionality. Hinestroza calls what he does a "technological oxymoron."

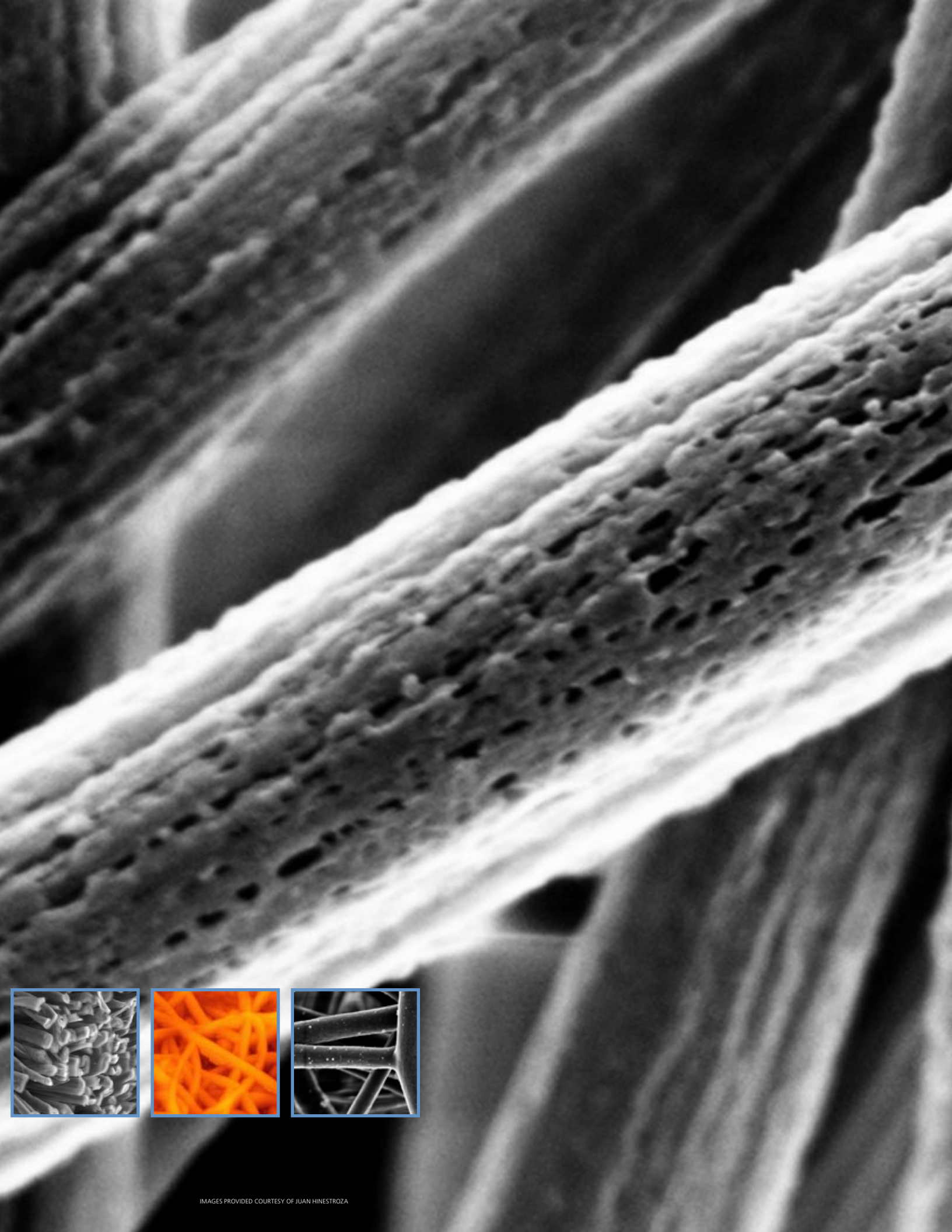
"People perceive textile manufacturing as an old technology, but it can provide the bridge to making nanotechnology a commercial reality," he explains. "What I'm doing is merging two revolutionary technologies that are 200 years apart (textile technology and nanotechnology), complementing the old technology with new developments in science. I say 'revolutionary' because both technologies have changed the way we see the world."

Having joined the College of Human Ecology faculty in January 2006, Hinestroza is developing remarkable fibers potentially capable of filtering out viruses, bacteria, and hazardous particles too small to see with the naked eye. He received a John D. Watson Young Investigator Award from the New York State Office of Science, Technology, and Academic Research in 2005 to expedite this work, which is being done in collaboration with scientists at the Centers for Disease Control and Prevention (CDC).

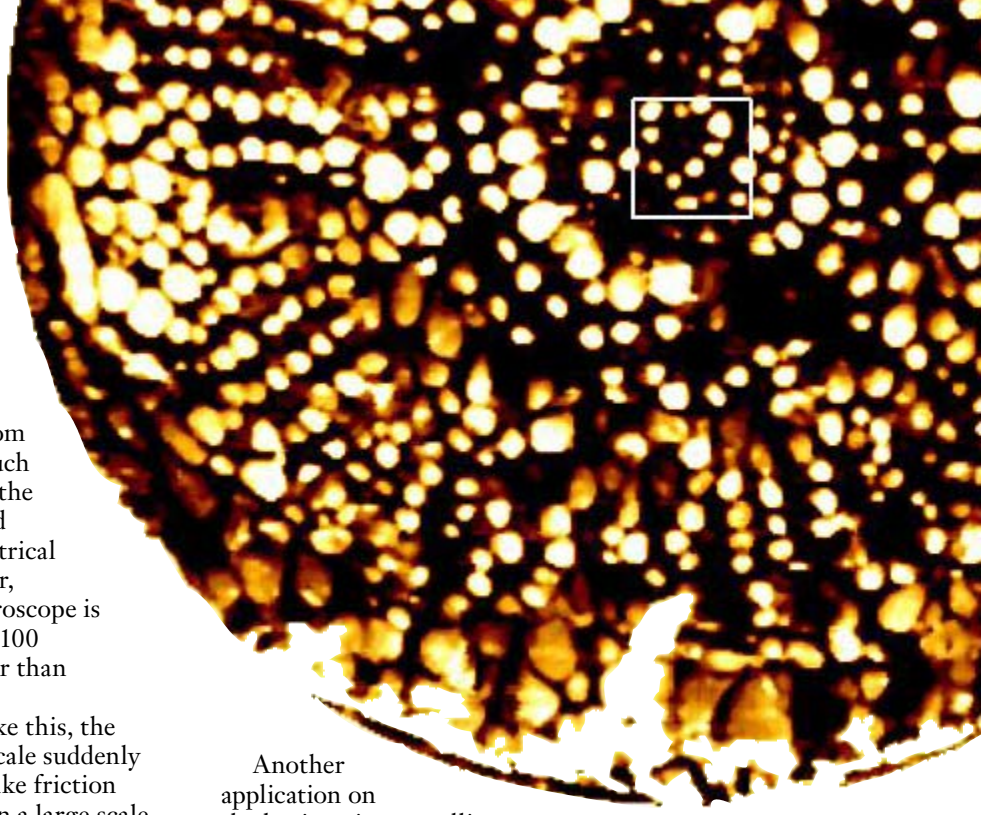
"It was humbling to get that award," Hinestroza reflects, "because the award is named in honor of James Watson, who received the Nobel Prize for discovering the structure of the DNA, and he's still alive." Hinestroza also receives support from grants of the National Science Foundation and the U.S. Department of Commerce. > > >



Large photo: Ultra-porous polyacrylonitrile nanofibers with silver nanoparticles are developed for antibacterial applications. The nanofibers were produced via electrospinning and a sacrificial polymer.



IMAGES PROVIDED COURTESY OF JUAN HINESTROZA



Merging the old and the new, Hinestroza uses a process called electrospinning to create the fibers from which he constructs his much-in-demand biofilters.Electrospinning has been around since 1934 but has been used on the commercial scale only since the early 1990s. It involves dissolving a polymer—either a natural polymer derived from plant-based cellulose or a synthetic polymer such as nylon or polyester—in a solvent, squeezing the liquid polymer solution through a pinhole, and applying high voltage to the pinhole. The electrical field pulls the polymer solution through the air, stretching it into a tiny fiber. An electron microscope is needed to see these fibers, which are less than 100 nanometers in diameter, or 1,000 times smaller than conventional fibers.

"Once you get to a really small-size scale like this, the forces that dominate everyday life on a large scale suddenly become much less important, and properties like friction and flow past objects that are less significant on a large scale become the dominant terms," Frey explains. "Nanoscale fibers are roughly equivalent in size to air molecules. So if we're looking at filtration devices, nanofibers make very effective filters because they don't get in the way of the air flowing past them. And less power is needed to push the air through the filter because the volume of the fibers isn't blocking the air flow."

Ingenious modifications Hinestroza has made to the electrospinning process enabled him to create his supersensitive biofilters. By manipulating magnetized nanoparticles in a magnetic field during electrospinning, he can direct the flow of the polymer and target chemical molecules to deposit layer after layer onto the surface of the electrospun fibers. The advantage is that both the size and the position of the nanofibers can now be precisely controlled.

"Because of the combination of the small size of the fibers and the electrical fields created between the fibers, we are able to capture particles in the 100- to 300-nanometer range," he explains. "It just so happens that that's the size of viruses and bacteria."

It is expected that these novel filters will provide protection against infectious agents that cause severe acute respiratory syndrome (SARS) and avian flu. However, the process can be customized to serve a variety of purposes. By applying nanolayers to natural fibers, for instance, Hinestroza can produce protective clothing that selectively blocks hazardous gases and minuscule contaminants but allows air and moisture to flow through so that the wearer can sweat and feel comfortable. Users who might appreciate this kind of gear are firefighters, emergency responders controlling a biohazard threat, or military personnel on duty in hot climates.

"Fashion designers see garments as an expression of creativity," Hinestroza muses. "Chemists and materials scientist see garments as a collection of molecules. Now we can take these molecules and create fashion with function." It's just a matter of time before lightweight smart textiles like these are being used by hikers and other athletes, or even by environmentally sensitive individuals.

Another application on the horizon is controlling the movement of medicine through fibers.

"Some companies are interested in using this technology to administer time-released antibacterial and antiallergenic compounds," Hinestroza claims. "So you could have your arthritis medicine while you're wearing your gloves." Or one might soon encounter antibacterial sheets in hospitals or military barracks that could help prevent the spread of illnesses where lots of people are confined to small, common spaces.

Even the law is going nano. Hinestroza is able to embed magnetic nanoparticles inside a garment or paper document that create a unique but invisible signature, which could be scanned, for example, to detect counterfeit currency, fake passports, or even knockoff designer clothing.

Textiles as Sensors The unique characteristics of nanofibers—such as greater surface area and porosity—got Margaret Frey thinking about fabricating a textile that could act as a sensor. She envisions a material, perhaps something that looks like a sponge, that anyone could easily use to swab a piece of fruit or meat, or wipe a food or surgical preparation surface, to detect the presence of hazardous bacteria such as *E. coli* or anthrax. If the contaminant is detected, the fibers would capture it and alert the user by changing color or becoming fluorescent.

"The idea is to create something that people without a high level of training can use fairly quickly," Frey says. "A lot of very good detection screens already exist, but it takes a week or longer to get analyses back from the lab. By then a victim has already suffered the effects of eating contaminated food or undergone some kind of potentially unpleasant treatment—whether or not he or she was actually exposed. We'd like to create something that has enough sensitivity to alert users instantaneously to a problem so that they can either take immediate steps to protect themselves or know for sure that they haven't been exposed. If you can determine that a workplace has not been contaminated with anthrax, then people wouldn't have to lose work time."

Polyester nanofibers are encapsulated into a polyethylene macrofiber. These nanofibers were created via bicomponent extrusion allowing the manufacturing of thousands of nanofibers in large quantities.

On another project that makes creative use of the high surface area of nanofibers and their ability to absorb more liquid than conventional fibers, Frey is collaborating with two scientists in Cornell's College of Agriculture and Life Sciences—Mike Hoffmann in Entomology and Alan Taylor in Horticultural Sciences at the Geneva Experiment Station—to create a polymer tailored to absorb pesticides or herbicides. Fibers saturated with time-released pesticide could be planted with seeds as an alternative to spraying the pesticide. The goal is to develop a textile that would not only biodegrade by the end of the growing season but would replenish the soil with nutrients as it degrades.

"Our strategy is to enable growers to place the right amount of pesticides exactly where they want them to go, with none of it dispersing into the air, getting deposited on the playground, or running down the hill into the stream as it can when it's sprayed. Farmers would use less pesticide, and the pesticide would be doing its job and nothing else," Frey says. The project is far enough along for her to pilot-test it next summer.

Frey and TXA colleagues Kay Obendorf and Ann Lemley have teamed up with Alan Hedge in the Department of Design and Environmental Analysis to try to enhance objects that already exist in the built environment with the ability to cleanse the air around them.

"Did you ever feel like there's just not enough air in airplanes?" she asks. "We're exploring the idea that the doilies over the passenger seats or seat cushions or wall hangings could continually absorb particles or gases or other biohazards from the air—maybe even viruses—without using any energy." In addition to measuring what actually gets caught in the fabric, the group plans to survey people using these environments to see if they perceive cleaner air.

The team received a seed grant from the college to begin the project. When that grant expires at the end of a year, they expect to have enough data to apply for external funding to continue the study.

Frey and Hinestroza are both members of the Cornell Center for Materials Research (CCMR), a facility that offers them shared work space, access to high-powered, specialized equipment, and opportunities for interdisciplinary collaboration with university and industry researchers. Using many facilities at CCMR, Frey recently completed a two-year project with CLARCOR, a commercial provider of filtration products and services, where she and a CLARCOR technician developed fibers that improved the performance and energy efficiency of the company's air filtration systems. The partnership's success can be measured by the patent and two published papers that resulted from the project—and that CLARCOR recently hired one of Frey's student researchers who had worked on the project from the beginning.

Although collaboration between Frey and Hinestroza so far has been limited to experimentation with cellulose solvents, their overlapping interests are likely to lead to future partnerships. Frey is currently working with other Cornell researchers from the Department of Biological and Environmental Engineering and Department of Chemical and Biomolecular Engineering on incorporating biosensors into electrospun cellulose fibers. Her work parallels Hinestroza's in this area, and she uses some of the measurement tools he has developed.

Hinestroza is right about nanotechnology revolutionizing our world. With its promise to deliver precision materials with fewer defects and greater functionality, it won't be confined to the lab for long.

"I think in five years nanotechnology will change many of the products we use," Hinestroza predicts. "Nanotechnology will no longer be a commercial anomaly. Many of the phenomena we're seeing now were predicted in the 1960s, but we just didn't have the tools to make them happen. Now we have the tools, and hopefully we're predicting things that will happen in the near future."

He estimates that within a decade nanotechnology will have a market impact of hundreds of billions of dollars, and textiles will occupy an important share of that market. ●●●

Nano in the Near Future

These applications of nanotechnology in creating novel fibers and textiles are either already materializing or likely will be in the future:

- supersensitive biofilters made of fibers capable of filtering out viruses, bacteria, and hazardous particles;
- nanolayers applied to natural fibers and then made into protective clothing for firefighters, emergency responders, and military personnel that selectively blocks hazardous gases and minuscule contaminants but allows air and moisture to flow through;
- lightweight smart textiles for hikers, athletes, and environmentally sensitive individuals;
- fibers that control the movement of medicine to administer time-released antibacterial and antiallergenic compounds; for example gloves that deliver arthritis medicine or antibacterial sheets in hospitals;
- magnetic nanoparticles embedded inside a garment or paper document to create a unique signature that can be scanned to detect counterfeit currency or fake passports;
- sensors that could swab a food or surgical preparation surface to immediately detect the presence of hazardous bacteria;
- biodegradable fibers saturated with time-released pesticides that could be planted with seeds as an alternative to spraying pesticides;
- doilies, seat cushions, or wall hangings used in airplanes that would continually absorb particles or gases or other airborne biohazards.

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A new study uses personal digital assistants to look at ways to reconfigure health care spaces to benefit medical teams and the patients they serve.

Finding Space to Learn, Room to Heal

BY ROGER SEGELKEN

Most viewers of television medical dramas suspect that the personal interactions that occur among fictional doctors and nurses in the halls of hospitals don't really portray the behaviors of their own health care providers. But there could be one similarity between television's hospital scenarios and real ones, Franklin D. Becker suspects: "The best learning opportunities—the informal kind from which people retain the most—probably occur in the corridors."

Becker, professor and chairman of the Department of Design and Environmental Analysis (DEA), is studying what he calls "the ecology of knowledge networks" in an attempt to determine how and where doctors, nurses, and other medical personnel accumulate their life-saving medical knowledge.

"By some estimates, formal training programs of all types in the United States are a $100 billion a year business, although no one knows for sure," Becker says. What is known, he notes, is that only about 10 percent of what people hear in formal educational situations—lectures, seminars, and in-service training, for example—actually gets applied on the job. That leaves a knowledge gap to fill with informal, opportunistic, learning-on-demand situations, according to Becker. He is interested in how the physical design of workplaces—and health care facilities in particular—influences the way knowledge is transferred and absorbed.

"Nowadays health care is provided by multidisciplinary teams who have to work together and interact—and, we hope, to learn from one another," he says. "Our social-network analysis question is: Where, how, and what transpires as health care teams move through a workplace where we, as patients, hope to receive the best-available care?" >>>

One traditional way to study work and learning behaviors is to follow and observe health care practitioners in their daily routines, in the manner of an anthropologist conducting fieldwork with an exotic culture, but that has its limitations. It is extremely time consuming and potentially intrusive at a time when patients expect privacy in their medical matters.

Asking health care providers to fill out written surveys about daily activities and interactions has well-known accuracy problems. "Who remembers exactly what they did the day before?" Becker points out.

For a while he planned to track health care personnel with radio-frequency devices—similar to the EAS (electronic article surveillance) tags that thwart shoplifters—but Becker discarded that plan for reasons of privacy and practicality. "People would feel like Big Brother was watching—or worse, that they were merchandise—and we would have to place dozens of radio-frequency detectors throughout the hospitals."

Then came the idea for what might be a first in studies of this type, if it works in Becker's pilot study. He is asking volunteers to carry PDAs (personal digital assistants) and to answer a few questions—where they are, what they're doing, and with whom—when an hourly alarm goes off. At the end of the workers' shifts, they pass along the PDAs to their replacements. Once a day, Becker's associates collect the PDAs to download the recorded data and hand the volunteers fresh PDAs for another day of data gathering. (The pilot study will start in Cornell's Gannett Health Services clinic before expanding to other facilities, such as Ithaca's Cayuga Medical Center.)

Current PDA and data-analysis technology is up to the task, Becker expects, but there are a few issues that remain to be resolved. For example, trouser-clad volunteers can wear the PDAs on their belts, but some nurse's uniforms have no belts. And a PDA dangling from a lanyard around the neck could interfere with medical procedures. One potential problem has been solved with a bit of computer reprogramming: If a study participant is too busy to respond when the hourly alarm goes off, the signal can be reset for 10 minutes. After a couple more tries, the PDA will wait for the next hourly reporting interval.

When combined with results from other kinds of studies, such as written surveys and direct observations, the PDA study could demonstrate how health care teams interact to do their jobs, how the physical spaces might be changed to improve the quality of medical care, and how to give team members a place to learn and to feel satisfaction in the jobs they do.

"Job satisfaction—feeling valued and respected for your knowledge and contributions—is one key to retention of professionals, such as nurses, who are in short supply," Becker says.

Recently the place where patients and hospital visitors expect to find nurses, the so-called nurses' station, has been undergoing changes in the name of efficiency. Instead of a large, central nurses' station for each hospital unit (or entire floor of a hospital), some redesign schemes distribute several smaller nurses' stations closer to the areas they serve. Satellite nurses' stations can benefit patients who need assistance in a hurry, Becker notes, but health care workers sometimes feel out of contact with their associates. "There is less opportunity to share information and learn from others if you're too isolated," he says.

"If we find certain areas of hospitals where communication and learning occur—and they may not necessarily be the corridors—then we can incorporate more opportunities for those interactions in the design of facilities"

Becker is particularly interested in who holds sway in which parts of a hospital and how communication patterns change with the territory. No one questions that physicians rule clinical parts of the hospital, including the surgery suites, and the patients' rooms when doctors stop by to check on their patients. Social workers and chaplains exert dominance in the waiting rooms, pharmacists in the pharmacies, and so forth. But the walls around nurses' stations don't exclude doctors, "who feel free to come and go," Becker observes. Yet nurses think twice before daring to enter the doctors' locker rooms and break rooms, or even to catch up on lunch and the latest news at hospital cafeteria tables where doctors congregate.

The question of who's in charge where is important when it comes to informal, opportunistic learning, Becker says, because one part of learning is challenging an authority who might be wrong. Except in television dramas, nurses rarely challenge a doctor's wisdom in a clinical setting—even if the patient is sedated at the time and family members and other advocates are out of earshot.

But there is some anecdotal evidence, which Becker hopes to confirm in the upcoming study, that hospital corridors are a sort of no-man's land where all health care personnel feel a little more free to communicate, regardless of rank, and even to learn from one another. The PDA experiment, together with observational data, should give environmental design specialists a better idea of where and how health care personnel spend their time. Responding to a few questions each time the PDA buzzes should take less than 15 seconds, Becker estimates, and then the study participant can get back to work.

"If we find certain areas of hospitals where communication and learning occur—and they may not necessarily be the corridors—then we can incorporate more opportunities for those interactions in the design of facilities," Becker says. "The interdisciplinary health care teams are made up of dedicated professionals who want to improve their skills, work with each other as colleagues, and learn new ways to provide the best care. We'd like to learn how to give them the spaces to make that happen." ●●●

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Kimberly O'Brien uses the college's new Human Metabolic Research Unit to find out how humans metabolize calcium and other minerals—whether they are pregnant teens or weightless astronauts.

Weightless or Pregnant: Maximizing Mineral Metabolism

BY JANE BAKER SEGELKEN

Kimberly O'Brien, an associate professor in the Division of Nutritional Sciences, has been concerned about the nutritional needs of children since she began to understand that there was a huge gap in that knowledge, especially about how minerals are metabolized by the body under situations of physiological stress or increased needs. It was that realization that has led her to focus much of her research on the nutritional effect of pregnancy, particularly in teenagers who become pregnant before they reach age 19.

O'Brien, who joined Human Ecology's faculty in September 2005, uses the college's new 5,007-square-foot, state-of-the-art Frances A. Johnston & Charlotte M. Young Human Metabolic Research Unit for her research. She is also chair of the unit's advisory board. As such, she is responsible for its operation, research direction, and management.

Utilizing the unit's mass spectrometry lab, O'Brien investigates the absorption and metabolism of calcium, as well as iron and zinc. Mass spectrometry is a powerful analytical technique that is used to identify unknown compounds, to quantify known compounds, and to elucidate the structure and chemical properties of molecules. Detection of compounds can be accomplished with very minute quantities. This means that compounds can be identified at very low concentrations in chemically complex mixtures.

In her research, O'Brien found in one study that 30 percent of the adolescents, shortly after giving birth, had low bone mass when compared with expected total body or lumbar spine bone mass for a teen of the same age. In addition, in a separate study involving data obtained in 1,100 pregnant adolescents, O'Brien found that the femur of the developing fetus was significantly shorter in teens with low calcium (dairy) intake when they began prenatal care.

"Teenage mothers are still building much of their total bone mass > > >

Liquid nitrogen spurts and steams out of the top of the thermal ionization mass spectrometer (TIMS) in the Human Metabolic Research Unit. Inset: The source chamber and sample turret of the TIMS is inside the machine and is lit by a rhenium filament.





Left to right: An atomic absorption spectrophotometer, which can measure down to parts per billion (ppb); a magazine for the thermal ionization mass spectrometer; high-throughput ELISA (Enzyme-Linked ImmunoSorbent Assay) processor, used for nutritional assessment to determine concentrations of nutrients, bone markers, etc.; a bone densitometer, specifically a Hologic Discovery A DXA (dual energy x-ray absorptiometer); close-up of ELISA processor.

during these years," O'Brien explains. The unborn baby's need to develop its skeleton may compete with the teenage mother's need for calcium to build her own bones, compromising her ability to achieve peak bone mass that will help protect her from osteoporosis later in life.

Pregnancy is a calcium drain, and it is not known whether adolescent mothers can regain lost bone after their pregnancy ends and/or they stop breastfeeding, and will be able to go on to achieve their genetic potential in peak bone mass. Nor do experts agree on dietary recommendations for teens or what should be done to maximize the bone health of the teen mom and the baby.

In pregnant adolescents, O'Brien used oral and intravenous stable (nonradioactive) calcium isotopes as tracers to compare rates of calcium absorption during the teens' third trimester of pregnancy and the early postpartum period. The isotopes were then measured using mass spectrometric techniques. Total-body and lumbar spine bone-mineral densities were measured using dual-energy X-ray absorptiometry (DXA).

What O'Brien and colleagues found was that teens who consumed more calcium during pregnancy showed less bone loss when tested postpartum, compared to those with poor or average calcium intakes. They also found that a low calcium intake limits fetal bone growth in pregnant teens. Now she is taking her research and her advanced instrumentation to the next level to better understand the in-utero environment, as well as the long-term impact of early pregnancy and breastfeeding on a teen's ability to reach peak bone mass.

"We need the tools to trace what is happening between the teen and her fetus," O'Brien says. "The more we understand, the better we will know what to recommend to ensure that girls get adequate calcium to prevent or minimize losses and avert any detrimental, long-term effects on bone growth."

Not only does optimal nutrition protect the adolescent during pregnancy, but insufficient transfer of nutrients to the fetus during pregnancy could have life-long consequences for the offspring. Known as developmental programming, O'Brien's research approach has implications that can be extended to pursue how the development of the fetus in the womb affects that individual's lifetime health. It is well known, she explains, "that pregnant women need to get adequate nutrition. We need to learn what adequate nutrition means regarding pregnant teens. Effective strategies to prevent mineral deficiencies require a detailed understanding of the metabolism of these nutrients."

To gain that insight, O'Brien and her team will follow 300 Rochester, N.Y., teens throughout their pregnancies. The bone mass of the teens, aged 12–18 years, will be monitored throughout pregnancy by measuring bone mass at the heel (using heel ultrasound measures); fetal bone growth will be longitudinally followed using standard prenatal sonograms. O'Brien, who also holds an appointment at the University of Rochester School of Medicine and Dentistry, will work with clinicians from the Rochester Adolescent Maternity Program and Highland Hospital to measure teens' dietary intake and maternal hormone levels throughout their pregnancies.

"Within one month of delivery, we will monitor total body and lumbar spine bone mineral content in the teens," O'Brien explains. "At some point, we hope to also follow the ability of teens to regain any pregnancy-associated bone losses over a much longer period following delivery." > > >

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Human Metabolic Research Unit

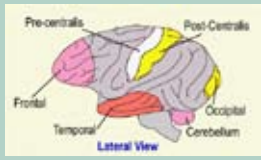
In addition to a mass spectrometry lab, the facility includes a metabolic research kitchen and dining area with associated labs for clinical chemistry measures, physical performance, and body composition analysis, and accommodations to house up to three people for overnight studies. Capable of supporting studies of human subjects, the new unit's research includes population surveys of biochemical status, feeding trials, and confined metabolic studies of diet and health.

The laboratory for human performance allows researchers to study the effects of nutrition on physical work capacity, energy expenditure, and physical activity and metabolic responses to exercise. The ability to measure metabolic function lets researchers assess nutritional status and the response to nutritional interventions.

The food analysis laboratory was designed to facilitate the study of the composition and chemical properties of food. Human feeding experiments conducted in the Metabolic Research Unit involve the development of special menus that have a specific nutrient composition. This lab enables researchers to analyze these diets and provide quality control for dietary studies.

Thomas Brenna Uses Mass Spectrometry to Find Fatty Acid Needs of Babies

You might be tempted to call J. Thomas Brenna a tech junkie, especially when you hear him say he gets really worked up about "doing very technologically sophisticated stuff." But when you listen more closely, you learn that the professor and director of undergraduate studies in the Division of Nutritional Sciences is especially energized about how the high-tech techniques and instruments he has helped develop have influenced the way we feed babies.



Fatty acid analysis of neonatal primate brain tissue shows areas of DHA concentration

"It's probably the thing that excites me the most about doing my work," Brenna says.

Although his interest in fat metabolism dates back to the mid-1980s when he was a master's degree and Ph.D. student at Cornell, it was the three-month premature birth of his twins nearly 16 years ago that fueled his interest in the polyunsaturated fatty acid requirements of fetuses and babies. "They came along and I realized that omega-3 fatty acids were a huge issue," he says.

Omega-3 fatty acids, which are required in the human diet, are classified as essential because they cannot be synthesized in the body from other fatty acids and must be obtained from food.

Brenna spent the better part of three months with his wife and infants in a neonatal intensive care unit in Syracuse, N.Y., all the while reading intensively on how premature infants (his daughter weighed 1 pound 6 ounces at birth) are managed and communicating with neonatalogists from around the world. Although he might have developed an interest in this particular aspect of his research eventually, he says, "It was kind of a natural how it all turned out."

Using stable isotope ratio mass spectrometry*, Brenna and his colleagues worked to learn the requirements of fetuses and babies for omega-3 fatty acids, specifically the long-chain polyunsaturated fatty acid, docosahexaenoic acid (DHA), which is present in high concentration in the brain cortex and the retina. The question they were trying to answer, Brenna says, is whether DHA should be added to infant formula, which at the time did not contain the fatty acid. Because human breast milk normally contains DHA, its consumption is not a concern for breast-fed babies.

"We get our omega-3 fatty acids in two ways," Brenna explains. One is by consuming the long-chain omega-3s primarily from marine sources. The other is by eating them as precursors that are present in some plant foods, such as nut and seed oils, and relying on the body to convert them to long-chain fatty acids, essential for neurological development. It was unclear when Brenna began the studies whether premature and full-term newborns had the capability to make the conversion.

The results of their research showed low rates of conversion, confirming other studies that show that DHA in formula administered to premature infants improved their eyesight and their cognition. A paper authored by Brenna and his colleagues was one of seven cited by the U.S. Food and Drug Administration in 2002 when the agency ruled that DHA could be added to formula.

"Breastfeeding is best," Brenna emphasizes, "but some mothers cannot breastfeed and others simply won't." In addition, some infants are lactose intolerant.

Today Brenna continues to develop highly advanced mass spectrometry procedures for biomedical applications with the goal of learning how much DHA should be in formula.

And the twins? "They're gorgeous, fantastic, perfect," the proud father says, adding they're in accelerated math, "which is significant because about 50 percent of premature kids are behind in math."

And to what does he owe their success? "I put Mom on marine oil when she was nursing."

JANE BAKER SEGELKEN

Space Exploration In her other research, O'Brien is studying the impact of weightlessness on calcium metabolism and bone turnover during space flight. This study, being conducted in collaboration with Scott M. Smith, a NASA scientist at the Johnson Space Center in Houston, and involving many other researchers at NASA, the University of Texas Medical Branch at Galveston, and elsewhere, is one of many being done in preparation for the impending Mars voyage.

"A flight to Mars will be very lengthy," O'Brien says. "Because people tend to lose calcium and bone mass in environments where there is very little net gravitational force, it is important to know what might be done to counter bone loss."

The problem O'Brien and colleagues are trying to solve is whether the changes can be prevented or minimized by including artificial gravity, in the form of centrifugal force, on the extended voyages. Healthy individuals matched for age and other characteristics of the astronauts will be recruited to participate in the study. The participants will be confined to strict head-down tilt bed rest for 21 days; bed rest can mimic some of the detrimental effects of weightlessness on the body. The only time the participants will be allowed out of bed (while remaining in a 6-degree head-down tilt) is for one hour each day when they will be positioned on a short-radius centrifuge and spun at a force equal to 2.5 times Earth's gravity at the level of their feet (and 1 times gravity at the level of their heart).

A key question is how much artificial gravity the astronauts will need to stay fit and to maintain their bones. "A stable calcium isotope will be given orally and intravenously," O'Brien explains. "Using the mass spectrometer, we will measure calcium absorption and rates of bone turnover and make some determinations about diet and other interventions." The ultimate goal is to understand the side effects of artificial gravity on humans and to determine the nutritional requirements, including calcium, for extended-duration space flight. ●●●

For more information:

see www.human.cornell.edu/che/bio.cfm?netid=jtb4

*Isotope ratio mass spectrometry is a chemical analysis technique for determining ratios of stable isotopes of carbon and other elements with precision sufficient to detect changes due to natural processes. A sample is admitted to vacuum, its constituent molecules are ionized by energetic electrons and, using a magnet, sorted by mass to determine the amount of the different forms of carbon, C-12 and C13, present. For the work described in the article, it is used to detect minute amounts of metabolites of stable isotope enriched compounds that are administered to a subject. Besides sensitivity, it allows Brenna to do studies exclusively with stable isotopes that otherwise would have to be done with radioactive isotopes. He uses no radioisotopes.

Toward Healthy, Energy-Efficient Homes

BY ROGER SEGELKEN

Educational outreach programs from Human Ecology's Department of Design and Environmental Analysis (DEA) take aim at two serious problems for homeowners and renters today: unhealthy indoor environments and rising energy bills. Led by Joseph Laquatra, the Hazel E. Reed Human Ecology Extension Professor in Family Policy, and Extension Associate Mark Pierce, the DEA education program confronts high energy costs and environmental health problems with a range of tactics.

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PHOTO PROVIDED COURTESY OF BLEACHOLDMYTH.COM

Energy Town Meetings Participants in a popular series of Energy Town Meetings "attend" these workshops virtually, by way of wide-area network teleconferencing or web streaming. The town meetings, sponsored in part by NYSERDA (New York State Energy Research and Development Authority), cover such topics as mold mitigation, indoor air quality, lighting and heating system efficiency, and photovoltaic and wind energy technologies.

Hundreds of building and remodeling professionals, educators, and the general public have participated in the workshops. Additional support from Cornell Cooperative Extension encourages county extension educators to attend the trainings and, in turn, to teach thousands of others with curricula and "Energy $mart" materials developed by Cornell and NYSERDA.

Laquatra's educational outreach work has earned him a national reputation as an expert in house health problems. His phone rang for months after Hurricane Katrina turned Gulf Coast homes into a morass of mold. Louisiana is one of the few states to regulate mold-mitigation contractors, Laquatra notes, but much work remains before homes in and around New Orleans are safe to reinhabit.

Widespread flooding over a period of four days in the Southern Tier and Catskills of New York State in late June 2006 resulted in 20 counties being included in a federal declaration of disaster. Damage to homes, property, agriculture, and infrastructure was widespread. In the immediate aftermath, Laquatra and Pierce prepared "Responding to Flood Damage" packets of information. The materials, including items written by Cornell faculty and others prepared by the Red Cross and FEMA, were distributed widely across the area.


PHOTO PROVIDED COURTESY OF FREEFOTO.COM

Healthy Homes Video Mold is just one of the allergens covered in a new educational video from DEA. *Healthy Homes: Assessing Your Indoor Environment* was produced by Laquatra and a video crew from the Ithaca-based Christopher Julian Designworks.

Available in DVD format with English and Spanish language tracks, the video was commissioned by the U.S. Department of Housing and Urban Development's (HUD) Office of Healthy Homes and Lead Hazard Control and supported by the Cooperative State Research, Education, and Extension Service (CSREES) of the U.S. Department of Agriculture.

Healthy Homes follows county Cornell Cooperative Extension educators on requested visits to two homes in need of help. In one, an elderly woman is concerned because a leaky furnace released carbon monoxide (before repairs were made), but she learns of other dangers lurking: radon and mold in the basement and lead in old paint where her grandchildren play. In the same town, an apartment-dwelling boy suffers with asthma. The extension educator soon discovers several asthma "triggers": secondhand smoke from the father's cigarettes, dander from the family dog, and cockroaches from a nearby restaurant.

The DVD has a happy ending when homeowners and renters learn their problems can be solved. The grandmother is relieved that test results from the radon kit in her basement are below EPA "action levels." She learns how to clean paint-borne lead dust from windowsills and where to place mold-busting dehumidifiers.

The asthmatic boy breathes easier because the dog has been trained to sleep in its own bed, his father now smokes outdoors, and the roaches are controlled by sticky traps, not toxic pesticides.

Another happy ending occurred recently in real life. HUD employee Emily Williams gave a training session to field staff, and the next day she was visited in her office by a participant. "She told me that the segment in the DVD on carbon dioxide poisoning made a dramatic impact on her. She had neglected to keep her gas furnace maintained and had experienced flu-like symptoms all winter. She said she was purchasing CO_2 detectors that very day, seeing a doctor, and having her furnace repaired immediately," recalls Williams.

Healthy Homes: Assessing Your Indoor Environment was distributed by CSREES and HUD to extension specialists and HUD employees throughout the U.S. For more information on this resource, contact Joseph Laquatra at JL27@cornell.edu.

For more information on healthful indoor environments, see www.hud.gov/offices/lead. ●●●

Sean Nicholson investigates how rapidly physicians adopt new medical procedures, drugs, and devices.

What Determines the Rate of Adoption of Technology in Health Care?

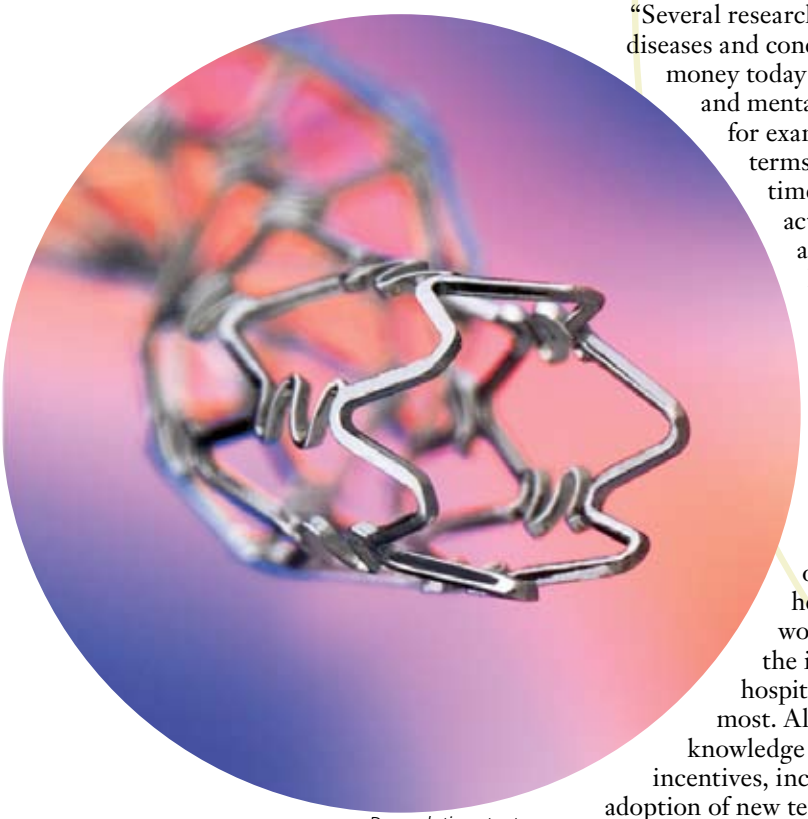
BY METTA WINTER

Few topics make the news more consistently than the spiraling cost of health care, most of which is driven by new technologies—each new device, drug, procedure, or treatment protocol usually costs more than the one it replaced.

Yet, says health economist Sean Nicholson, technology—broadly defined as how a patient is treated for an illness—is also the source for much of the improved health care benefits available to many, but not all, Americans.

"Several researchers have looked carefully at particular diseases and concluded that, yes, we spend a lot more money today treating people who have heart attacks and mental illness than we did 10 to 20 years ago, for example, but if you adjust for quality in terms of increases in longevity or amount of time spent symptom-free, then prices are actually falling," explains Nicholson, an associate professor in Human Ecology's Department of Policy Analysis and Management and a Faculty Research Fellow at the National Bureau of Economic Research.

"Technology is the critical issue because if we adopt technology smartly, then although spending will go up, the benefit will have been worth it," he says.



Drug-eluting stent

STENT IMAGES PROVIDED COURTESY OF CORDIS CORPORATION

Nicholson spent the first four years of his career as a consultant with a health care specialty firm and found in working with many different hospitals that the interactions between physicians and hospital administrators intrigued him the most. Along the way he gained firsthand knowledge about how hospitals respond to incentives, including incentives that promote the adoption of new technologies.

Nicholson joined the Human Ecology faculty in 2004 from the Wharton School of the University of Pennsylvania, where he had spent seven years on the faculty of the Health Care Systems Department. While there, he addressed questions about how physicians are trained, among them: how much medical students know about physician income, how medical students form expectations about what they will earn in various specialties, how important money is when medical students choose a specialty, and why the government subsidizes the training of medical students and medical residents.

Today Nicholson's studies build on that foundation by examining how medical students make decisions once they've graduated and go into practice. He is particularly interested in their decisions regarding the adoption of new technologies.

In cardiology, for example, there are many new technologies available to physicians. Their adoption is a decision that's made jointly by the physicians and the hospitals with which they are affiliated.

One of the most rapidly adopted new devices is the drug-eluting stent. It was a significant improvement over the bare-metal stent inserted into arteries to keep them open after balloon angioplasty, because the new stent retarded the build-up of plaque on the stent (a problem that required a repeat angioplasty or by-pass surgery). When the drug-eluting stents came onto the market in 2003, they were quickly adopted by physicians because not only were the new stents effective for much longer, but Medicare recognized this and reimbursed hospitals that used the better device, even though it was more expensive.

"This was a rare case where it was clear that, in the long term, what was good for the patient was also good for the tax payer," Nicholson says.

Nicholson and colleagues did a study to see if the same hospitals that had rapidly adopted the bare-metal stents in the 1990s also quickly used the improved drug-eluting ones. They found they did.

"This showed that there are hospitals that like new technologies, and if you give them repeated choices, they'll continue to adopt them—if they are not penalized financially," Nicholson says.

When it came to which patients received the newer technology, however, there were clear disparities according to race and form of payment. The data show that—within the same hospital—Medicaid and uninsured patients receiving coronary stents were less likely to receive the newer drug-eluting stents than private-pay patients. And African American patients were less likely to receive them than white patients.

The policy significance of this finding, notes Nicholson and his co-investigators, is that "preferentially providing expensive new technologies to patients on the basis of payer or race, in the absence of clinical justification, may exacerbate inequities in health care delivery."

The study, Within-Hospital Payer and Race Differences in the Early Use of Drug-Eluting Coronary Stents, was a collaboration among Nicholson; Jonathan Ketcham, an assistant professor in the School of Health Management and Policy, Arizona State University; and the following from Yale University: Andrew Epstein, an assistant professor in the division of Health Policy and Administration; Saif S. Rathore, a lecturer in the Department of Internal Medicine; Jeptha Curtis M.D., an instructor in the Section of Cardiovascular Medicine; and Harlan Krumholz M.D., the Harold H. Hines Jr. Professor of Medicine and Epidemiology and Public Health.

Because medical devices and new pharmaceuticals are where most health care research and development dollars go, Nicholson is also conducting studies related to the development of new drugs. One of his most recent investigations centers on developing a quality-adjusted price index for colon cancer drugs. One of the most recently developed drugs costs $52,000 per year. The question he is investigating is whether it's worth spending this amount of money. In the study, A Quality-Adjusted Price Index for Colon Cancer Drugs: 1993–2005, Nicholson and co-author Claudio Lucarelli, who has recently joined Human Ecology's Department of Policy Analysis and Management as an assistant professor, show that in this case the benefits may not justify the cost.

"It's striking," Nicholson says, "that the newer drugs launched in 2000, 2002, and 2004 have shown only slight improvements in survival rates while skyrocketing in price."

Treatment Styles In two new studies, Nicholson found that where physicians trained had little effect on differences in their treatment styles and that they appeared to be influenced little by their peers.

He points out that much has been written in the literature of health economics showing that the kind of medical care individuals receive depends on where they live; for example, people are more likely to be hospitalized and receive aggressive treatment if they live in Miami than in a small midwestern city such as Minneapolis. What's more important to most people, however, is how differently two physicians in their town or city are likely to treat them if they randomly choose a physician. So Nicholson, working with Andrew Epstein of Yale, investigated how differently physicians in a single market would treat essentially the same patient.

The results were surprising: the variation across physicians in a single city is two to three times greater than the variation between cities. This finding then raised a second question: Why is there such disagreement among physicians about how to treat patients? Could the answer lie in where they had received their training? Nicholson and Epstein found that where they trained explained almost none of the variation.

"Our findings show that physicians seem to be independent, free thinkers who have their own opinions, that these neither reflect where they trained nor are they strongly influenced by the way colleagues in their own community treat their patients," Nicholson explains.

"The problems involved in health care economics will take many lifetimes to solve," says Nicholson, who, early in mid-career, looks forward to making contributions to this vital area. "And because the subject is so prominent in the news, there's a chance that my research may affect policy." ●●●

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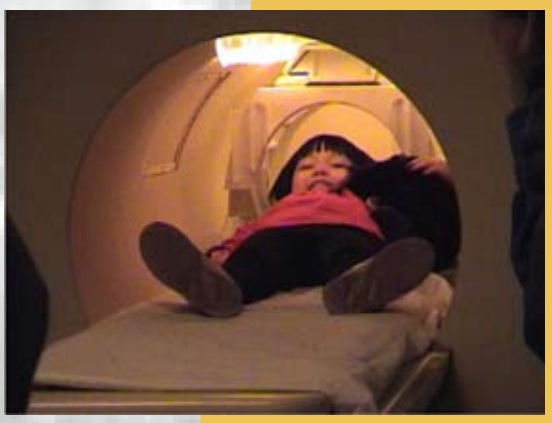
Human Development's Elise Temple leads kids where some researchers feared to tread: into MRI machines to discover how humans learn.

Further Adventures of the Incredible Plastic Brain

BY ROGER SEGELKEN

The photos—given from a motherly looking neuroscientist to youngsters who endured weeks of remedial training (for dyslexia) and survived trips through a scary environment (a magnetic resonance imaging [MRI] machine) while mapping arbitrary symbols onto the auditory system (reading)—were more than just keepsakes. The pictures were something to show those kids back at school and tell them: "You can call me 'dummy,' you can call me 'dyslexic,' but I'm rewiring my brain. What have you done for yours lately?"

Elise Temple had just arrived at Cornell, as a newly appointed assistant professor of human development in the College of Human Ecology, when the prestigious *Proceedings of the National Academy of Sciences* (March 2003) published her work—conducted as a graduate student at Stanford—that changed the way neuroscientists and educators think about developmental dyslexia. Although all the causes for severe difficulties in learning to read were yet to be explained, Temple and her research colleagues found a way to track treatment for dyslexia. Temple's widely hailed experiment with fMRI (functional magnetic resonance imaging) scans of the brains of children with dyslexia—before and after remedial training when the children learned to associate vowels and consonants with English language sounds—showed that specific regions of the brain become more active as the children begin to learn to read.



Even more interesting to neuroscientists, the children with dyslexia were using different parts of their brains—in the right side—compared to children with good reading skills, as their language skills and reading performance improved.

BRAIN SCAN IMAGE PROVIDED COURTESY OF GALLERY HD. GIRL IN MRI PROVIDED COURTESY OF THE UNIVERSITY OF CONNECTICUT

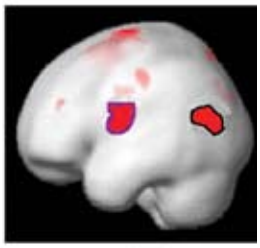
Functional MRI highlights brain activity by proxy, by looking for changes in blood oxygenation when particular neurons become more active. The fMRI scans of kids with dyslexia learning to read also detected some activity in the left side of the brain (specifically, the left temporo-parietal cortex and left inferior frontal gynus), but not as much activity as normal-reading children show in that region. The surprising finding was that children with dyslexia displayed activity in "mirror" regions of the right brain (the right-hemisphere frontal and temporal regions and anterior cingulate gynus) that normal-reading children rarely use. Before their training sessions, the dyslexic children had no brain activity in any of those regions as they struggled with exercises that simulated reading.

Two Reasons for Pride "They were rewiring their brains in response to a behavioral-treatment program," Temple says. And she didn't mind if the children went back to school to brag about their achievements. She had reason to be proud, as well. Temple was among the first researchers to show that functional neuro-imaging can be conducted on fidgety young children—with a few inducements.

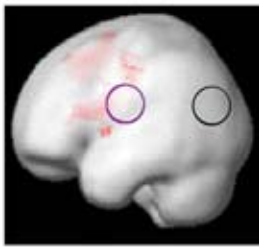
While fMRI had been applied to brain scans of adults for more than 10 years, few researchers were eager to try the time-consuming technique on children. Other technologies had their drawbacks, too. Positive emission tomography (PET) scans require injections of radioactive tracers, and PET scans are not allowed simply for research on children under age 18, according to U.S. Food and Drug Administration rules. And brainwave scans with electroencephalography (EEG) do not have enough spatial resolution to pinpoint changes in brain activity, compared with fMRI, although Temple has used EEG with young children in other kinds of studies.

So Temple decided to try to adapt fMRI to young children (ages 7 to 12) by alleviating fears and offering rewards. Before the children agreed to enter a real MRI machine, they got to try a look-alike simulator, complete with recordings of the noises they would hear when the powerful magnets and motors switched on. If they weren't discouraged by the simulator, they graduated to the real MRI machine. The payoff for remaining absolutely motionless for each five-minute scan was their choice of baseball or Pokemon trading cards—plus the coveted picture of their actual brain in action!

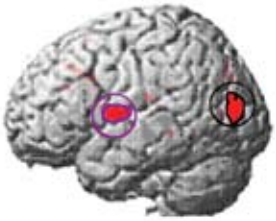
POKEMON CARDS PROVIDED COURTESY OF JOCELYN DAVIS



Brain function in children with no reading disability



Brain function in children with developmental dyslexia



Children with dyslexia show increased brain function after training

Left side of brain

Just for Science Temple was careful not to make too many promises and raise false hopes with the children's parents. Her neuro-imaging tests are not a diagnosis of dyslexia or any other disorders, and they're certainly not a treatment. If children and parents are to participate in the studies, it is "just for science," to have a small but meaningful role in advancing the understanding of how the developing brain works its magic.

In the case of the dyslexia studies, the participants helped to show that intervention programs can change the way the brain functions. The children learned a new meaning for *plastic*, as in neuroplasticity. They were living proof that human brains have a lifelong ability to reorganize their own neural pathways. (Temple examined results of the Scientific Learning Corporation's Fast ForWord Language program, but others might work equally well, she says).

Temple's take-home message to parents, children, and educators is that many cognitive developmental disabilities have a biological basis. Children with dyslexia, for instance, are not necessarily incurably "defective" in some mysterious way. Rather, their brains work differently—and more important, there's something they can do to change that.

At least that's what Temple says. What kids hear is: "My brain is plastic! Way cool!"

Into the Classrooms That's also a message that resonates with seventh-graders when Temple's undergraduate students take "Brain Science" into Ithaca-area classrooms. The undergrads share some of what they've learned in Human Ecology courses, such as HD 220 The Human Brain and Mind: Biological Issues in Human Development and HD 320 Human Developmental Neuropsychology.

The undergraduates' discussions of neurons and synapses and neurotransmitters and memory make perfect sense to seventh graders, who already know more about computers than most parents ever will. Since middle-schoolers usually are reading > > >

somewhere near their grade level and are beginning to learn new languages, they appreciate the difference between language acquisition, which many animal species can do to some extent, and learning to read, which is exclusive to the human species.

Then comes the shocker: scientists can tell—and display in pictures—precisely which parts of the brain are active when the brain's owner is sounding out the syllables of an unfamiliar word. Or storing cell phone numbers and the sounds of their signature ringtones. Plasticity of learning and memory! Who knew?

That's why brain science is a natural way to turn kids on to science, which is another of Temple's passions. She dreams of hearing a knock on her office door and a tentative: "Professor Temple, I heard about neuroscience when your college students came to my class at DeWitt Middle School. Well, I got into Cornell and now I want to learn more." Or even more farfetched but not impossible: "Dr. Temple, I was one of the original participants in your dyslexia studies, and now . . ."

Can proximity to horrific events change the brain—even in people who do not have Post-Traumatic Stress Disorder or depression or anxiety?

The Visible Brain Temple's Cornell students, who are already intrigued with cognitive neuroscience and human development, become even more so with the opportunity to get involved in her research. Working together with Human Development graduate students and postdoctoral researchers, the undergrads help analyze data, test new experiments before they're run in the MRI machine, and prepare participants for their turns. The closest available machine for fMRI is in New York City at Weill Cornell Medical College's Sackler Institute of Developmental Psychobiology, where Temple is a faculty fellow.

A typical dyslexia experiment, for example, displays random letters on a screen inside the MRI machine. Participants might be asked to indicate (with a hand-held keypad) which letters rhyme (*D* and *B* rhyme, but *D* and *K* do not). Or they might be shown a nonexistent "word" that readers can sound out, phonetically, but one that would deter some people with dyslexia who have trouble connecting letters with the sounds they represent.

The Human Ecology undergrads have proved to be so adept that Temple might enlist their help with MRI experiments on even younger children. Age five is probably the lower limit (because staying absolutely still is difficult for a preschooler), and Temple doubts that the costly fMRI scans will ever be used routinely to diagnose dyslexia. But her work might lead to early-detection screens that could be performed in schools or even in preschool situations.

More Tests for Neuro-imaging While Temple's studies of learning in the developing brain continue apace, she also is involved in fMRI studies of brains that learned to be horrified. She is helping Sackler Institute colleagues study New Yorkers who lived or worked near the scene of the World Trade Center attacks on September 11—people who might have reason to suffer post traumatic stress syndrome (PTSD) but apparently do not.

An earlier Cornell study looked at PTSD in New York City firefighters who were directly involved in 9/11 rescue operations. This time, study participants inside fMRI machines were shown photos. But the pictures were not the now-all-too-familiar images of planes ramming the towers, or fires, or people who died in the attacks. Rather, the pictures simply showed human faces with various expressions. Some faces appeared calm, while other faces expressed fear. Temple and her research colleagues are asking the question: can proximity to horrific events change the brain—even in people who do not have PTSD or depression or anxiety?

Another developmental neuroscience project will try to apply neuro-imaging and other techniques to test the so-called theory of mind explanation for autism. According to the theory of mind hypothesis, something in the autistic brain blocks normal perception of other people's emotions, attitudes, and beliefs. Temple and her colleagues will ask: Do individuals with autism have a deficit in the ability to pay attention to the "correct" aspects of a situation? Are they especially impaired when information has social cues?

She looks forward to working with a new faculty member in Human Development, Matthew Belmonte, whose fMRI and EEG research provided physiological evidence that people with autism lack an ability to selectively enhance relevant stimuli (and instead resort to amplifying everything in a state he calls hyper-arousal). Belmonte suspects "too much cross talk between separate neural systems" in the autistic brain as the cause of reduced information-processing capacity. Evidently, "either everything is turned on or everything is shut off," Belmonte has written, noting that "pseudo-autistic traits, in small doses, can confer cognitive advantages" for detail-oriented tasks like engineering and computer programming.

"We have so much to learn about the brain mechanisms that underlie reading and language," Temple says. "We choose to focus on an especially exciting time in the development of the brain, when children age and undergo education and become literate. Sometimes an easier way to get at 'normal' development is to study what's happening when Plan A fails and development doesn't proceed as scheduled. Or to study how the brain compensates for a traumatic injury—perhaps a stroke or a gunshot wound—with its amazing capacity for neuroplasticity. If we're smart and lucky, our payback for those people will be the development of new ways to treat their disabilities."

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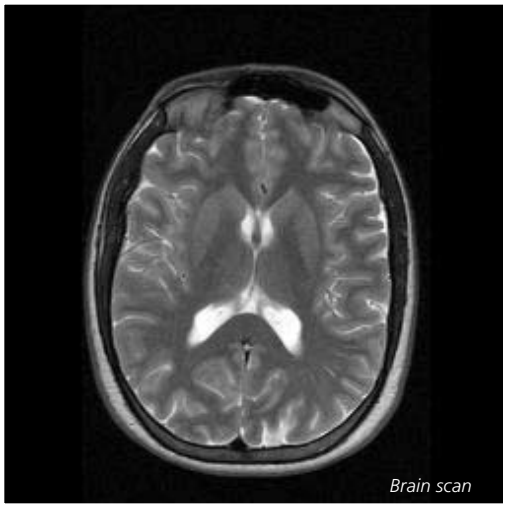
Building a Behavioral-Neuroscience Faculty

One of the fastest-growing sections in Human Ecology's Department of Human Development, the field of behavioral neuroscience, is adding specialists in autism and in aging. Recruiting **Joseph A. Mikels** from the Stanford University Department of Psychology and **Matthew Belmonte** from the University of Cambridge's Autism Research Centre should make Cornell behavioral neuroscience a force to be reckoned with as the discipline of developmental psychology moves toward a behavioral-brain perspective. The increase in faculty also will give Human Ecology students a more comprehensive array of course work from which to choose. Other members of this new section include:

Richard Depue, a faculty member since 1992, who focuses his research on the neurobiology and neurochemistry of personality, emotion, and cognition. Of particular interest to Depue are the personality traits of extraversion, fear-anxiety, affiliative bonding, and behavioral stability. Depue teaches HD 266 Emotional Functions of the Brain.

Steven Robertson, who uses a range of techniques, including eye tracking, to study mind-body development during early infancy, when independent locomotion is not yet possible and "visual foraging" is the way infants explore their world. Noted for his dynamical-systems approach to questions in developmental psychobiology, Robertson creates mathematical models of visual foraging in collaboration with colleagues at Cornell's Center for Applied Mathematics. Robertson teaches undergraduate courses such as HD 334 Infant Behavior and Development.



Brain scan

Elise Temple, whose research and teaching are described in the accompanying article. Temple uses brain-imaging techniques, such as functional magnetic resonance imaging, in an effort to understand neural processing as children develop language and reading skills, as well as the way the brain compensates when injury or developmental disability occurs.

Mikels conducts behavioral, neuro-imaging, and life-span studies of the aging brain to examine the interfaces between emotion and cognitive processes such as selective attention and working memory. His students at Cornell should not be surprised when Mikels has memorized their names by the second class of the new semester—using a memory trick he developed at Stanford: take pictures of every new student and connect faces with bits of personal information he has learned.

The appointment of Belmonte marks a return to Cornell for the neuroscientist and computer scientist, who received his A.B. in 1990 from Cornell's College of Arts and Sciences and whose research at Cambridge, beginning in 2002, used functional magnetic resonance imaging to study perceptual and executive systems in autism. Now regarded as one of neuroscience's preeminent researchers in autism, Belmonte previously examined parallels in information processing by computers and the human mind in the 1993 book, *Computer Science, And Why: Science, Language, and Literature*. At Cornell, Belmonte will teach a Human Development class in autism and the brain, and will help establish a new electroencephalography laboratory in the College of Human Ecology.

ROGER SEGELKEN

Human Ecology's Martha Van Rensselaer Hall

UNIVERSITY PHOTOGRAPHY

What's new

Remote Control Devices Activate Learning

Richard Burkhauser's course ECON 101: Introduction to Microeconomics might skew Cornell's student-faculty ratio rankings with enrollment at 450, but Burkhauser has found a way to interact with every student in class. In fall 2005, he agreed to pilot-test "clickers," small handheld remote devices students use in class to answer questions about course material.

"I'm really a reactive teacher," admits Burkhauser. "I say something in class, and I expect a reaction from the students. Then, depending on how my students react, I will react. It's a back-and-forth process. But once you get above 75 or 100 students in a class, no one wants to talk in such a large classroom. Clickers are absolutely spectacular because they involve the students in a very serious and immediate way."

Burkhauser brings a laptop to class equipped with a small receiver. He has two screens that display PowerPoint presentations of the material he's covering that day. Embedded in the slides are multiple-choice questions. When Burkhauser flashes a question, students respond by selecting a key on their clickers that corresponds to the answer they think is correct. A radio frequency is emitted from the clickers and picked up by Burkhauser's receiver. A third screen records the distribution of the answers in a bar graph.

"If everyone gets the right answer, we move on to the next concept," Burkhauser explains. "If they don't do too well, we can examine the concept further. Because students know these questions are coming, they are active listeners." And clickers serve as a mirror for students to see how well they understand the material—and to show that they're not alone when they get an answer wrong. "It's much less painful for them to discover what they don't know in class than in an exam," he adds.

CLARE ULRICH

New Ph.D. Combines Law, Psychology, and Human Development

Charles Brainerd, professor of human development, is the coordinator of a new graduate concentration called Law, Psychology, and Human Development. The goal is to prepare scholars who will contribute original research in human development and the law, and psychology and the law. The first students will enroll in fall 2007.

The program takes advantage of Cornell's unique cluster of nationally recognized scholars in law and social science across three colleges: Arts and Sciences, Human Ecology, and the Law School.

Brainerd, the author of *The Science of False Memory,* says, "Law is about what people say and report, and what they say is what they remember. Historically, legal studies have not been an empirical science; they have not been scientifically based on research data on human beings."

According to recent statistics, physical forensic evidence is gathered in less than 10 percent of felonies. When such evidence is gathered, it is usable in less than half of those cases.

"What that means," Brainerd says, "is that the evidence that is being used is evidence from people's memories. Even when physical forensic evidence is used in court, it is presented by an expert who's talking from memory."

The other neglected aspect of the law that this new curriculum addresses is the psychology behind what people do with the information presented in court. For example, what is the cognitive psychology of juries? How do jurors make judgments and decisions?

"If science is going to be helpful to the practice of the law, it has to provide the best information on human memory, judgment, and decision-making," Brainerd says.

In addition to Brainerd, Human Ecology faculty members involved with the program are Stephen Ceci, John Eckenrode, Valerie Reyna, and Wendy Williams, all in the Department of Human Development. The Cornell law faculty participating are John Blume, Roger Cramton, Valerie Hans, and Jeffrey Rachlinski; and the psychology faculty member is David Dunning.

CLARE ULRICH

'Go Figure!' Web Site Lets Kids See How They Rate

http://gofigure.cce.cornell.edu

Jeans are ubiquitous among American teens—most have at least four pairs. And so is playing games online. Charlotte Coffman, a senior extension associate in the Department of Textiles and Apparel, has brought these two essentials of teenage life together in Jeans Jargon, one of three activities in Go Figure!, an interactive web site. Coffman created the web site with Suzanne Loker and Fran Kozen, also in Textiles and Apparel, and Patricia Thonney, Nutritional Sciences, to teach math and science—painlessly.

"Very often kids separate things they learn in school from their real life," Coffman explains. "In this activity they see how statistics are used to track fashion trends." They're surprised to discover, too, that a career in fashion depends on skill in math!

But the real grabber in Go Figure! is that teens find out how they compare with other teenagers—a matter of intense interest at this age.

In another activity called Frisbee Fling, they enter how far they threw a Frisbee on three tries. The computer calculates an average and then up pops a graph showing their performance in relation to everyone else in a data pool collected by the Go Figure! design team. With a few clicks, they can narrow that down to kids of their same age and gender.

More than 4,000 kids aged 8 to 19 in 11 states have provided data, 40 New York teens evaluated each activity, and all users can complete an online form that rates the web site's overall appeal.

Three more activities will be launched soon: Who's Average? debunks body image stereotypes, Pedal Away teaches about bicycle fitness and safety, and Create a Smoothie shows how nutrition labels change with different ingredients.

METTA WINTER

Colleen Keller's "Spring and Summer Carousel" children's wear

Kathleen Dombek's and Kristin Modra's "When I Grow Up" apparel line

Students Take Top Awards in Textile Digital Print and Product Design Competition

It was as real world an experience as a student could get: the contest was sponsored by the nation's leading trade association, the American Association of Textile Chemists and Colorists, and developed by its Computer Integrated Textile Design Association. The judges came from the biggest names in the apparel industry, among them Target Corporation and Russell Athletics. They were looking for the very best in digital design and printing—the avant-garde technology that could keep the American apparel industry competitive while also helping to preserve the environment.

After scrutinizing 90 entries submitted by students from 19 institutions, the judges chose the top five based on the highest quality of color, texture, appearance, reproducibility, and overall presentation. Two of the five finalists were from the College of Human Ecology. The top prize was awarded to apparel design sophomore Colleen Keller for her line of children's wear, which she called "Spring and Summer Carousel."

"What was particularly wonderful about this competition was that although the students were asked to create a selection of digital fabrics, our program is so advanced that our students could submit finished garments," says senior lecturer Anita Racine of the jumpers and jumpsuits designed by Keller and her classmate Kristin Modra and graduate student Kathleen Dombek. Dombek and Modra's apparel line, "When I Grow Up," took a runner-up spot.

Right from the start, Racine introduces freshman apparel design majors to digital technologies that enhance a designer's creativity while reducing the industry's production costs and environmental impacts. In the course Introduction to Computer-Aided Design, Racine teaches students how to create original sketches using AutoCAD software. Color is painted in with Photoshop's palette of hues. Then the design is printed directly onto fabric using a 42-inch Hewlett Packard ink-jet printer, then cut and assembled.

"Students get very excited about this process because they are creating the real thing," says Racine of the freshman project in which they design a one-of-a-kind asymmetric sun top. In doing so, they learn digital skills that they will refine over the next four years, so as they build their own portfolios they can feature fully made garments instead of the traditional static line drawings with fabric swatches. They also experience firsthand why flexible digital technology is the wave of the future.

Racine explains that creating garment samples is one of the most expensive processes in apparel production, because traditional printing methods necessitate a run of hundreds of yards of fabric to get the 10 or so needed for a designer to try out an idea. The remainder goes to waste. With digital technology, the designer works within the boundaries of a single pattern piece so it's quick and easy to try out lots of shapes and color schemes making just one at a time. And because ink is applied only inside the shape of each pattern, there is no need to run bolts of fabric through huge dye vats filled with water, which currently is discarded into the environment. Already, more than 100 types of fabrics—from sheer silks to heavy woolens—are available for digital textile printers. Overall time, space, materials, and energy costs shrink using speedy computers and printers.

Being on the forefront of the latest in industrial production technology is a hallmark of the Department of Textiles and Apparel. In 1986 Racine offered one of the nation's first courses in computer-aided apparel design. She says it's vital to stay on the leading edge of the newest commercial innovations, and she is looking to acquire a color-fast steamer, a laser cutter, and an ultrasound (threadless) stitching machine.

"Our students need to be experiencing all of these technologies so that when they graduate, they'll have the skills to work anywhere, from small firms using traditional methods to enormous firms like Liz Claiborne, where design and production is highly computerized."

METTA WINTER

For more information, go to www.human.cornell.edu/che/bio.cfm?netid=arr5

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Faith Fenton, a pioneer in research on freezing foods and vitamin retention, was a faculty member in Cornell's College of Home Economics (now Human Ecology) from 1922 to 1959. In this 1950s photograph, Fenton is shown in her food science lab. The college has a long history of innovation, first in the field of home economics, bringing science to the farm home, and later in the wider perspective of human ecology, preparing people to take leadership positions in academia, public education, government, and industry.

Human ECOLOGY

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