THE UNIVERSITY OF MICHIGAN
DEPARTMENT OF ECOLOGY AND EVOLUTIONARY BIOLOGY

NATURAL SELECTIONS

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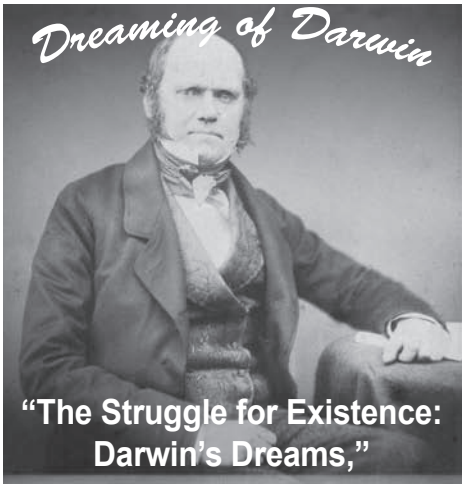

"The Struggle for Existence: Darwin's Dreams,"

an original play written by EEB Professor Catherine Badgley and directed by Kate Mendeloff of the University of Michigan's Residential College (director of Shakespeare in the Arb), was performed in late November in the Exhibit Museum of Natural History.

Badgley imagined Charles Darwin as he wrote the last chapter of "The Origin of Species." The play explores Darwin's struggle to resolve the conflict between his sense of accomplishment with his worries about the possible misuses of his theory of evolution. Performed by a cast of students and faculty, the play moved throughout different parts of the museum for each act. A public reception and a discussion with the director, playwright, and cast followed some of the performances.

"It has been fascinating to work with manuscripts, letters, and articles from the 1850s for this play," said Badgley. "Some of these people were brilliant writers as well as great thinkers."

She added, "It's a thrill to see the play come to life and to get so much appreciation for its meaning as well as for our efforts."

Intro bio dramatically improved

Imagine taking a class along with 700 students that covers ecology, evolution, and molecular and cellular biology in just 40 lectures during one 15-week semester. This daunting task is now relegated to the annals of biology education at the University of Michigan.

The undergraduate introductory biology course underwent a transformation in the 2007-2008 academic year from a single required introductory course to two lecture/discussion courses and an accompanying laboratory course.

In 2004-05, a joint committee of EEB and MCDB faculty members met to review how well the curriculum was working. They identified significant opportunities for improvement. Much subsequent planning and exploring of options brought the departments to their current course offerings: Introductory Biology: Ecology and Evolution; Introductory Biology: Molecular, Cellular and Developmental Biology; and Introductory Biology Lab.

Professor Diarmaid Ó Foighil, EEB's associate chair of curriculum at the time, was a central figure in bringing all relevant parties together and finding solutions to issues that spread into many other departments as a result.

"It involved mini surgery, turning a one-term five-credit class into two

see intro bio, page 3

"Beetle mania" in the rainforest

John Schroeder spent the summer of 2009 trudging through the rainforests of Barro Colorado Island in the Panama Canal collecting beetles and leaves amid exotic understory flora and fauna. Everyone was welcoming except for the capuchin monkeys who shook branches at him as he passed by. Schroeder, an EEB concentrator who is an honors student in his junior year, worked alongside EEB graduate student Brian Sedio as part of a project conducted at the Smithsonian Tropical Research Institute with their advisor Professor Chris Dick.

The researchers are studying at least 100 beetle species that are found on shrubs in the genus *Psychotria*. Schroeder censused plots, counting quantities of 21 different plant species on his daily rainforest excursions. The beetles range from the size of a letter on this page to about the size of a dime. (There were also giant beetles as big as a cell phone, but those weren't dining on the plants of interest.) Back at the U-M lab, Sedio is sequencing the DNA from the beetles' guts to determine what they eat using DNA bar coding techniques.

see beetle mania, page 6

chair's notes

Deborah E. Goldberg
Elzada U. Clover Collegiate Professor and Chair, Ecology and Evolutionary Biology

Dear Friends,

It has been an extremely busy fall as we welcome a number of new people to the department. Professor Pej Rohani (featured on p. 5) has braved the cold to join us from the University of Georgia. Pej is an internationally-renowned researcher in the ecology of infectious diseases and the author of the authoritative textbook on the subject. He has a joint appointment with the Center for the Study of Complex Systems and we are delighted to have him. Dr. Evan Economo is our new Michigan Junior Fellow, joining Dr. Manja Holland. The Michigan Society of Fellows is a unique interdisciplinary community of Junior Fellows, which are three year positions as Assistant Professor and Postdoctoral Fellow, and Senior Fellows, chosen from among the faculty of the university. Only eight Junior Fellows are invited each year out of (this year) 700 applications, so it is a highly selective process and EEB is very proud of our long record of continuous Fellows. This year, I am lucky enough to be a Senior Fellow in the Society and our monthly talks and dinners on subjects ranging from the archaeology of south India to French medieval poetry to string theory remind me why being a professor is the best job in the world.

We also welcomed two wonderful new lecturers, Drs. Lynn Carpenter and Laura Eidietis, who are joining our two current outstanding lecturers, Drs. Jo Kurdziel and Marc Ammerlaan. Lynn actually started last January and is doing concentration advising for Biology and EEB, coordinating curriculum, and teaching the laboratory course in introductory ecology and a non-majors course on the history of life. Laura, a PhD. graduate of EEB, is coordinating the discussion sections for 700 students a semester in the EEB introductory biology course, teaching the honors discussion sections of that course, as well as teaching in animal physiology and animal diversity.

This year, we have a record number of Postdoctoral Fellows in the department – 32, supported on a diversity of research grant funds and fellowships. They come from many countries including China, Russia, Cameroon, France, Italy, Venezuela, the United Kingdom, Nepal and the Netherlands and bring great intellectual energy and diversity to our community.

Adding to the fun of being in EEB is our very own baby boom by faculty, staff, postdocs, and graduate students. In the last year alone, we have welcomed nine babies, with four more due this winter. While the university has had a policy of modified duties for new parent faculty, this year is the first year that a similar policy exists for graduate students, helping them to juggle their many responsibilities. The department strongly supports facilitating a healthy balance of life and work.

Finally, I would like to thank the many of you who have contributed to EEB for graduate student support, undergraduate international opportunities, our strategic fund, and to our newest fund, the David Bay Photography Fund. As noted on p. 6, thanks to several very generous gifts, we have decided to try to reach the $10,000 needed to enable the David Bay Photography Fund to become an endowment and support the photography and graphics needs of our graduate students in perpetuity.

My warmest regards to all of you and I hope to see you in Ann Arbor,

intro bio

intro bio from page 1

terms with an integrated lab for a total of 10 credits," said Ó Foighil. "It was surprisingly complicated."

With the new class structure entering a third academic year, Ó Foighil and the other faculty who teach the courses now have some perspective on how the change is working out.

"Students certainly are getting a much more extensive grounding in biology," Ó Foighil said. "It means that you can cover issues in much greater depth and context, rather than hitting abstracted highlights only."

Experienced senior EEB faculty teach in the introductory courses, including Professors Mark Hunter, Barry OConnor and Ó Foighil, as well as two exceptional lecturers, Drs. Marc Ammerlaan and Jo Kurdziel, who is also an assistant research scientist.

Kurdziel, who joined EEB in 2003 to teach the introductory biology sequence, said students often decide if they're going to stay in the field or not while enrolled in the course. With the more comprehensive coverage students receive from the stand-alone EEB course, she has noticed an increasing number of students find an affinity with ecology and evolution, which might change the course of their educational path and career.

"Under the old course structure, we couldn't devote much time to describing the diversity of life on earth," said Hunter. "By reorganizing the course, we've been able to expand our coverage of organismal diversity and give students a greater appreciation for the diversity of life with which we share the planet."

The new course structure also has transformed the laboratory component of introductory biology. Previously, the lab was designed to expand upon a key concept from lecture that week rather than teaching about the process of science. The new separate laboratory course focuses on teaching students how science works, getting them to think like biologists, ask interesting questions, learn to analyze data and interpret their results.

Ammerlaan, who has been at U-M for 15 years, teaches the weekly lecture that preps students for the upcoming lab and oversees 18 graduate student instructors. He recalls that in the former lab, the content was somewhat dictated by the instructors and the pace was set by the lecture.

The lab now has four three-week modules, rather than having a different topic each week, covering four big thematic areas: enzymes, molecular biology, evolution and ecology. The lab is a series of open-ended investigations relating to each other.

"We try to show students that when you're studying enzymes, there's a component of evolution in that," Ammerlaan said. "When we're looking at ecology, the organisms are interacting because of capabilities that ultimately trace back to genes and enzymes. We try to step back and have a bigger look at important concepts in biology rather than the week by week topics. Students have to design projects and discuss them. Often times the process of how they go about figuring something out turns out to be more important than whatever answer they get. The focus is on training students to think like scientists and letting them figure things out on their own."

Marc Ammerlaan

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Jo Kurdziel

With the more comprehensive coverage students receive from the stand-alone EEB course, Kurdziel has noticed an increasing number of students find an affinity with ecology and evolution, which might change the course of their educational path and career.

graduate profile

Stressing out has its costs – even for tadpoles

Untold dangers lurk in the murky pond waters where unsuspecting wood frog tadpoles hatch. It is estimated that a mere five to 10 percent of tadpoles survive their first 60 days to crawl out of the pond toward their new terrestrial home because, among other things, numerous predators are on the prowl. As tadpoles flit around the pond, fish and the larvae of dragonflies, beetles and salamanders hungrily seek them out for their next meal.

Jess Middlemis Maher

"I was raised as an ecologist."

Investigating the suspenseful scene playing out in the ponds' depths is graduate student Jessica Middlemis Maher, who is interested in how genetic and environmentally-induced variations among individuals impact tadpoles from an ecological and evolutionary perspective.

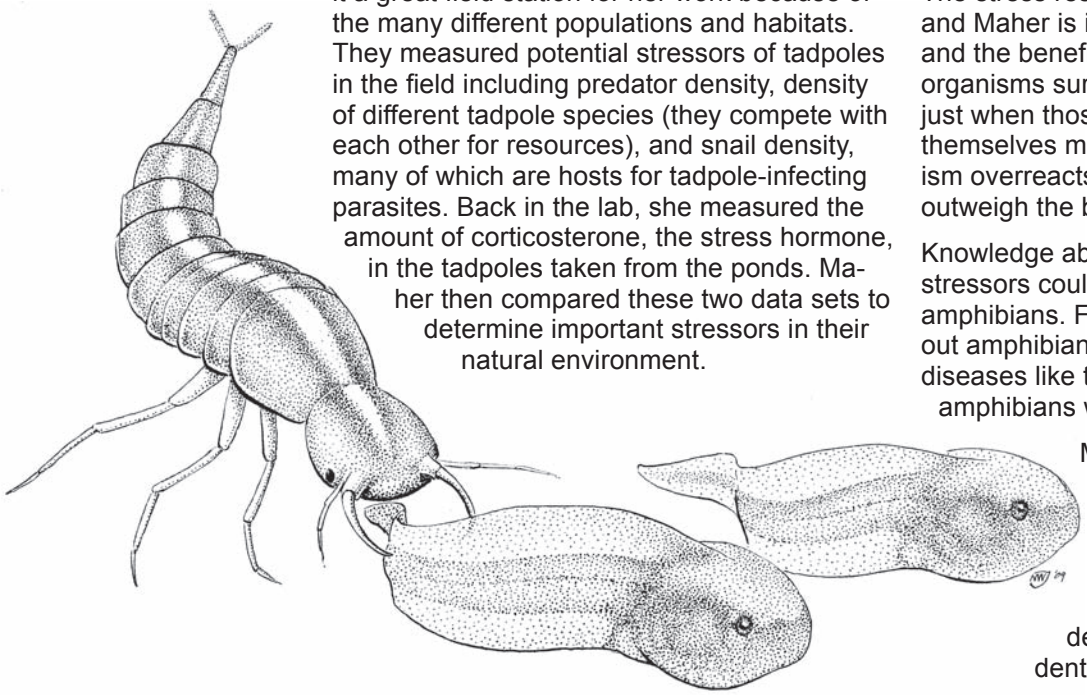
"I use stress as a measure in my research. I'm especially interested in how stress is experienced and how it plays out in the early stage of development as well as later in the life cycle." To get started, Maher tagged along with Professor Earl Werner and his students on a pond survey at the E.S. George Reserve in Pinckney, Mich. The reserve is home to a large, thriving amphibian population making it a great field station for her work because of the many different populations and habitats. They measured potential stressors of tadpoles in the field including predator density, density of different tadpole species (they compete with each other for resources), and snail density, many of which are hosts for tadpole-infecting parasites. Back in the lab, she measured the amount of corticosterone, the stress hormone, in the tadpoles taken from the ponds. Maher then compared these two data sets to determine important stressors in their natural environment.

"Predators, not too surprisingly, jumped out as a big one. I then was able to corroborate that with experiments where we manipulated predator presence and then measured stress hormone production. I found that not only does the presence of predators increase baseline stress hormones but also that the effect continues after metamorphosis. This was somewhat unexpected since aquatic predators aren't necessarily predictive of anything the frog will experience after metamorphosis when it's hopping around in the woods. So, not only were they going into the terrestrial stage with higher than normal levels of stress hormones circulating in their bodies but they also couldn't respond as well to a novel stressor, which would most likely put them at an adaptive disadvantage."

Knowing that producing the stress hormone can be costly, Maher is now looking at how different species that live with different densities of predators respond to that stressor, since those species that experience greater predation risk would potentially incur a greater cost for "stressing out." That cost can manifest itself in a number of ways including reduced growth rate and reduced ability to ward off disease and parasites as well as reproduction in the adults.

The stress response can also be beneficial and Maher is interested in both the costs and the benefits. "The stress response helps organisms survive difficult situations. It's just when those difficult situations present themselves many times, or when the organism overreacts, that the costs might start to outweigh the benefits," she said.

Knowledge about how frogs respond to new stressors could help conservation efforts for amphibians. For example, already stressed-out amphibians could be more susceptible to diseases like the chytrid fungus that threatens amphibians worldwide.



Maher has taught graduate student instructor workshops and acted as a Rackham mentor for incoming STEM (science technology, engineering and mathematics) graduate students, especially international students. She was awarded a Doctoral

see stressing out, page 7

faculty profile

Hot on the trail of childhood diseases

"As a teenager I was drawn to biology and trying to understand how nature works," recalls Professor Pej Rohani, EEB's newest faculty member. "I was also interested and intrigued by mathematics."

It was a very tough decision for him to make at the age of 17 when he was applying to British universities. It's very different from the United States, where the most popular major among incoming freshmen is "undecided." He chose mathematics and later was very excited to find that he could use mathematics to help understand and explain aspects of biology.

Rohani is a theoretical and disease ecologist who joins U-M from the Odum School of Ecology at the University of Georgia. He is also a professor in the U-M Center for the Study of Complex Systems. He will teach cross-listed courses on infectious disease ecology and modeling infectious diseases. Rohani speaks with a melodic accent that is a product of his Iranian descent and growing up in Britain.

In the mid-1990s, Rohani began working on the transmission and dynamics of childhood infectious diseases and over the past couple of years, he has advised the World Health Organization helping to improve estimates of mortality and morbidity for measles and whooping cough (also known as pertussis) via their QUIVER (Quantitative Immunization and Vaccines Related Research) committee.

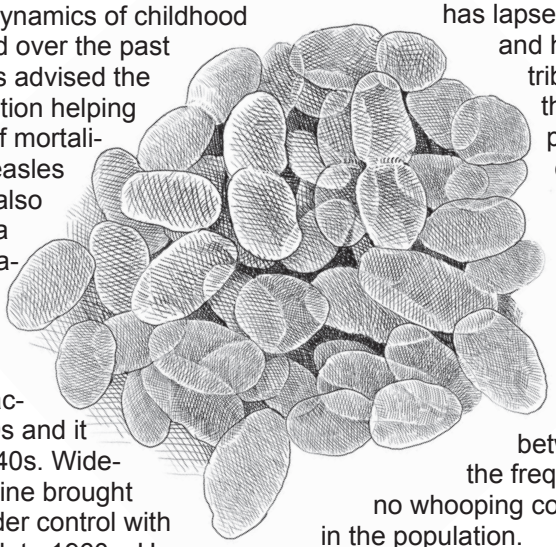


illustration: pertussis bacterium

Work on a pertussis vaccine began in the 1920s and it was licensed in the 1940s. Widespread use of the vaccine brought the disease largely under control with only rare cases by the late 1960s. However, despite widespread vaccine use, the number of reported cases of whooping cough began to increase in the 1980s in much of the United States and several other countries. To further confound matters, the increase is being seen predominantly in adolescents and adults rather than in children.

"Clearly, this is worrisome from a public health perspective," Rohani said. "There are difficult issues to disentangle." Are you immune to pertussis once you've had it? If you are immune, for how long? If you get a second episode of pertussis, how infectious are you? Are you a carrier or a silent carrier once you've been exposed?

These are tough questions to address clinically, he explained, therefore Rohani and Helen Wearing, his former postdoctoral fellow, used mathematical models to explore various scenarios and compared the predictions generated by those models to data on whooping cough incidence. Their results on whooping cough immunity were published in the October 2009 open-access journal *PLoS Pathogens*.

Pej Rohani

One leading explanation of the recent surprising increase in cases is that the immunity conferred by vaccination or previous exposure wears off after some time. The researchers tested this by constructing two models with different assumptions about what happens when a person whose immunity has lapsed is exposed to pertussis and how much that person contributes to transmission. Then they compared the models' predictions to whooping cough incidence data from England and Wales from both the pre-vaccine era (1945-1957) and the vaccine era (1958-1972). In particular, Rohani and Wearing looked for matches in two key measures: the number of years between big outbreaks and the frequency of extinctions, when no whooping cough cases were reported in the population.

"There are so many cool people around – it's very exciting."

The analysis revealed that model dynamics are consistent with the data when, on average, whooping cough immunity lasts at least 30 years and perhaps as long as 70 years after natural infection. "This is surprising because clinical epidemiologists currently believe the duration of pertussis immunity is somewhere between four and 20 years," said Rohani.

In addition, repeat infections appear to contribute relatively little to the transmission cycle, the researchers found. And when people whose immunity has waned are re-exposed to whooping cough, they rarely become infected. In fact, their immunity to the disease may be boosted

see hot on the trail, page 7

undergrad feature

John Schroeder

beetle mania from page 3

They are investigating host specificity (which plants are eaten by which beetles), whether they are generalists or specialists, and how the habits of these herbivores might be affecting the evolution and distribution of the plants.

"It's the best job I've ever had," Schroeder said of his experience. He said the field site is really unique, situated on a 16 square kilometer island in the canal. The island is a study site for biologists with a 50 hectare censused plot and multiple projects ongoing at any given time.

"Every day I saw something really unique," he said. From toucans, howler monkeys, spider monkeys and the aforementioned cranky capuchins, to a multitude of interesting plants and insects, such as army ants. While Schroeder was on the island, someone photographed a spotted jaguar a couple of hundred yards from their camp for the first time. "Everyone was a little wary working out in the forest, knowing there was a jaguar wandering around in this small area with us," Schroeder recalled.

A very different project Schroeder also worked on last summer was collecting microbes from Yellowstone Lake to identify what species are present. He collected lake water and pumped it through filters of various sizes. Once they extracted the DNA from the various organisms they found, the DNA was sent to a facility for a process called pyrosequencing that generates huge sets of sequence data. He said they are finding substantially more species than originally predicted. The current estimate is that between 30 – 40,000 species of bacteria live in the lake, more than some relatively recent estimates of total bacterial species on the planet. This summer job, through Montana State University, was funded by the National Science Foundation.

Schroeder explained that identifying the microbes is a preliminary step to understanding their ecological roles. Some of these microbes may have important roles in industrial processes such as bioremediation (cleaning up toxic sites), agriculture, and bioprospecting (searching for substances that are produced by living organisms that may be of medicinal or commercial value).

In what seems to be a recurring, and not so surprising, theme among scientists, ever since Schroeder was a young child, he was keenly interested in nature. He kept pet bugs and watched caterpillars transform. He enjoys camping, hiking, skiing and just being outdoors. He wanted a job that would put him out in the environment, so ecology fit his personality. He started working in Dick's lab as a freshman, and that's what turned his interests toward tropical ecology.

"My understanding is that before you can discover something that's useful in everyday life you need to know what's there and what it's doing."

Shroeder's interests expand beyond the bounds of science. He played cello in the campus orchestra for three years, he likes to play guitar and he recently joined the U-M mountain bike racing team.

His senior honors thesis will be on how seed and pollen dispersal contributes to genetic structure of tropical tree populations. "I'd like to apply to grad school next year and see where that takes me," Schroeder said. He's interested in continuing his research in tropical biology and exploring how various processes contribute to biodiversity.

Seeking endowment status: David Bay Photography Fund

We are currently over 40 percent of the way toward reaching our goal of making the David Bay Photography Fund an endowed fund at the $10,000 level. The fund was established in his memory by Susan Campbell, David Bay's wife and a former employee of the Biology Department in the 1980s. The fund will help pay for poster and photography printing for students presenting their research, and other graphic needs that may arise. Bay was EEB's and its predecessor department's "photographer-at-large" for over 34 years and was known and loved by many faculty, students and staff. Thanks to your donations, he will continue to support many generations of his favorite graduate students in a way that would make him smile.

To make a donation, visit http://www.eeb.lsa.umich.edu/eeb/alumni/giving.html or call toll-free (888) 518-7888 or (734) 647-6179.

hot on the trail from page 5

by re-exposure, the study suggests.

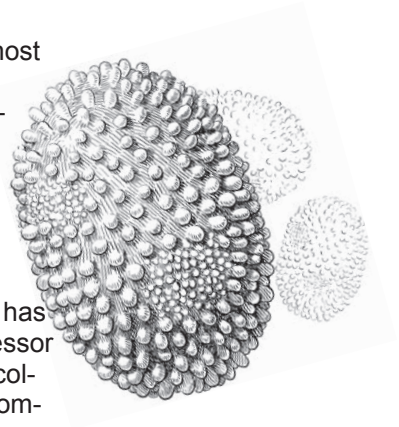
If correct, the results represent encouraging news, Rohani said. “They suggest that loss of immunity may be playing a less significant role than is currently thought. And at least in these historical data, vaccination seems to interrupt transmission substantially.” His research continues to investigate possible causes of increased infection rates and the age of those getting infected.

In another research realm, Rohani recently received a grant from National Science Foundation to study the transmission dynamics and evolution of avian influenza viruses in North American wild bird populations. It is thought that wild bird populations are essentially the mixing vessel for the diversity of influenza viruses that spasmodically spill over into humans. Avian influenza viruses have been implicated in the four previous pandemics of influenza virus in humans as well as the current H1N1 flu outbreak. Experimental work in the field and in the laboratory by Rohani’s collaborators have shown that influenza viruses can survive in water for extended periods of time, from days to months depending on conditions. The researchers are using these results as well as long-term surveillance data from wildlife disease biologists as input to mathematical and statistical models to study the dynamics and evolution of these viruses.

“We are in the process of understanding how this kind of environmental reservoir for the virus affects transmission dynamics and what implications it might have for the long-term evolution of these viruses in avian species.”

Rohani also investigates the predator-pathogen host system that includes the Indian meal moth, *Plodia interpunctella*, (the number one agricultural stored product pest) and its competitor, the Almond moth, *Ephestia cautella*, and their natural wasp enemies. He’s also been working on trying to link infectious disease ecology with economics.

So, just what does this professor enjoy most about his work? “This is going to sound awfully nerdy,” he said, “but there is nothing more exciting than generating that unexpected finding that makes you think differently, then looking at it and saying ‘wow, that’s so cool.’”



Rohani is already collaborating with EEB Professors Aaron King and Mark Hunter, has previously written articles with EEB Professor Mercedes Pascual and looks forward to collaborations with several others in EEB, complex systems and epidemiology. “There are so many smart and interesting people around, it’s very exciting,” he said.

[with excerpts from a U-M News Service press release by Nancy Ross-Flanigan]

stressing out from page 4

Dissertation Improvement Grant from the National Science Foundation and the Helen Olsen Brower Memorial Fellowship in Environmental Studies from the department.

“I was raised as an ecologist,” she joked. Her parents are outdoor enthusiasts who work in the sciences. Maher has a horse named Keilah, who has grown up with her since her freshman year of high school. Maher and her husband, Michael, recently celebrated the birth of their first baby. Perhaps another budding ecologist has been born?

E. Tibbetts

The EEB buzz: Your alumni news online

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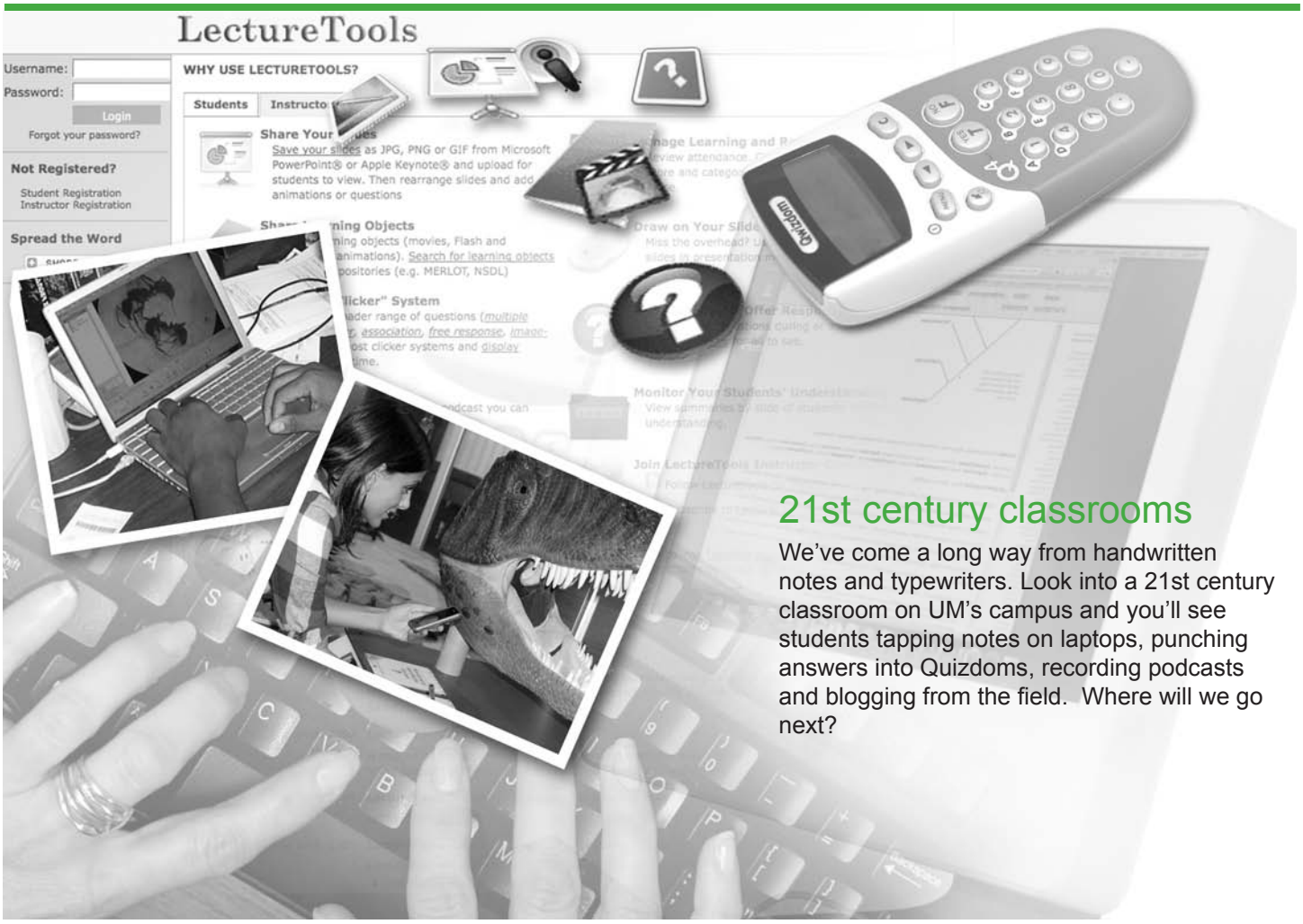

21st century classrooms

We've come a long way from handwritten notes and typewriters. Look into a 21st century classroom on UM's campus and you'll see students tapping notes on laptops, punching answers into Quizdoms, recording podcasts and blogging from the field. Where will we go next?