

BACTERIA AID SOCIAL COMMUNICATION

Twitter may limit humans to 140 characters, but a just-as-brief scent post can convey an encyclopedia of information about the animals that left them.

MSU BEACONites Kevin Theis and Kay Holecamp studied multiple groups of male and female spotted and striped hyenas in Kenya and found that “when hyenas leave paste deposits on grass, the sour-smelling signals relay reams of information for other animals to read.” However, it’s actually the *bacteria* in pastes that appear to be sending the messages.

Variation in scent gland bacterial communities was strongly correlated with variation in the glands’ odor profiles, suggesting that bacteria were responsible for the variation in scent. “Hyenas can leave a quick, detailed message and go. It’s like a bulletin board of who’s around and how they’re doing ... Scent posts are bulletin boards, pastes are business cards, and bacteria are the ink.”

Using next-generation sequencing methods, the Theis team ‘read’ these messages through the eyes, or noses, of hyenas. They found that the diversity of odor-producing bacteria in spotted hyena scent glands is much greater than historical studies of mammals had suggested. This diversity, however,

still consistently varies between hyena species, and with sex and reproductive state among spotted hyenas. “There have been around 15 prior studies pursuing this line of research ... but they typically relied



on culture-based methods, an approach in which many of the similarities and differences in bacterial communities can be lost. If we used those traditional methods, many of the key findings that are driving our research wouldn’t be detected at all.”

Theis’ team was the first to combine microbial surveys and complementary odor data from the wild animals. “The next phase of this research will be to manipulate the bacterial communities in hyenas’ scent glands to test if their odors change in predictable ways.”

Read more in the November preprint here: Theis et al 2013, “Symbiotic bacteria appear to mediate hyena social odors,” *PNAS*. Article DOI: 10.1073/pnas.1306477110

BEACON DAY AT NC A&T

Colleagues at North Carolina A&T State University (NC A&T) treated their BEACON partners to a wonderful research visit complete with interesting talks, state-of-the-art facility tours, and excellent idea exchanges by all.

The visit, held in October, was a chance for researchers across BEACON to meet at NC A&T to foster future collaborations and make progress in existing partnerships. During the visit, BEACONites toured a computer science lab and heard lightning talks from students (pictured right, above). The group also toured the impressive Joint School of Nanoscience and Nanoengineering and Biology Centers (pictured below right and left, respectively).

Faculty and student research presentations, as well as a student poster session, helped to establish current expertise held among BEACONites and where challenges still exist. The visit then culminated with the group dividing into working groups to brainstorm potential avenues toward solutions and plan how to get there.



NORTH AMERICAN GENDER SUMMIT

Diversity Leads to Excellence

The Gender Summit, held in Washington DC mid-November, focused on achieving “positive change towards greater diversity in the Science, Technology, Engineering and Mathematics (STEM) workforce and leadership, and greater inclusion of biological sex and gender considerations or the ‘gender dimension’ in research content and process.”

Four BEACONites, including two graduate students (Carrie Glenney (U Washington) and Emily Weigel (MSU), Dr. Jenny Boughman (MSU), and BEACON’s Diversity Director Dr. Judi Brown-Clarke were in attendance. There, the diverse group of national and international experts and stakeholders from various types of institutions discussed what it means for science to be “gender neutral,” that is, “to show that the study design has taken into account the needs of both women and men as equally important.”

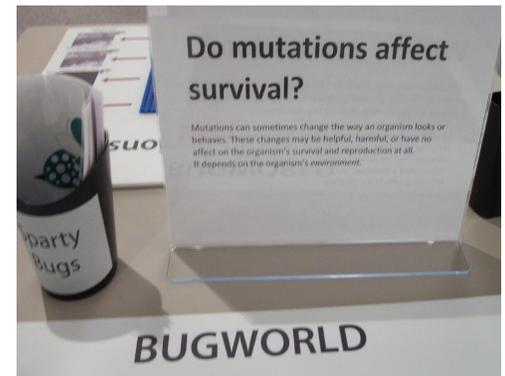
Given the considerable benefits to research, in not only quality, but also new frontiers of scientific knowledge, the Summit

promoted evidence-based, concerted and integrated actions to diversify STEM. Specifically, it established “a collective commitment and capacity to strengthen human capital development, research and innovation through diversity” and addressed strategies to meet this goal based on quality evidence of how the gender dimension (and diversity broadly) positively affects STEM work.

Notably, the Summit allowed leaders to share solutions on how to incorporate the gender dimension into institutional structures, funding structures and peer review processes, as well as how to foster an inclusive community of experts -- cross-disciplinary, government, industry, academic, and citizen partnerships -- for change.

The Summit addressed and prioritized what deserves immediate attention regarding gender attrition, the most appropriate, beneficial and impactful actions that different stakeholders can take, what ways inter-stakeholder collaboration can increase, and what strategies would best to achieve global impact.

CHECK OUT MSU MUSEUM’S MUTATION STATION!



In late October 2013, a new portion of the BEACON exhibit opened at the MSU Museum. This hands-on unit, called the Mutation Station, was co-created by BEACONites Julie Fick (MSU Museum) and Emily Weigel (MSU Zoology), and is intended to specifically address what mutations are and how they impact evolution to shape species.

The exhibit activity is divided into 3 parts which address:

1. What mutations are (and are not!)
2. What effects they can have on organisms
3. How they affect evolution and shape species

To start, the mutation activity explains some basic types of mutations. Through a hands-on approach using LEGO pieces ('DNA'), visitors assemble 'sequences' which each reflect a non-mutated and various mutated sequences of DNA. When the LEGO pieces of DNA are added or removed, for example, visitors can easily see that the number of pieces differs and that information has been added or removed. Likewise, when pieces are rearranged, visitors can compare and see that the colors for each of the LEGOs are now in a different order, although the pieces of DNA within the sequence are all still present.

The second part of the activity uses a fictional insect species, Spartybugs, to illustrate what these constructed sequences 'mean' genetically -- that is, how each of the mutations affect vision in Spartybugs. Here, visitors can see how their mutated Spartybug sees and associate a mutated sequence with, for instance, blurred vision. This portion of the activity points out not only the rarity of mutations, but also targets several misconceptions surrounding how various mutations can affect gene function.

Finally, the evolution portion of the activity asks visitors to pick a Spartybug and determine its fate within different parts of 'Bugworld'. This habitat has several different regions where different sequences (mutated and not) are favored to different degrees, as noted by a smiley, neutral, or frowny face. This portion of the activity addresses the misconceptions that mutations are always good or bad, and has visitors work through examples where the effect of a mutation (good, bad, or neutral for survival and reproduction) depends on the Spartybug's current environment.

We hope this simple activity will get visitors -- even you! -- to think about the connections between genes, the environment, and evolution. So go check it out!

KEEP CLIMBING...

Bacteria Show Evolution Doesn't Peak

It's great to know you'll never hit your peak -- fitness peak, that is. Bacteria in MSU BEACONite Richard Lenski's Michigan State University lab are still growing 'fitter' even after 58,000 generations -- and 25 years! -- of living in the same, simple environment.

In a recent paper published in *Science*, Michael Wisner, lead author and MSU zoology graduate student in Lenski's lab, compares this continual evolution to hiking.

"When hiking, it's easy to start climbing toward what seems to be a peak, only to discover that the real peak is far off in the distance," Wisner said. "Now imagine you've been climbing for 25 years, and you're still nowhere near the peak."

Here, the peaks aren't mountains, but 'fitness peaks', where the population has the optimum set of mutations so it can no longer improve, and any new mutations would knock the population down from the peak to a suboptimal state.

While biologists have known that organisms keep evolving as the environment changes, even when the environment is constant, Lenski asserts, "there doesn't seem to be any end in sight...We used to think the bacteria's fitness was leveling off, but now we see it's slowing down but not really leveling off."

To determine the bacteria's ascent toward possible fitness peaks, Wisner used hundreds of frozen samples—bacteria all the way back to generation 0 in Lenski's 25-year experiment. Because these bacteria were still alive, Wisner was able to compete samples of different generations against one another to measure their survival and ascent toward the potential fitness peaks.

From these samples, Wisner determined the bacteria's ascent matched a mathematical function called a power law, which decreases in slope over time, yet never reaches a peak.



"It was surprising to me that a simple theory can describe the entirety of a long evolutionary trajectory that includes initially fast and furious adaptation that later slowed to a crawl," co-author Noah Ribeck said. "It's encouraging that despite all the complications inherent to biological systems, they are governed by general principles that can be described quantitatively."

This article understandably has received much attention, as it has been covered by National Geographic, New Scientist, National Public Radio, and even German radio stations have gotten in on the action.

So when will it all end? Not for many generations. This long term experiment continues to produce fruitful results shaping our fundamental understanding of evolution in action.

If this article has 'piqued' your interest, read more here: M. Wisner, N. Ribeck, R. Lenski (2013) "Long-term dynamics of adaptation in asexual populations," *Science* [DOI: 10.1126/science.1243357]

Photo and video link in the QR code are courtesy of MSU

NO PAIN, ALL GAIN, SAYS MOUSE

Grasshopper mice aren't just cute: they EAT scorpions. The painful, potentially deadly stings of bark scorpions don't bother them; stings are just par for the course in devouring a meal.

In a paper published in *Science*, MSU BEACONite Ashlee Rowe and colleagues demonstrated that the grasshopper mice are essentially numb to the pain caused by the toxin in the sting.

By sequencing the genes for the different sodium channels which respond to the toxin, the scientists discovered that one channel in the grasshopper mice has amino acids different from other mammals sensitive to bark scorpion stings. By binding to this particular sodium channel in the mouse pain neurons, the toxin blocks the firing of a pain signal to the brain. Thus, the toxin acts as an analgesic rather than a pain stimulant, leaving the mice generally resistant to the bark scorpion toxin.

"We know the region of the channel where this is taking place and the amino acids involved," she said. "But there's something else that's playing a role, and that's what I'm focusing on next."

Read more here: A.H. Rowe, Y. Xiao, M.P. Rowe, T.R. Cummins, & H. H. Zakon (2013). "Voltage-Gated Sodium Channel in Grasshopper Mice Defends Against Bark Scorpion Toxin," *Science* 342 (6157), 441-446. [DOI: 10.1126/science.1236451].



BEACON INVADERS NATIONAL ASSOCIATION OF BIOLOGY TEACHERS MEETING

Several MSU BEACONites (pictured at right with Sean Carroll, HHMI's Vice President for Science Education) attended this year's National Association of Biology Teachers (NABT) Professional Development Conference last November in Atlanta.

Melissa Kjellvik and Liz Schultheis hosted hands-on workshops, "LadyBug: Using an Evolutionary Game to Capture Young Students' Enthusiasm for Evolution-in-Action" and "Data Nuggets: Unearthing Quantitative and Inquiry Skills." Amy Lark and Wendy Johnson hosted a hands-on workshop as well: Evolution in Action in the Classroom.

BEACON played a big role this year, not just by sending a host of members, but also in co-sponsoring a workshop and symposium with the National Evolutionary Synthesis Center (NESCent).

The workshop, "Teaching Biogeography" and symposium, "Wallace, Islands, and Biogeography: 100 Years Later" focused on Alfred Russel Wallace, the British naturalist and contemporary of Charles Darwin. Wallace's contributions include fundamental concepts surrounding natural selection, island biogeography, and speciation. Teachers were given workshop resources, ideas and strategies to introduce these topics.



Finally, BEACON and NESCent co-sponsored four travel awards to outstanding high school and community college instructors. These instructors were given the "opportunity to participate in multiple symposia, workshops and presentations focusing on evolution science and pedagogy."

CONGRATULATIONS, BEACONITES!

Celebrating recent efforts around BEACON

Invited Talks and Presentations:

Imani N. Sharpe, Quincy Cunningham, Joseph L Graves Jr., Scott H. Harrison (NCA&T) were invited to give a talk on Nov. 16 at ABRCMS 2013 in Nashville, TN. Sharpe, an undergraduate BEACONite, will speak on "Whole-Genome Association Study of Silver Resistance Pathways" which she investigated in summer 2013.

Erik Goodman (MSU) was invited to give a seminar to the Automation and Control Engineering department of

Tongji University in Shanghai, China. Dr. Goodman spoke on "Multi-Criterion Decision Making Using Multi-Objective Optimization for a Land Use Problem."

Travis Hagey and Matthew Riley (U Idaho) recently gave an invited talk for the Mechanical Engineering 501 graduate student seminar class entitled, "Using FEA Simulations to Investigate the Gecko Adhesive System", which was also the subject of their poster at the IBEST Science Expo at the University of Idaho.

Education and Outreach:

Aide Macias Muñoz (UC Irvine) participated in 'Ask-a-Scientist Night' at Rancho San Joaquin Middle School in Santa Ana, CA in October. Aide met with and guided science fair students on the design and implementation of their projects. These 6th-12th graders put on a great fair, with over 200 student and parent attendees!

And of course, special congrats to our recent graduates! Best of luck!

CURIOUS ABOUT SUBMITTING CONTENT?



New to BEACON? Veteran BEACONite? Here's how to submit possible content to the newsletter:

1. Do what you're already doing: Log into the BEACON Intranet (accessible through the BEACON site: <http://beacon-center.org>, at the "For Current Members" tab.) Then go to the "Outputs and Activities" tab at the top banner, and fill in information about

your papers published, grants received, etc. New entries will be flagged automatically.

2. Tweet about it. Tweet about what you'd like to cover as it happens to @BEACON_Center with the hashtag #news. We'll see it, and so will others!

3. Email content directly. Please email weigelem@msu.edu if you've got content you'd like to highlight that doesn't fit into the website categories.