KBS K-12 Partnership

Winter Newsletter

Issue 12 Ecological Literacy in K-12 Classrooms November 2012

From the Directors

Dear KBS K-12 Partners,

This has been another great year for the K-12 Partnership, filled with workshops, field trips, and a few surprises. The BEST plots suffered some in the dry summer heat, but inspired us all to think deeply about climate change communication. We welcomed four new Fellows and a new program coordinator to the Partnership and said goodbye and congratulations to Robin. We anticipate further changes as the MSP program winds down next spring but are working hard to maintain key aspects of the Partnership. On the following pages, you will find district updates written by our fellows - exciting things happening in the classroom, the schoolyard, and here at KBS. As always, we would love to hear from you. Contact the leadership team with any questions and don't forget to visit our KBS GK-12 website at kbsgk12project.kbs.msu.edu for current news and events.

Until next time,

Phil Robertson, Tom Getty, Andy Anderson
Sara Syswerda, & Sarah Bodbyl

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GK12 Bioenergy Sustainability Project

http://kbsgk12project.kbs.msu.edu

www.msu.edu www.nsf.gov

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You say 'Goodbye'

Farewell, Robin Tinghitella

Dear KBS K-12 Partners,
For the last four years I have had the great pleasure of working with and learning from every last one of you. It has been such an amazing ride. My role as the GK-12 Project Manager was to work with our graduate student Fellows to develop their teaching and science communication skills. Along the way, I learned so much thanks to your guidance and inspiration! I developed my own teaching philosophy, practiced the art of "winging it" in front of an audience of hungry teachers waiting for their oatmeal, and developed skills and practices that will make me a more confident and better-prepared new professor. Most importantly, I was infected with the passion for science education that all of you bring to your students and to the KBS K-12 Partnership.

Thank you for the opportunity to learn and grow with you. I'll take your excitement with me to the University of Denver. Keep in touch!

Best wishes,
Robin

I say 'Hello'

Welcome, Sarah Bodbyl Roels

Hello K-12 Partnership! I am thrilled to be the new GK-12 program coordinator and have enjoyed getting to know some of you over the last couple of months. For those of you who do not yet know me, here is a short introduction: I am a native Michigander, growing up just south of Grand Rapids. I majored in biology at Calvin College and received a doctorate in Ecology and Evolutionary Biology at the University of Kansas. I am broadly interested in the evolutionary significance of the diverse reproductive strategies found among plant and animal taxa. I plan to continue research in the field of evolutionary biology in partnership with KBS and MSU.

I was a GK-12 fellow at the University of Kansas from 2011–2012. I partnered with a 7th grade physics class in an inner city middle school. The GK-12 experience launched me into the world of science education and science communication, where I developed a deep conviction to improve science literacy.

Please join with me to continue growing relationships between the graduate students, faculty, and staff of KBS and the teachers, administrators, and students of the GK-12 partner districts. Feel free to contact me at bodbyl@msu.edu

Summer Institute 2012, A Review

By K-12 Partnership correspondent, Joelyn de Lima

A magical week of making movies. That is the first thing that comes to mind when I describe the days from June 25th to 29th at KBS. The KBS K-12 Partnership Summer Science Institute was more than just sitting around learning science in input-driven sessions and discussions. This year the teachers, led by the returning fellows (Michael, Tomomi and Tyler), worked on preparing movies based on the protocols that are conducted on our BEST Plots Research Network. The aim of this exercise was to prepare 60-75 second videos introducing the protocols in a manner that would spark a student's interest and help with performing the protocols. We saw some definite Oscar potential in direction and performances.

Since this was a 'Science Institute' we did have some fun Science sessions, too. The first plenary speaker was Dr. Sarah Bodbyl Roels. She spoke about her doctoral research on mating system evolution in a plant, *Mimulus guttatus*. The second plenary talk was given by our very own Dr. Jenny Dauer (Michigan State University). She spoke about her doctoral research as well, which dealt with calcium nutrition in Oregon forests. The final speaker was Julie Doll (KBS) who gave a great talk about Climate Change Communication.

Multiple GK-12, MSP, and teacher led sessions gave participants some great ideas for lessons in their classrooms. Here are just a few highlights: Jennifer and Fellow Michael lead a session called Snakes on a Glade: Helping students understand the role of disturbance in shaping ecosystems. Using the case study of the giant Burmese Python, which is invasive in the Florida Everglades, they explored how students think about ecosystem disturbances. Jenny and Andy explored the question 'How are inquiry investigations connected to student learning?'. In their session Fizz, burn and grow: Inquiry about Carbon, they conducted experiments that dealt with what happened to the carbon when soda water fizzes, ethanol burns and plants grow. In Who Let the Dogs Out? Cheryl Hach, Debi Kilmartin and Liz Ratashak (with the help of Cheryl's adorable dog) examined the relatedness of various dog breeds. They also explored current research involving the Dog Genome Project and health issues for dogs and their companions.

Field trips were held for participants throughout the week. The first visit was to the historic Fort Schemske (site of the epic battle between Elaphines and Homo sapiens). While there they interacted with a number of researchers (including Fellow Liz Schultheis), who spoke about their work on various subjects including genetics, population ecology, invasive species and competition. Another field trip explored the Farming Systems Center and the Bird Sanctuary. Bioenergy educator Dennis Penington met the teachers and spoke about bioenergy in the U.S. Teachers had some great hands-on experience with the subject – they actually made biodiesel out of canola oil! The final field trip was to the LTER research site. Participants went on a newly developed walking tour and helped Robin with the landscape protocols for the KBS BEST plots.

The highlight of the week, though, was the last session. After hours of laborious editing, the BEST Research Network movies were finally ready to view. Thanks to you all for another great Summer Science Institute!

I love plants, and I love learning about which plants grow together in different ecosystems, especially rare ones. North American prairies have been reduced to a fraction of a percent of their historical area (far more than rainforests), which makes them irresistible for me to study. In particular, I am interested in restoring prairies.

My research addresses how many plant species are necessary to successfully do so. Ecosystems with greater diversity (more species) are generally better at providing "ecosystem services" – clean air and water, erosion control, pollination, resistance to invasive species. However, seed for restorations is expensive and adding more species won't necessarily improve ecosystem services. For example, I've found it matters what current land use is being restored back to prairie – hay fields, row crops, or old fields. One reason might be that these land uses encourage different microbes that affect prairie species differently. I am conducting greenhouse experiments where soil has been "spiked" with a slurry of microbes from each of those land uses. My aim is to provide guidance for restoration practitioners based on decades of ecological study. My research refines this knowledge and tests in which cases it should guide restoration, and when it can not.

Comstock and Parchment

By GK-12 Fellow Tyler Bassett

Greetings, I am Tyler Bassett, the GK-12 Fellow for Comstock and Parchment. Most of my in-district time this fall has been with the BEST Plots protocols. This schoolyard experiment is investigating the impact on the environment of producing biofuels, and is replicated in 13 school districts in southwest Michigan. As a scaled-down version of current MSU research, these plots contain two different biofuel crops, some of which are fertilized and some of which are harvested to mimic large-scale biofuels production. At Parchment, I have been working with Mrs. Lugar-McManus' 9th grade biology students; at Comstock, I have been working with Mrs. Rodwan's 9th grade biology and Mrs. Grintals' 7th grade science students.

They are future scientists, or at least tomorrow's adults who will need to think critically. Many (certainly not all) problems we face can be approached using the scientific method: 1) observe a problem or inquire about a mystery, 2) develop predictions from existing knowledge, 3) ask a question testing your prediction, the answer to which will address the problem, 4) test your prediction experimentally. . . *and this is the best part* . . . 5) develop new questions based on new insights. We are guiding the students through inquiry about how to sustainably produce biofuels, while building core knowledge of biodiversity and the interrelatedness of Earth's biological, geological, and chemical systems. In the BEST Plots we are identifying plants and insects, sampling soil nutrients, and plant biomass. These are the variables in the experiment – it is up to the students to ask questions about how each variable affects the others.

In its most basic form, science as a way of thinking or approaching problems does two things: develops useful *skills*, and cultivates *curiosity*. I see both as equally important, and both are my goals in the classroom. I look forward to some future activities, opportunities to guide every student's curiosity. For example, both 9th grade classes will be working with living machines. These are microcosms of interconnected ecosystems in large plastic containers, connected by tubes. Students can manipulate almost anything – temperature, nutrients, even add pollutants – and measure how those variables affect water chemistry, aquatic plants, and more. As a plant scientist, I also look forward to utilizing the greenhouse space at both schools for experiments on plant growth. The main fun, however, is encouraging the students to explore questions that excite them!

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Gull Lake

By GK-12 Fellow Tomomi Suwa

This is my second year as a GK-12 fellow but I'm gaining a lot of new experiences working with middle school students for the first time. I am working at Gull Lake Middle School and with highs school students at Kalamazoo Area Math and Science Center (KAMSC).

At Gull Lake Middle School, I have spent much of my time with Mrs. Clancy's 6th grade earth science class. We took advantage of the beautiful fall weather and spent a lot of our time outdoors at the BEST plots, collecting data on plants, invertebrates and soil. One of my favorite activities we did this year was a study on invertebrate diversity. We wanted to know if there were differences in the kinds of invertebrates from plot to plot. So students set up two types of traps (sticky traps and pitfall traps). One week later, they collected the traps and tried to identify and count the invertebrates they found. In the sticky traps, they caught many types of flies and wasps and even grasshoppers! In the pitfall traps, they found spiders, beetles, and other types of crawling invertebrate species. Some students were a little scared of looking at the dead creatures at first, but most of them got really excited to find so many different kinds of invertebrates in the trap. Great job, young scientists!

I also worked with 8th graders from Mrs. Boyle's science class and worked on BEST plot Soil Protocol. We took soil samples from the plots and examined soil nitrate, ammonium and pH. Overall, I think the BEST plots at Gull Lake Middle School are doing very well – we observed some native plants that were planted two years ago.

With KAMSC's high school students, I was lucky enough to join Mr. Chopp's field trip to Oval Beach, Saugatuck. There, we learned about dune ecosystems and succession. Succession is a process of change in plants and animal communities over time. Michigan's dunes are perfect to study succession because you can observe changes in the ecological community (beach → grassland → forest) within 500m distance. To witness this phenomenon, students used some of the basic field techniques to examine factors such as plant composition, light availability and humidity between beach and forest. Next year, I'm planning to work more with KAMSC students. I'll be also helping Mrs. Hatch's microbial biology class, which should be a lot of fun.

My research focuses on how soil bacteria make it possible for plants to live in different habitats. Rhizobia, a type of soil bacteria, live inside the roots of some plants and acts like natural fertilizer. Rhizobia can convert nitrogen in the atmosphere into ammonia, a form nitrogen plants can use. In turn, plants can provide sugar to rhizobia. This beneficial interaction is called mutualism. Rhizobia can help plants grow in areas where they might not live otherwise. Just like human relationships though, plants and rhizobia may not be compatible, or one of the partners may not even be available! For example, rhizobia may not survive or convert nitrogen effectively in certain environmental conditions, like in shade or high areas of nitrogen in the soil.

Using a native plant called the hog peanut (Amphicarpaea bracteata), I am looking at how rhizobia in its roots can make it possible for plants to live in different habitats.

Hog peanuts tend to grow in small patches in the forest and wetlands but it's unclear why they grow in certain microhabitats. Is it because rhizobia are distributed in a patchy way or is it because rhizobia benefit plants differently in various environmental conditions? I am currently conducting a series of field and greenhouse experiments to test this hypothesis. So stay tuned!

I have always been fascinated by invasive species and their ability to outcompete native species when taking over habitats. The number of invasive species is growing year-by-year as plants, animals, and microbes are introduced into habitats where they did not historically occur. Invasive species are often destructive, causing over $137 billion in damages to native ecosystems and human interests around the world annually. Yet, despite all the problems they cause, we still do not know what causes some species to be invasive and not others. My research addresses this question by testing whether invasive species are those that are not strongly controlled by competitors, predators, and herbivores outside their native range. That is, they are successful invaders because they have left their natural enemies behind.

I am testing this hypothesis by growing three categories of plants together in a field experiment with and without natural enemies: native plant species, introduced plant species that are not invasive, and invasive introduced plant species. Plant growth, survival, and reproduction will be measured in the presence and absence of herbivores and disease. I predict that removing natural enemies will have a greater benefit to native and non-invasive species than invasive species, because enemies have relatively little impact on invasive species. My research will help determine what factors contribute to invasion success and can, therefore, help predict and prevent future invasions.

Gobles

By GK-12 Fellow Liz Schultheis

Hi, my name is Liz Schultheis and this is my third year as a GK-12 fellow, and my first year at Gobles. GK-12 has been an amazing opportunity for me so far as I have been able to share my research with teachers and students from 4th to 12th grade. My research focuses on invasive plants in Michigan, and what makes them so successful when introduced from other areas. This summer I was able to bring K-12 teachers out to my field experiment and show them my work as a scientist at Michigan State University.

My first days in the classroom this school year have been spent with Becky Drayton's 7th and 8th grade classes where I led an activity where students learned about invasive plant species. In this lesson, students learn about invasive species in Michigan, characteristics that make species good invaders, factors that influence plant community assembly, and the role that people play in causing and proliferating invasions. Students first discussed invasive species that they have encountered and we brainstormed the characteristics of these species. They were then given background on the question I research – what it is it that explains why some species become successful invaders? Each student was then given a species card, some native, some invasive. Different events allowed the students to move forwards and backwards and eventually make it into the "community". Each round of the activity resulted in a different community and taught students what events help invasive species outcompete native species. This activity was a good challenge for me, as it gave me the opportunity to relate the complex topic of invasibility in an approachable way. This activity addresses topics covered in my research, such as the community assembly, competition, and disturbance. It was very satisfying to see students at the end of the day calling out characteristics that make a good invader.

In November, I had the opportunity to travel to Dallas, Texas to attend the National Association of Biology Teachers (NABT) Professional Development Conference with another GK-12 fellow, Anne Royer. There we presented a lesson on evolution, using the program BoxCar2D (www.boxcar2d.com). Our lesson explored how the basic principles of evolution can be used to produce a better vehicle using web-based software. The program allows us to observe evolution in action with cars in a virtual environment and design vehicles to move over a variety of 2-dimensional landscapes. The program utilizes the basic principles of biological evolution: mutation, reproduction with recombination, and selection (moving faster and farther = higher fitness). It was great to see teachers' enthusiasm for the program, and to hear their ideas for great future lessons.

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Harper Creek

By GK-12 Fellow Cara Krieg

I'm Cara Krieg, a first year GK-12 fellow at Harper Creek this year. I'm looking forward to sharing my excitement about learning and doing science with kids at all grade levels. Before coming to Harper Creek, I was a teaching assistant for several introductory and advanced biology undergraduate courses. At Harper Creek, I am now working with high school, middle school, and elementary school students to learn basic ecology using the BEST Plot network (kbsgk12project.kbs.msu.edu/best-research-network). My goal is to harness my own excitement for my research on animal behavior to show students that science can be fun and interesting, even if they don't plan to make it a career.

This fall, I've been traveling to the high school, middle school, Wattles, and Sonoma Elementary to help students investigate biodiversity on switchgrass and mixed prairie plots. Students at the schools put out yellow sticky traps to catch flying insects and pitfall traps to catch those that crawl along the ground. Students at all the grade levels have been fascinated by all the different shapes and sizes of bugs they caught. Sometimes the bugs even tried to escape! A giant grasshopper took a tour around Mrs. Joostberns' 4th grade class room before being released back on to the BEST plots. At all the schools students noticed there seemed to be more insects in the plots that had been fertilized compared to the ones that were not. Does fertilizer make plants more delicious to insects? Students just finished collecting biomass on all the plots to find out if fertilizer caused plants to grow more.

High school students have been digging deeper into biodiversity both on and off the BEST plots. Mrs. Suber's freshman students ventured out into the BEST plots in September to find out which kind of plants were actually growing in the plots. The prairie species we planted are looking strong and healthy! Mrs. Hawkins' students traveled down to Harper Creek to look at the diversity of invertebrates living in the stream. Students waded into the stream to collect bags of submerged leaves. Back in the classroom the students sifted through the leaves and identified the invertebrates they discovered. Students learned that while some of the invertebrates can handle high levels of pollution, some are very sensitive and can only live in clean water. Some of the leaf bags had these sensitive invertebrates! Watching students at all grade levels appreciate biodiversity has been very rewarding.

Growing up, I was always interested in animals and now I study animal behavior. Have you ever heard someone say "men are from Mars and women are from Venus"? Have you ever wondered how much of this is a product of biology and how much is a result of culture? In nature males are typically the more aggressive sex, particularly when it comes to fighting over females. However, females are often aggressive too. Why females fight and whether female aggression is different from males' isn't as well understood. Working with house wrens, I study aggression in males and females to understand how and why their fighting styles differ. House wrens compete aggressively for the valuable nest boxes. Using recorded songs and a model house wren, I simulate a threat to these nest sites and record the aggressive responses by the male and female birds. After measuring aggression, I keep track of the eggs and nestlings each bird raises to determine if aggression has consequences for their babies. Do the demands of raising offspring prevent one sex from being very aggressive? Does aggression provide a bigger benefit for the meeker sex? Or are the sexes more similar than we think? Check back later to see what I find!

Despite my affiliation with the Zoology department, you won't find me observing the behavior of animals or crossing lines of fruit flies. You're actually much more likely to find me hip deep in mud in an overlooked wetland in southwestern Michigan. Instead of explicitly studying organisms, I study ecosystems. Specifically, I focus on shallow aquatic ecosystems like wetlands and streams and how these systems transfer and transform the nutrients and materials that support the sexier organisms that other scientists study.

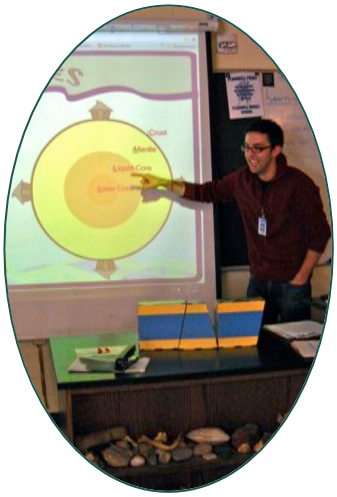
Freshwater ecosystems are a precious and increasingly limited resource on this planet. Globally, the construction of dams, urban and agricultural development, and climate change are contributing to the degradation of these systems. I am broadly interested in environmental changes that influence surface water quality.

One question I am investigating is how climate change, specifically the increased intensity of drought, alters the chemistry of surface water in streams and wetlands that don't typically experience extended dry periods. Another question I am interested in is how nutrient inputs from agriculture—primarily nitrogen and phosphorous—affect surface water quality. One project I am working on is experimentally drying a wetland that hasn't been dry for more than ten years in order to study the changes in surface water chemistry once the wetland is re-flooded.

Plainwell Middle

By GK-12 Fellow Dustin Kincaid

Hi all, I'm Dustin Kincaid and I'm a first year GK-12 fellow and second year PhD student in the Zoology department at MSU. Before enrolling at MSU as a graduate student, I spent time as a naturalist in northern Wisconsin teaching elementary, middle school, and high school students about our natural resources. I enjoyed this experience and feel fortunate to have the opportunity to interact with students and educators at Plainwell Middle School this year. My goal as a GK-12 fellow is to share my passion for science and inspire students to foster their curiosity about the world in which they live. Concurrently, I hope to build upon students' understanding of science as a process and how it is used as a means to illuminate the unknowns in our world.



I have spent most of my time this year working with the students in Mr. Green's earth science classroom. Not surprisingly, we spent several weeks reacquainting students with basic concepts taught in previous science courses to prepare them for standardized tests. A few highlights included reviewing the water cycle and learning about infiltration rates in different soil types, measuring changes in carbon dioxide and oxygen in a plant growth chamber to explore photosynthesis and respiration, simulating populations of fish to explore how traits such as scale color are genetically inherited, and filling landscaped boxes with water to simulate changes in elevation in order to create topographic maps.

More recently we've been learning about topics more related to earth science. The lessons I've helped facilitate have covered concepts ranging from the different layers of the earth and their properties to the theory of continental drift, plate tectonics, and earthquakes! After learning about earthquakes and tsunamis, I think the students are feeling pretty fortunate to live in a state where major earthquakes are rare! I have greatly enjoyed helping students to understand the multiple lines of evidence scientists use to support their conclusions about the inner structure of the earth, the past configurations of continents, and where earthquakes originate. I'm looking forward to a great year with Mr. Green and his students!

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Plainwell High

By GK-12 Fellow Sara Garnett

Hi! I'm Sara Garnett, a third-year graduate student in Zoology at the Kellogg Biological Station. I'm currently in my first year in the GK-12 program, where I'm working with Sandy Breitenbach at Plainwell High School. Since my first day in her AP Biology classroom, we have been working to help the students understand the scientific method and strengthen their scientific inquiry skills. We've done this in several ways, including having them generate testable predictions for the factors that drive insect biodiversity on the BEST plots, or guiding them as they develop their own independent research projects.

For their independent projects, students have formed groups to choose scientific questions they find interesting, research necessary background information, design and carry out an experiment to test their question, and analyze and present the results. This can be a pretty daunting process, especially when most of them have never done this before -- this is where I come in! I've been meeting with students during class time and answering their e-mails to help them figure out their interests, how to shape those interests into an appropriate question, and what knowledge is necessary before beginning the project. They will soon be diving into experimental design to prepare for performing the experiments in the next few months. Stay tuned to see what kind of interesting results they'll find!

We've also taken advantage of stretches of nice weather to complete most of the protocols on our BEST plots. With three sections of AP Biology, we've been able to have each section complete the biomass and biodiversity protocols on one set of plots. Students have worked carefully and thoughtfully to identify plant and invertebrate species within the plots. Soil samples collected by the AP classes also provided Sandy's Biotech class with an opportunity to get involved in BEST plot work as they characterized the properties of the local soil.

We're off to a good start at Plainwell High School, and I'm looking forward to what the rest of the year will bring!

Like most people with siblings, I am familiar with the potential for conflict in family relationships. Despite frequent competition with brothers and sisters for toys, parental attention, and access to the remote, you still love them and want them to succeed. This pattern is not unique to human families; seeking a balance between cooperation and competition happens in a wide variety of animals. We're used to thinking about nature as a competitive place where only intense fighting for shelter, food, and mates will bring success. However, we see individuals put themselves at greater risk to predators or compete less intensely for food or mates when relatives are involved. Behaving in ways that help relatives survive and reproduce can be an effective strategy for an individual to pass on their genes to the next generation because relatives share at least some of the same genes. This raises questions about when it is best for an individual to focus on itself compared to its relatives.

My research examines these questions using American toad tadpoles. Tadpoles prefer to swim near siblings rather than non-siblings in their birth ponds, using chemicals in the water to tell who their relatives are. I am investigating whether these chemicals provide information that influences how quickly tadpoles grow and develop, or how intensely they compete for food. In addition to the chemical communication aspect, I am also interested in whether environmental variation impacts these responses. By looking at how these factors influence tadpole growth, I can get an idea of how tadpoles improve the chance that they (and their siblings) will make it out of the pond in a variety of environmental conditions.

My name is Anne Royer, and I'm a returning fellow this year (after several years off GK-12). Growing up in rural Indiana, I spent summers running through fields, rolling around in the creek behind our house, and inspecting the plants and animals that surrounded me. This transformed into a professional interest – why do these organisms look the way they do? My research looks at how the shapes of flowers are influenced by natural selection from the insects that visit them.

Currently, my work focuses on the mustard plant family. Most flowers have many identical stamens (male structures), but mustards have two kinds within a flower – long and short ones. Long stamens seem to attract pollinators, but no one knows what the short stamens are for.

The data I have collected support the idea that the short stamens help the plant by slowing release of pollen (plant sperm) from flowers to insects. Like a secret chocolate stash – hard to find, so the pollen lasts longer and ends up spread more widely. However, for species that pollinate themselves without insects, short stamens may not be useful. So while most mustards make short stamens because they help them reproduce better, others seem to retain them just because their ancestors did.

Lawton

By GK-12 Fellow Anne Royer

Along with my mentor teacher Marcia Angle, my focus as a GK-12 fellow at Lawton this year has been on thinking about scientific questions and working with data. In several different classes, we've been practicing forming questions, stating them as hypotheses and predictions, and graphing our predictions. I've also been developing ideas for short lessons in reading graphs and analyzing data, feeding off the KBS GK-12 program's popular Data Nuggets™ (okay, so maybe they're not officially trademarked yet; we're sure they will be soon! Check them out at http://kbsgk12project.kbs.msu.edu/data-nuggets/).

Like all the fellows, my fall has been stuffed with work on the **B**io**e**nergy **S**us**t**ainability plots (BEST plots). Fortunately, getting to know the experiment intimately and experiencing the excitement of data collection first-hand is just the thing to get students jazzed about hypotheses, predictions, and data analysis.

Marcia Angle's 8th-graders at Lawton adventured out into the fall weather to explore the plants and animals living in their BEST plots. We started with insect biodiversity. After learning how to randomize the location of our traps, we left the traps out for a week. We were rewarded with an abundance of insects and one rotten smelly mole. Being a good fellow, I threw the mole back in the plot it came from, and we took some dead-mole-smelling insects back into the classroom to identify and count. (Most of the insects just smelled like dead bugs). We had a great time discovering what we'd caught. A few days later the same students braved a frosty morning with plant identification booklets in hand, and even managed to not lose any dice. The plant biodiversity data they collected will be combined with biomass and soil data collected by Holly Visich's high school Environmental Science students.

The Environmental Science class performed the fantastic feat of collecting data on all 16 plots with just one class period. They were super focused and organized, collecting soil one day and spending three more days working through the lab protocols to determine soil texture and chemistry.

All of the students have been working with forming hypotheses and predictions using the BEST plot variables, so we're looking forward to exploring some of these questions later this fall with the real data we collected ourselves! Moving beyond the BEST plots as the school year progresses, I anticipate getting involved in projects as diverse as updating Lawton's beloved woodland trail and teaching lessons on evolution using a fun, interactive online program evolving cars.

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Olivet

By GK-12 Fellow Jake Nalley

You don't know about me without you hearing from your 8th grader, but that is of no matter. Call me Jake*. I have the privilege of working alongside Russ Stolberg and his 8th grade Earth Science students at Olivet Middle School. Taking advantage of the warm weather early in the semester, all of the Earth Science classes were able to get out into the BEST plots at Olivet and map out the landscape of the land surrounding the plots. We were able to make predictions about how the elevation may influence water movement and identify potential run-off sources that could affect the plots, such as oil from the nearby parking lot. We also had fun as we tried to perfect using the water level which resulted in a few wet students.

To better visualize the movement of magma in the Earth's mantle, students simulated their own mantle using a clear tub of water with some dots of food coloring. Placing a cup of hot water underneath the dye drops, students caused the dye to rise and fall in the same circular motion that takes place in the mantle, known as convection currents. Although students enjoyed the experiment, the "Dry Halloween" lesson was a unanimous favorite. Students experienced the amazing chemical characteristics of dry ice, or solid carbon-dioxide. Students had the opportunity to add the dry ice to water, creating large clouds of smoke that could be used to make gas-filled soap bubbles.

The main highlight of the semester for me has been the opportunity to bring my personal research interests into the classroom. I really want to get the students excited about working with algae, so I developed a hands-on experience for the students to grow their own algae in the classroom. We currently have over 25 containers of algae growing with four different species and three different "treatments". Two of the treatments are investigating how removing either nitrogen or phosphorous from the water can affect the growth of algae. Other groups are pitting two species against one another to see which species is the better competitor or if they both live together. These are questions I am asking in my personal work, and with so many eager young scientists, I have found that the students have a lot of new questions that are worth investigating later on in my research. Algae may not be as exciting as panda bears, but the students seem to be really enjoying the hands-on experiment and can not wait to see the result.

*Credit to Mark Twain for the intro.

The topic of renewable energy is gaining more and more attention as humans begin to look more closely at the effects we have on the environment. I have always had a deep passion for understanding the relationship we have with our surroundings, primarily on how we can function more as stewards rather than consumers. As I was looking for graduate projects to work on, I jumped at the opportunity to research such a promising renewable energy source.

My main focus at Michigan State University is researching how we can generate diesel fuel from microscopic algae. We know that algae is a wonderful fuel source, after all the fossil fuels we burn today are from pre-historic algae. I believe that through growing large outdoor ponds of algae on areas of land we do not use for food production, we can generate a fuel source that is inexpensive and more importantly takes in more carbon-dioxide than it gives off when it is burned. I focus mainly on identifying a number of algal species that can be grown together to produce large amounts of diesel fuel, while also growing in changing environmental conditions and fighting off unwanted invading algal species.

If you have ever lived near a pond or swamp then chances are every spring your nights were filled with the sounds of singing frogs. Male frogs form these large choruses to attract females. We know that females prefer to mate with males that call at a high rate and produce long calls; however, not every male calls this way. Why wouldn't every male try to call as frequently and as long as possible? Well one reason is that calling is costly; singing takes a lot of energy and exposes the frog to predators. Being eaten while trying to attract mates is obviously never a good thing, but it actually may be worse for some frogs than for others. A young male frog that gets eaten is losing out on several years' worth of future mating opportunities. On the other hand, an old frog that gets eaten is not losing as much because he was near the end of his life anyways.

In my research I investigate whether this difference in the cost of calling for old and young frogs influences their calling behavior. By making numerous recordings of frogs singing I can see whether older males are putting a greater effort into calling than younger males as a result of the younger males having more opportunities to mate in the future.

Delton-Kellogg and Hastings

By GK-12 Fellow Michael Kuczynski

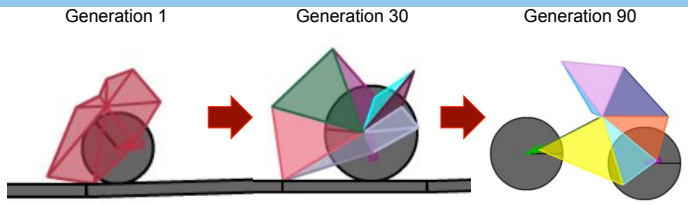
Hello, my name is Michael Kuczynski, I am a second year GK-12 fellow working in the Delton-Kellogg and Hastings school districts. This year in Delton-Kellogg I have been working at the high school with Connie High's classes. So far we have primarily been focused on working on the BEST plot protocols. We are collecting data to answer the question "Can we grow grass or flowers for fuel, and save the butterflies too?" Students have had the opportunity to collect biomass, set up traps for catching invertebrates, identify and count plants, and collect soil samples. The students seem to enjoy working with the plots (especially when it means they get to go outside) and we have had a lot of fun. My personal favorite protocol that we worked through was the invertebrate biodiversity. I found it very amusing to watch different students' reactions to the invertebrates we collected. Some are completely disgusted by the dead bugs squished on the sticky traps or floating in the pitfall traps, while others are completely fascinated and can't wait to poke around to see what's there. Now that we have largely finished protocol work I am excited to move on to something new for Delton students.

This year in Hastings I have been working at the high school with Marty Buehler's biology and AP biology classes. So far we have covered multiple topics with a wide variety of activities. I introduced myself to the students with a presentation on my field of research (behavioral ecology) where we discussed how scientists study animal behavior and what I specifically do in my own research. One of the classes I presented to was a zoology class which was particularly fun for me since the students were very eager to hear about all of the interesting and sometimes bizarre behaviors I talked about. This year I have also had the opportunity to present a game that teaches students about invasive species and the different methods scientists use to control their spread. Later in the semester we started talking about carbon and the students did an activity investigating what happens on the molecular level when ethanol burns. Recently, I accompanied the AP biology class on a field trip to different forest and prairie communities. We discussed the importance of biodiversity and students got the chance to calculate commonly used diversity index for different forest sites. I look forward to the opportunity to continue using these varied techniques to delve into more topics in the future.

Partners in the News!

Darwin builds better cars

By GK-12 Fellow Anne Royer



Fellows Liz Schultheis and I attended the National Association of Biology Teachers (NABT) annual conference this year in Dallas, Texas, where we presented a workshop on using a free web-based program, BoxCar2D, to teach students about evolution in engaging, inquiry-based lessons.

Anne and Liz present at NABT

Teaching evolution at any level can be challenging due to the complexity of the concepts, the difficulty of observing evolution in action, and its controversial standing in some communities. With its video-game feel, BoxCar2D gets around these issues by being so fun and interesting that students learn the principles of evolution by natural selection almost in spite of themselves. The evolving organisms are vehicles moving on tracks that become increasingly challenging; they show evolution happening fast enough for students to see it happening. With a realistic physics package governing the behavior of the cars and a genetic algorithm that includes mutation, recombination, and reproduction based on "fitness" (how far a car travels on the track), BoxCar2D shows an authentic approximation of evolution by natural selection in cars.

A participant makes a model car

NABT attracts high school and college teachers from around the country, and several of those attending our session were excited to finally find a tool like BoxCar2D for their classrooms. If you're interested in exploring the program yourself, check out BoxCar2D.com, or email royerann@msu.edu for lesson plan materials.

GK-12 Fellow receives teaching award

Congratulations to **Anne Royer** for being selected as a recipient of the MSU *College of Natural Sciences Excellence-in-Teaching Citation*! Anne has been selected for this award in recognition of her outstanding contributions in undergraduate instruction.

WGVU morning show interviews teachers

Thornapple-Kellogg Middle School science teachers Jamie Bowman, Shaun Davis, and Martha LaVoie chatted about their involvement with the K-12 Partnership and the BEST plots this fall. The link to the audio interview can be found at the TKMS website at www.tkschools.org/schools/middleschool

Mark Your Calendars- Happenings at KBS

December

12/5: KBS K-12 Workshop; Academic Bldg. Auditorium -- Weeds, Seeds, and Dispersal. 8:00-4:00 PM. Please RSVP to Sara at parrsar1@msu.edu

12/1, 7-8, 14-15, 19-20: Holiday Walks at the Manor House from noon to 5 PM. See http://www.kbs.msu.edu/visit/manor-house/holiday-walk for more details and the holiday vendor list.

12/8: Bird Olympics at the Kellogg Bird Sanctuary. 1:00-2:30 PM. Contact birdsanctuary@kbs.msu.edu for more information.

March

3/21: KBS K-12 Partnership Workshop; Academic Bldg. Auditorium -- Native Plants and Ecosystem Services. 8:00-4:00 PM. Please RSVP to Sara at parrsar1@msu.edu

April

4/12 - 4/21: MSU Science Festival. A 10 day celebration of science on the MSU main campus. Topics will range from astronomy to music to zoology. The event is open to the public and all ages.

June

6/24 - 6/28: (proposed dates) KBS K-12 Partnership Summer Institute. Stay tuned for more details!

6/28 - 7/3: BEACON High School Biology Teacher workshop. See facing page for more information.

KBS K-12 Partnership

Issue 12 January 2012

Unleash your inner scientist

Employing and enjoying inquiry in the classroom

Whether you're new to inquiry learning in your classroom, or you're looking for new projects to spice up your curriculum, this workshop is for you! Come enjoy an **intensive week of field and lab exploration**, working with scientists and educators. Participants will experience five days of cutting edge research, while **creating lessons that will work in the classroom** and with the Next Generation Science Standards.

Lessons cover a diverse set of topics, including ecological field research, mathematical modeling, evolution, and computer simulations. Not only will participants come away with new research ideas, but more importantly, an increased comfort with the process of real science – including the unexpected and exciting new results that come from scientific inquiry!

BioQUEST CURRICULUM CONSORTIUM

BEACON An NSF Center for the Study of Evolution in Action

A summer workshop for high school biology teachers

Save the Date: June 28 – July 3, 2013

Register here: http://beacon-center.org/teacherworkshop

KBS K-12 Partnership

Phil Robertson, Co-Director
Phil is a University Distinguished Professor of Ecosystem Science in the Department of Crop and Soil Sciences at MSU. His research interests include the biogeochemistry and ecology of field crop ecosystems. He studies how nitrogen and carbon cycle in terrestrial systems and their impacts on crop yield, water quality, and atmospheric chemistry.

Tom Getty, Co-Director
Tom is a Professor of Behavioral Ecology in the Department of Zoology at MSU. His research focuses on the role of information in various aspects of behavior, ecology, and evolution including: mate choice, aggression, cooperation, predator-prey interactions, and habitat choice.

Charles (Andy) Anderson, Co-Director
Andy is a Professor of Science Education in the Department of Teacher Education at MSU. His research centers on the classroom teaching and learning of science. He studies how students' prior knowledge, language, and social relationships affect their engagement in science learning and the development of environmental science literacy.

Sara Syswerda, MSP Coordinator
Sara earned her PhD in Crops and Soil Sciences and Ecology, Evolutionary Biology, and Behavior from Michigan State University. Her interests are in nitrogen and carbon cycling, environmental pollution, sustainable agriculture, and science education. Sara works with teachers, visits schools, manages the K-12 Partnership web pages, and coordinates workshops.

Sarah Bodbyl, GK-12 Coordinator
Sarah earned her PhD in Ecology and Evolutionary Biology at the University of Kansas. Her interests are in mating system evolution, particularly in plants and birds, and science education. Sarah meets with fellows, visits schools, manages the K-12 Partnership web pages, and coordinates workshops.

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