KBS K-12 Partnership

Spring Newsletter

Issue 13 Ecological Literacy in K-12 Classrooms April 2013

From the Directors

Dear KBS K-12 Partners,

April showers bring May flowers…and Spring! Nature is busy growing and greening and we are busy planning another exciting year for the K-12 Partnership. Our current Fellows are wrapping up their year in the classrooms, which you can read about in the district updates on the following pages.

The Fellows have accomplished great things this year, both in the classrooms with the help of their Partner-Teachers and with their own research, so please join us in congratulating them on their accomplishments.

It'd be great to see you all at the Summer Institute, June 24-26, so mark your calendars! We have some great plenary speakers lined up and will introduce five new Fellows to the project.

As always, we would love to hear from you. Contact the leadership team with any questions you may have and don't forget to visit our KBS GK-12 website at kbsgk12project.kbs.msu.edu for current news, event announcements, and lesson plans.

Until next time,

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

Inside

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March Workshop Review: Native Plants and Ecosystem Services

By Joelyn de Lima, K-12 partnership correspondent

There was just one workshop for the KBS K-12 Partnership this spring....but what a great one it was! The first plenary speaker for the day was Dr. Dave Warners from Calvin College in Grand Rapids. He spoke on '*Enriching Education through Watershed Engagement: Plaster Creek Stewards and Calvin College.*' The two major talk themes were '*Pedagogy of Place*' (enhancing life in the place where education occurs) and '*Reconciliation Ecology*' (ecology done in the place where you live/work/study). Dr. Warners spoke of the specific problems plaguing the Plaster Creek Watershed, including flow dynamics, bacterial contamination, nutrient and thermal pollution, and toxic substances. The most astonishing thing, though, was the creeping normalization that had developed in the mindset of the local people – they took the pollution and contamination to be a 'normal thing' (Shifting Baseline Problem). Dr. Warners pointed out that all teaching occurs within a watershed and most watersheds need attention. Education will produce more engaged and thoughtful citizens. The take-home statement for me was a variation of the golden rule, '*Do to those downstream what you would have those upstream do unto you.*'

In the first set of concurrent sessions, Hannah, Andy and Jenny discussed Carbon TIME tools needed to teach climate change in the classroom. Jake, Michael, Tyler and Dustin were at the top of their form in their session '*Project GREEEN: Big Roots for Big Problems.*' The session was funded by Project GREEEN, which aims at using Michigan native plants to produce win-win situations for agriculture, communities and the environment. The teachers explored the benefits of native vs. exotic species and perennials vs. annuals by studying their respective root systems. A highlight of this session was making 'root dams,' where teachers competed with each other to make a root system that would reduce erosion the most. '*The BEST session: Using real data in the classroom,*' conducted by Cara, Tomomi and Alycia, explored the big question: Can we grow our fuel and save our flowers and butterflies too? Teachers practiced using the scientific method using real data gathered from our BEST plots and were introduced to four new Data Nuggets. The teachers got a chance to awaken their inner child in the session '*Darwin builds better cars: evolving online vehicles*' with Anne, Liz and Sara. They used the program BoxCar2D to explore the basic principles of evolution, which includes mutation, reproduction with recombination, and selection.

In the second plenary, Dr. Joe Krajcik spoke about the '*Next Generation Science Standards.*' He stressed the fact that the NGSS is for all students and not just the ones planning a career in science. The aim is to help students make intelligent decisions and live better in society. The NGSS are arranged around a few core ideas and crosscutting concepts, and idea Dr. Krajcik demonstrated using a light-box viewing activity.

It was interesting that Lisa and Sara chose to have their session, titled '*Food Safety, Microbes, and* Biosensors,' immediately after lunch. They spoke of the various microbes in our food that might make us sick. The teachers also learned about the ways in which food safety inspectors try to keep the food supply safe and what happens if there is a food-related disease outbreak. They brought in not only some icky bacterial cultures but also some really cute plush giant microbes to make their session fun!

The day ended with a district planning session, as always. But just before we finished we held an awards ceremony. The Fellows were presented with 'The Very Special Montgomery Burns Award,' the prestigious certificate awarded to GK-12 Fellow survivors. Thanks to all for another great workshop!

KBS K-12 Partnership

Gobles

By GK-12 Fellow Elizabeth Schultheis

* Liz being an introduced herbivore

Hi, I'm Liz Schultheis, and I'm finishing up my third and final year as a GK-12 fellow. I joined GK-12 because I saw it as a great opportunity to practice public speaking and get a chance to share my research with more than just the other scientists at KBS and at national conferences. My time in GK-12 has provided me with those experiences, and more. When reflecting back on my three years as a fellow, I'm sure that my first partner teacher, Marcia Angle, is proud of how far I've come from my first days in the classroom, afraid to do anything but help take attendance.

My proudest accomplishment as a fellow thus far has been the creation of the Data Nuggets. In collaboration with other fellows and teachers in our network, I helped develop these worksheets that give students the chance to practice interpreting quantitative information and making claims based on evidence (http://kbsgk12project.kbs.msu.edu/data-nuggets/). I created several Data Nuggets based upon my own research, and look forward to continuing to share my research in this way. This year, I attended the ESA Life Discovery conference with former fellow, Melissa Kjelvik. We presented Data Nuggets to teachers and professors interested in developing classroom materials, and got great feedback and tons of excitement after our talk, motivating us to continue our work. Next year I will be working as a BEACON Fellow at MSU, where I will get to spend more time working on the Data Nuggets. Melissa and I plan to create a new, user-friendly website to share the Nuggets, host workshops at other universities and schools to create many more worksheets based on cutting-edge research, and perform a classroom assessment to determine whether students' quantitative skills and understanding of the scientific process improve when using the Nuggets throughout the school year.

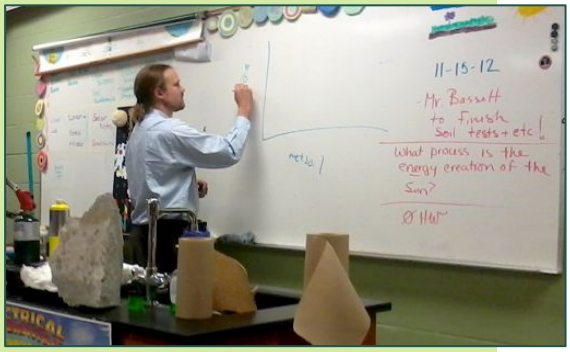
Along with Dave Williams, I presented at the Michigan Science Teachers Association Conference (MSTA). We shared a lesson that Dave developed while working as a Research Experiences for Teachers (RET) in my lab the past two summers. The lesson covers invasive species in Michigan (like purple loosestrife and garlic mustard), and guides students through collecting data to test the Enemy Release Hypothesis – which predicts that invasive species escape from natural enemies in their invasive range, contributing to their success. In this lesson, students develop predictions, design experimental sampling methods, collect data, and create graphs for data interpretation.

The number of invasive species is growing every year, as plants, animals, and microbes are introduced into habitats where they did not historically occur. Invasive species are destructive, damaging native ecosystems and reducing biodiversity. Yet, despite all the problems they cause, we still do not know what causes some introduced species to become invasive and not others. My research addresses this question by testing whether invasive species are successful because they are not strongly controlled by species interactions, like competition and disease, in their introduced range.

This summer, I will be finishing up a two-year field experiment, planted with 50 species growing with and without natural enemies: native plant species, non-invasive introduced, and invasive introduced plant species. Natives are those naturally occurring in Michigan, while introduced and invasive species are brought to Michigan by humans. While most introduced species mix with native plants and have little effect, some invasive plants have the potential to aggressively colonize natural areas and decrease biodiversity. In my experiment I measure plant performance in the absence and presence of herbivores and disease. I predict that removing natural enemies will have a greater benefit to native and introduced species than to 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.

I study prairie restorations, and how they can be designed based on ecological principles to benefit both natural ecosystems and humans. Ecosystems with greater diversity (more species) are often better at providing "ecosystem services" – clean air and water, erosion control, pollination, resistance to invasive species. However, seed for restorations is expensive and we need more proof that adding more species will improve ecosystem services. For example, I've found that resistance to invasive species depends on what current land use is being restored back to prairie – hay fields, row crops, or old fields.

This summer I will be studying several more ecosystem services in prairies with few and prairies with several species. This will allow me to generalize about when diversity matters, and when it doesn't. I will collect data on the diversity of pollinating bees, the stability and seasonality of biomass production, and how well prairies hold on to nutrients (instead of leaching them into streams, causing a whole host of problems).



Comstock and Parchment

By GK-12 Fellow Tyler Bassett

Salutations, I am Tyler Bassett, the GK-12 Fellow for Comstock and Parchment. At Parchment, I work with Mrs. Lugar-McManus' 9th grade biology students; at Comstock, I work with Mrs. Rodwan's 9th grade biology and Mrs. Grintals' 7th grade science students. I try to integrate ideas from ecology into all activities.

For example, the 9th graders at Parchment were studying comparative anatomy and classification, so I brought in a lesson that I had developed at the 2012 Summer Institute and adapted it to their curriculum. We started with a familiar activity, classifying shoes based on whatever 'traits' they came up with (color, brand, etc.). As they classified, I constructed a cladogram showing how all of their shoes were 'related'. Once their brains were primed, I presented several bird specimens on loan from the Kalamazoo Nature Center and asked them to repeat the drill. Now, their challenge was to classify the birds based on what they thought were important adaptations. I constructed cladograms based on their classifications on the board, and then placed the actual cladograms underneath for comparison. Who knew hummingbirds and chimney swifts were related? This lesson built upon the now-classic GK-12 lesson 'Geeked About Beaks!" where students came to understand beak size as an adaption to seed size in their environment. Based on 'Darwin's finches', students use different sized clothespins (beaks) to pick up different sized beads (seeds) and then graph their success. The beak activity itself built upon our exploration of stream invertebrates using leaf packs. I placed deciduous and coniferous leaves in the pools and riffles of a local stream and pulled them out a few weeks later for the students to inspect. They saw first-hand how different organisms prefer different environments (leaf type, placement in stream). So we explored, through three different activities, the relationship between species traits and how they are adapted to their environment, and how we use these differences to classify organisms. I love it!

My next big adventure will be at Comstock, where we will be building 'living machines' out of water jugs and using them to examine how pollutants affect the aquatic ecosystem. I'm really looking forward to going out with a bang, as this will be my final adventure in my 2-year stint as a GK-12 fellow. A big nod to all who tolerated me along the way – I learned a lot and had a lot of fun!

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Gull Lake & KAMSC

By GK-12 Fellow Tomomi Suwa

This is my second and final year as a GK-12 fellow. First, I want to thank the teachers, students and GK-12 team for two great years. I learned a lot about communication and teaching skills, and I am sad to be leaving the program. However, I hope to stay in touch with GK-12 community next year too. Next year I will be developing inquiry-based lessons to teach basic concepts of evolution, in collaboration with computer scientists, so stay tuned!

This year, I had an opportunity to work with students at Gull Lake Middle School and at Kalamazoo Area Math and Science Center (KAMSC). Last semester (Sept-Dec), I primarily worked at Ms. Kim Clansy's middle school class, collecting data from BEST plots and doing various inquiry-based activities. This semester (Jan-May), I have been focusing on working with KAMSC students. I worked with Ms. Cheryl Hatch's microbial biology class and Mr. Chris Chopp's biology class.

In Ms. Hatch's class, I did various activities using microbes. For example, students learned how to perform a serial dilution to estimate the density of certain microbes present in the soil. Some students used this technique for their independent research project this year. They also learned how to figure out what kinds of microbes in the soil are involved with the nitrogen cycle. Students collected soil from their own backyard and performed various chemistry tests over three weeks.

A few weeks ago, students began an experiment examining the effects of nitrogen on plant-rhizobia interactions. They will collect plant and rhizobia data in a month to test their hypothesis. I think this activity will be a great way to go through the entire process of science (assuming that not all the plants die before harvest!).

Another exciting thing I did this year, in collaboration with fellows Alycia and Cara, is create a bunch of Data Nuggets (worksheets to practice evidence-based claims and graphing skills) using student-collected BEST plot data. We presented a few of them in the last GK-12 workshop and are in the process of incorporating teachers' feedback right now. We're planning to post all of the Data Nuggets we created on the website as soon as possible (http://kbsgk12project.kbs.msu.edu/data-nuggets). So please visit and check them out!

It was a long winter but I spent a lot of time in a nice, warm greenhouse, growing over 600 plants for my experiments this summer. My research focuses on how soil bacteria make it possible for plants to live and prosper in different habitats. Rhizobia, a type of bacteria, live inside roots of some plants and act like natural fertilizer. Rhizobia can convert nitrogen in the atmosphere into a form that plants can use to grow. They can help plants grow in areas where they might not live otherwise. However, the plant-rhizobia relationship can be a complicated one. Just like human relationships, 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 areas with high amounts of nitrogen in the soil.

Using a native plant, hog peanut, I am looking at how rhizobia in its roots allow it to live in different habitats. I conducted a greenhouse experiment last year to test the effect of soil moisture on plant-rhizobia interactions. I found that plants benefit more from rhizobia under dry than wet conditions. Surprisingly, plants formed fewer nodules and produced less biomass when grown in wet conditions. This summer, I will be exploring similar questions in the field (Kalamazoo Nature Center, Pierce Cedar Creek and Clear Lake).

This fall, I will complete my Ph.D. degree. I have been spending most of my time writing up the work from my research for publication. My research helps us understand how new species form, which is a fundamental biological process that generates biodiversity. I am also interested in how environmental change, especially change caused by humans, affects how new species form and whether species go extinct.

This summer I will attend two conferences so I can share my research with other scientists, learn about other people's work, and network with researchers to find a postdoctoral research position that will prepare me to get a faculty job. The first conference is completely focused on evolution and will be held at a mountain resort in Utah so all the attendees can hike and enjoy nature as well as getting engaged with science research. The second conference is in animal behavior. The attendees have really broad interests ranging from training pets to figuring how to the brain controls behavior. Going to conferences really gets me re-energized to publish my work and start new projects.

Harper Creek

By GK-12 Fellow Alycia Reynolds-Lackey

This spring I was lucky enough to be able to come back to GK-12 and Harper Creek for the spring semester. I've paired up with Jim Eckert at Wattles Park Elementary. I get to visit two of Jim's three 4th grade science classes on Fridays, but Jim has his students rotate their other subjects so that I get to visit with all three classes over the course a few weeks.

So far we have done inquiry activities dealing with how seeds disperse from their parent plant to a new location to grow. I developed this lesson with GK-12 fellow Liz Schultheis. Students learn about how seeds have different physical characteristics that help them disperse in particular ways, such as by wind, water, or animal fur. Then students make predictions about how three types of seeds will travel, and they get to test their predictions in the classroom. This lesson is really fun and hands-on. Our discussions after the experiment also got us talking about the importance of using data as evidence to make scientific conclusions.

At the spring workshop, I did a session with GK-12 fellows Cara Krieg and Tomomi Suwa on exactly that topic -- using data to make scientific conclusions. We developed a game that models competition between plants for nutrients in the soil. Students then use their experience with the game to make predictions about whether switchgrass or prairie mix plots are likely to make more biofuel. We also developed four different Data Nugget worksheets that get students to practice making predictions, graphing data, and using data as evidence to make conclusions. Being able to critically evaluate evidence used to make claims is such an important skill for all students as they grow up to become decision-making citizens in society.

I have truly enjoyed being a part of GK-12 and the KBS teacher partnership over the past few years. I have greatly strengthened my abilities to explain scientific ideas to broad audiences. In return, I hope I have been able to bring some additional experiences in and enthusiasm for science to students. Working with these students certainly keeps me excited about doing and teaching science. I will take this with me as I move on in my career.

Thanks to all of you for being such a supportive community of teachers and scientists!

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Harper Creek

By GK-12 Fellow Cara Krieg

I'm Cara Krieg and I've been a GK-12 fellow at Harper Creek this year. I've had a blast helping students with all steps of the scientific process. During the fall semester I spent my time traveling to high school, middle school, and elementary school classrooms to collect data on our BEST school yard prairie and switch grass plots. Students were excited to take on the role of a scientist and carry out an experiment. As a teacher I found it exciting to see the different challenges of teaching at each grade level. This spring I've been at the high school helping students with the two ends of the scientific process: making predictions for experiments and writing about the implications of the results. In Ms. Hawkins' freshman biology classroom I've been helping students develop predictions for what might happen before they start their labs. Coming up with many different predictions as a class turns the lab into a contest to see who will be right! In Mrs. Erwin's chemistry class I've been helping students write about science.

One of the most rewarding things I've done this semester is help Mrs. Erwin's chemistry students learn to write about science. It might seem like writing is something that belongs in an English class, but it turns out that writing skills are really important in science. Professional scientists must write grants to get their research funded and write papers to tell the world what they found in their experiments. In this exercise students were asked to take on the role of professional chemist asked by the government to find a new way to control the local mosquito population. Students read three articles about recent research on mosquitoes. In one, students learned that mosquitoes prefer certain people because of the way bacteria on our skin makes us smell. In another, students learned that a special chemical that smells like butter overloads a mosquito's sense of smell, making it unable to find its prey. In the third, students learned that chemical cues can be exploited to lure unsuspecting pregnant mosquitoes into laying their eggs in traps set by scientists. After a lively debate with their peers, students wrote an essay about which method was the most promising. Students seemed to really get into the exercise! After all, no one loves those blood-sucking summer friends.

I am fascinated by animal behavior and I love understanding why animals do the things they do. I study sex differences in the behavior of house wrens. Have you ever heard someone say "men are from Mars and women are from Venus"? How much of this is a product of biology and how much is a result of culture? In nature males are typically the aggressive sex. However, females are often aggressive too! Female aggression has not received much attention from scientists. Working with house wrens, I study aggression in males and females to understand how and why their fighting styles differ. I use recorded songs and a model wren to mimic an intruder and I record the aggressive response by male and female birds. Last summer I discovered female house wrens become more aggressive if they are more likely to lose their territories. This summer I will be measuring how beneficial a female's aggressive abilities are in actually keeping a territory throughout the season. I will also determine whether it's the female or male's fighting skills that are more important in keeping territories. Males are seen as the territory defenders but perhaps females deserve the credit instead!

Winter freezes give way to warm spring rains, and in the upper Midwest, that means it's time for mud season. Microbes in our environment thrive during mud season and throughout the warmer months in our temperate region. These invisible organisms are responsible for processing and transforming a vast majority of the materials that flow through and over our landscape. While I don't study these microbes directly, I do study the processes they mediate, like removing nitrogen from the landscape. I tend to investigate these processes in shallow freshwater ecosystems like wetlands and streams.

Freshwater ecosystems are a precious and increasingly limited resource on this planet. Unfortunately, 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 fluctuations in water levels alter the chemistry of surface water in streams and wetlands when their mucky sediments are dried and later re-wetted. This summer I will also be exploring another mysterious microbially-mediated process that removes excess nitrogen from our landscape. If this process is abundant in our landscape, our research may provide clues for how to better manage our landscape to maximize the potential for this process.

Plainwell

By GK-12 Fellow Dustin Kincaid

At long last another Michigan winter has come and g— well, is slowly going. And though our calendars announced the arrival of spring here in the Midwest, we, as seasoned Michiganders know, the calendar is actually wrong; it's mud season here in our state. Our muddy tires tell us so. And our dirt-covered welcome mats remind us daily. We've been busy at Plainwell Middle the last couple of months so lets take a moment to reflect during this time of transition, excitement, and melancholy.

I spent most of my time these last several months working with the students in Mr. Green's earth science classroom. We transitioned from learning about processes that occur in the deepest parts of the earth to learning about surface processes and features on our planet. To do this we learned about volcanoes, hot spots for magma activity, and island arcs created by volcanoes. Once again I think the students feel fortunate they don't have to worry about volcanic activity here in Michigan!

We then began exploring how major geological events have influenced life on Earth. To accomplish this we learned how fossils are formed and how we can use them to learn about extinct organisms and how life has changed over time. The students also learned how scientists determine the age of rocks to find the absolute and relative ages of geological layers and fossils they dig up.

Our lessons later shifted focus to learn how humans and other life forms obtain and attempt to sustain important resources like energy and water on our planet. Mr. Green and I led discussions about the pros and cons of alternative energy options like biomass fuels and geothermal energy. The students had many creative ideas about how to conserve and be more efficient with the energy we use.

Because my research focus is on freshwater, I presented several lessons on how water cycles through the major reservoirs on our planet. One difficult concept for the students to understand was the movement of water underground; therefore, we spent several lessons learning about how groundwater moves through soils and rock layers and how important it is in southwestern Michigan and the globe.

As we continue to transition out of mud season and into the true spring season, I am looking forward to getting outside with the students a bit. Rumor has it we'll be exploring the Kalamazoo Nature Center at the end of April! Hopefully you'll plan to explore outside with your students and children as well.

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Plainwell

By GK-12 Fellow Sara Garnett

My first year as a GK-12 Fellow will be over in about a month, but Sandy Breitenbach's AP students and I are still keeping busy. In addition to the everyday workload necessary to prepare for the AP Biology exam (coming up in May), they have been hard at work on their independent research projects. I worked with them to design experiments addressing their research questions, and we spent several hours after school planting seeds, setting up fish tanks, and cultivating algae to get these projects off the ground. By now, almost every group has wrapped up their data collection, and I am currently working with them to organize and analyze their data. They will then work on presenting their results as either talks or posters; we hope that some of them will be able to present at the Michigan High School Math and Science Symposium at Grand Valley.

I've also helped develop some activities to help the students work with the concepts they've encountered in class. After they learned the basics of biological barriers that contribute to isolation between species, I found articles from the scientific literature that covered those topics. I created summaries of the papers highlighting some key points about the research questions, the organisms being studied, and the design of the experiments. I also pulled some figures illustrating key results from these papers and had the students work in groups to discuss the results, interpret the figures, and apply what they knew about reproductive isolation to these topics. Even though many of the graphs were more challenging than what students had previously encountered, they engaged with the material and had good discussions about their interpretations with one another. I also helped adapt one of the AP Biology labs into a format that would be easier for students to work with, and I will be teaching a lesson about animal behavior later this month.

I've had a great year in the classroom at Plainwell, and I'm looking forward to another great year as a GK-12 Fellow!

*See Sara on the game show Jeopardy!: http://kbsgk12project.kbs.msu.edu/blog/2013/03/10/garnett-jeopardy/

My research examines questions about how the presence of relatives influences competition and cooperation using American toad tadpoles. I have previously investigated whether tadpole growth and development is influenced by chemical cues in the water, which may provide information about kinship and resource availability. While there is some evidence that they adjust their growth and development in response to these factors during artificial conditions in lab experiments, this does not provide much information about what is actually going on in the field.

This summer, I will be conducting several experiments to get a better idea of what tadpoles are actually doing in the field and how strong their tendencies to associate with kin are. To look at how much tadpoles associate with kin, I will mark tadpoles according to their clutch and observe them in large tanks. By changing various factors that mimic environmental conditions or changes in population composition, I can observe how these factors influence the degree to which tadpoles spend time close by their kin. I will also use genetic analysis to explore the kinship structure of field populations of tadpoles. These experiments should shed light on whether kinship influences tadpole distribution and development in natural conditions.

As I close out my final semester as a GK-12 fellow and look back on two years in classrooms and workshops, I am grateful to everyone involved in the program for the fantastic opportunities I have had. Working with K-12 teachers has made me a better teacher and a stronger communicator, as well as helping me keep what I love about science firmly in sight when I occasionally stalled out in the dissertation doldrums.

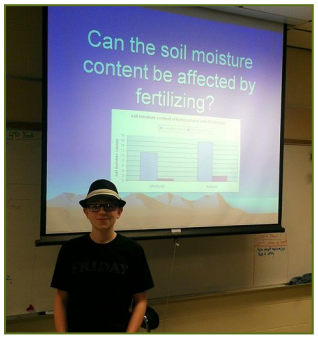
Happily, there is currently a strong wind in my research sails. I'm deep in analyzing my own data and writing about my discoveries, with the hope of submitting my first research manuscript in the next few months. Approaching the end of my graduate school adventure, continued opportunities to extract myself from the intricacies of gene models to ponder the difficulties of independent vs. dependent variables is positively refreshing.

Moving ahead, I will be teaching my own undergraduate course for the first time this summer and am planning to defend my dissertation in the coming fall. There is no knowing where the next steps will take my family, wherever we go we will carry a love for southwest Michigan, stoked by the connections GK-12 has given me.

Lawton

By GK-12 Fellow Anne Royer

Since finishing up with BeSt plot data collection in the fall, I've been keeping the students busy thinking about data. We celebrated our spreadsheets full of numbers in the traditional scientist way – by analyzing them! Marcia Angle's 8th-graders and Holly Visich's second-trimester Environmental Science classes all worked with the Lawton data they had collected themselves.



Students came up with a wide range of hypotheses to test, we explored graphing both by hand and on computers using Excel, and finally each student used their data to draw conclusions about their original hypothesis. Ms. Angle's class even researched what is already known about their hypotheses, and presented their final conclusions to their peers. This was an exciting example of bringing inquiry science full-circle, as the students were involved from the earliest stages of data collection to communicating the answers to their own questions.

This experience with BeSt data got me excited about spending more time in the classroom thinking about how to graph and interpret data. Where better to go in pursuit of a deeper understanding of real data than our own GK-12 Data Nuggets? I have since spent many hours in the classroom presenting real data collected by KBS scientists. Walking students in grades 7-12 through the process of clarifying a scientific question and then progressing from a table with numbers to a clear graphical interpretation and conclusions has proven fascinating. We have all learned a great deal along the way. I have a new appreciation for the complexity of the task and the brilliance of the teachers who communicate it clearly – who knew how many little steps actually go into turning raw data into an appropriate graph? The students seem to have also gained knowledge and confidence in navigating variable dichotomies (dependent/independent, continuous/categorical) and the vagaries of axis scale labeling. To find out exactly what and how much they can learn from Data Nuggets, we'll have to wait for the official assessments scheduled for this fall. This project will be coordinated by current fellow Liz Schultheis and former fellow Melissa Kjelvik, in collaboration with the BEACON Center at MSU's main campus. Be sure to read Liz's fellow page if you want to know more.

I am finishing up the semester with the ultimate Data Nugget challenge: turning some of my own data into a Data Nugget on the evolution of flowers. Look for it on the website (http://kbsgk12project.kbs.msu.edu/data-nuggets/).

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Olivet

By GK-12 Fellow Jake Nalley

Nothing could keep me out of the Olivet Middle School 8th Grade Earth Science classes with Russ Stolberg, not even being a Chicago Blackhawks fan stuck in Red Wings country or the many snowstorms that hit mid-Michigan. After a long winter break, we jumped right back into exciting, interactive, hands-on science like radiometric dating, lake mixing, and making our own clouds. The new year started off with discussing the rock cycle and all of the processes that can turn an igneous rock into a metamorphic or sedimentary rock, ultimately returning it back to the mantle to start the whole process over again. Students then got to participate in the Dating Game, radiometric dating that is. We discussed how fossils and skeletons are dated through our understanding of isotope decay.

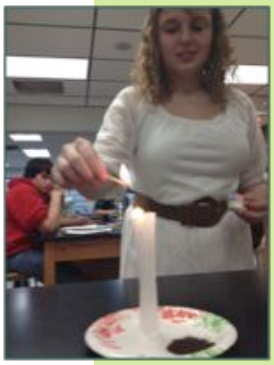
Moving from the lithosphere to the atmosphere, we began discussing dynamic weather events, like tornados, hurricanes, and thunderstorms. To visualize how warm air rises, that give rise to thunderstorms, students got to light emptied tea bags on fire. As the bag burned from the top down, the rising warm air currents lifted the flaming bag up into the air. Everything is always better when it is on fire. Students then got to research an extreme weather event that took place within their lifetime, from the Joplin tornado to Snowmageddon 2011.

Recently classes conducted a two-day lab to simulate how lakes respond to the four seasons they experience. Using plastic tubs as their lakes, students simulated the four seasons using heat lamps (the sun) and hair dryers (the wind) to warm surface waters and through intense winds turn the entire lake over. Students monitored the water temperature at specific depths to visualize how the lake became thermally stratified, or layered due to difference in temperatures.

Throughout the year, I have also been working with Terri Morton from Olivet High School, and next week a handful of talented high school students will be launching independent projects looking at how light levels, music, pH, or nutrient levels influence algal growth and fat production. Stayed tuned to the "News" section of the GK-12 website for results! I also had the opportunity to work with Marie Toburen and Cheryl Worden from the 4th and 5th grade to launch their annual Science Fair. The projects were great, and all of the young scientists were excited to tell me, the "Algae Guy," all about their work. Great job everyone!

My research into alternative fuel sources stems from a deep passion for understanding how we, as humans, can continue to develop as a society while maintaining our status as stewards of the Earth. As we continue to consume natural resources at extremely high rates, exterminate species, and pollute the environment around us, developing a more sustainable role for humans in the environment is extremely important. My research focuses on our energy consumption, mainly on identifying an alternative fuel source to the traditional fossil fuel supplies humans have quickly diminished. I believe one answer is algae.

We know that algae make a wonderful fuel source, after all the fossil fuels we burn today are from pre-historic algae. Not only can algae be used to produce fuel, it also can take in more CO_2 than it produces when burned, reducing its impacts on the environment. Large ponds of algae can be grown anywhere light and water are present so it will not infringe on our food production like other biofuels would. Research I conducted this year illustrated that growing multiple species of algae together, rather than by themselves, leads to higher than expected algal biomass AND more fuel potential.



With summer fast approaching the nights will soon be filled with the sounds of frogs and toads. Male frogs form large choruses where they call to attract females. This calling behavior is costly, both in terms of energy and increased conspicuousness to predators. The extent of these costs however may not be the same for each individual. A young male frog that gets eaten while trying to attract a mate 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 the calling behavior of gray treefrogs and American toads.

Over the course of the year I have been collaborating with a histology lab to determine the age of the male frogs and toads I have studied in prior summers. Our results suggest that in the wild male life expectancy is very short (for gray treefrogs only one male lived longer than three years) and does not seem to influence male calling effort. It is possible that because year to year survival is so low all males call at their maximal effort and hold nothing back.

Delton-Kellogg and Hastings

By GK-12 Fellow Michael Kuczynski

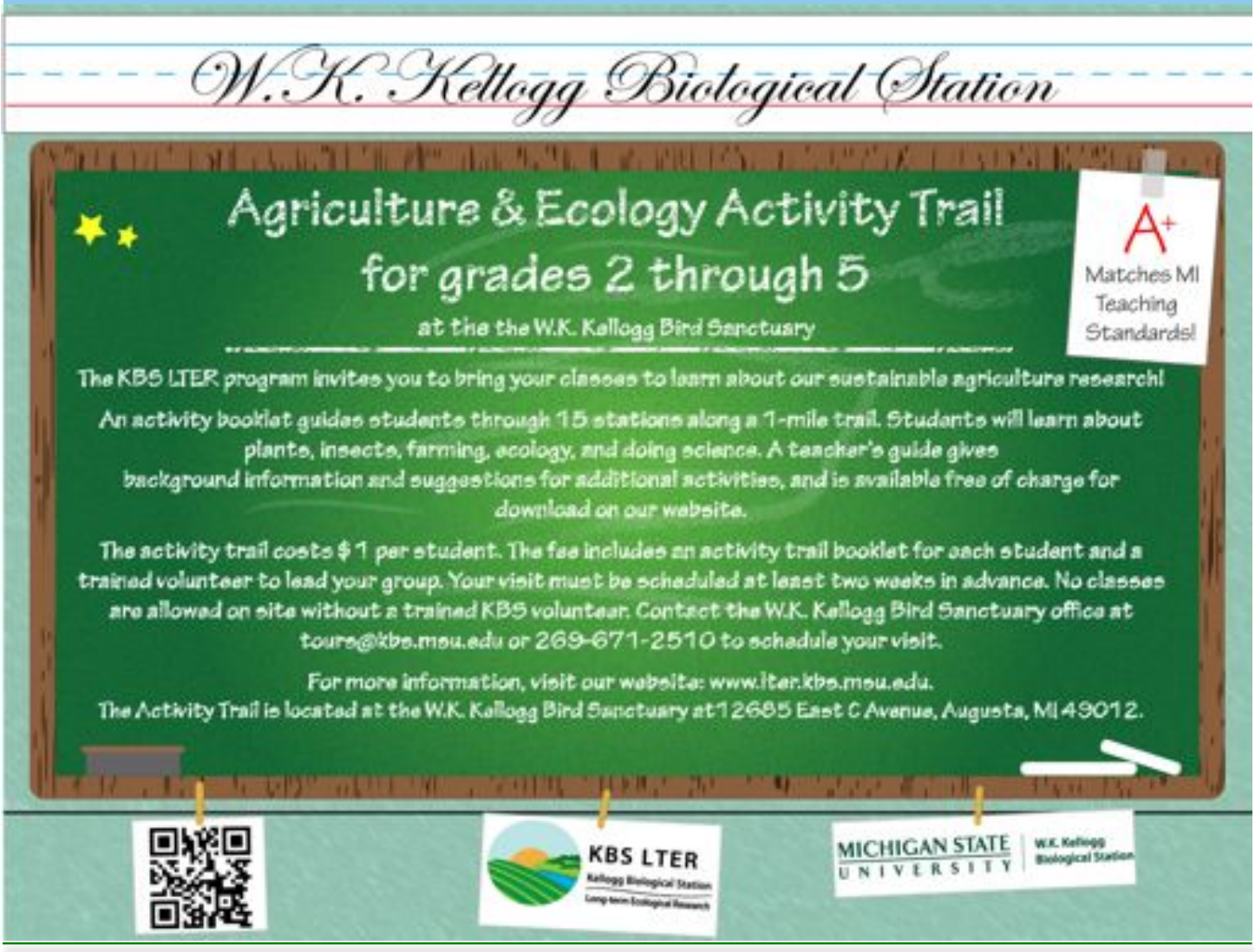
Hello, my name is Michael Kuczynski, I am a second year GK-12 fellow working with Connie High in Delton and Marty Buehler in Hastings. In Delton we began the year with a lot of work on the BEST plot protocols but soon moved on to a wide range of other topics and activities. During a unit on biodiversity students had the opportunity to play two different educational games, one demonstrating the benefits of biodiversity on ecosystem stability, and another that modeled seed dispersal. More recently, students have been studying electricity and are currently moving on to gas laws. We used Snap Circuits toy kits to teach students about parallel and series circuits, and we have a short lab lined up using Pop Rocks to teach the ideal gas law. Working with the students on these topics has been a lot of fun, and I must confess that playing around with the Snap Circuits is really entertaining.

In Hastings this year we have covered a variety of biological topics using a number of different activities and labs. At the beginning of the year students learned about biodiversity and even went on a short excursion to some local forests to directly measure biodiversity in the field. Later in the year during a body systems unit, I had the opportunity to teach the comparative anatomy of the digestive systems of carnivores and herbivores. Students examined the teeth and digestive tracts of several animals (just pictures for the digestive tracts) and based on what they observed they had to make predictions about the animal's diet. More recently, Marty has begun a genetics/evolution unit. Although the unit has just started students have already played a game I designed to demonstrate how genes and the environment interact to shape an organism's phenotype. I look forward to the coming weeks and anticipate many fun activities to help student understanding of evolution.

As the school year nears its end so too does my time as a GK-12 fellow. My time in the program has been incredibly rewarding and enjoyable. Over the past two years I have had the opportunity to work with three great partner teachers, Marty Green, Connie High, and Marty Buehler. Working with them has been a real privilege, and my time in their classrooms has definitely made me a better, more creative teacher and a more effective communicator of science. Next year I will return to teaching as a TA, and I am excited to bring the skills I developed in GK-12 to the undergraduate level. So to all of the teachers I have worked with and all those who have attended my workshop sessions over the past two years, thanks for the great experience, it's been a lot of fun!

KBS K-12 Partnership

News and Notes



11th Annual Plant Science Graduate Student Research Symposium

GK-12 fellows Tyler Bassett and Jake Nalley have been honing their public presentation skills all year in middle and high school classrooms. On March 29, they put those skills to good use by participating in the Plant Science Graduate Student Research Symposium that was hosted on Michigan State's East Lansing campus. Both presented on their individual research topics in front of a small crowd and judges. Tyler and Jake both research the many benefits that can come from diversity, a topic that should be familiar to students and teachers that have studied the BEST Plots. Tyler focused on how diversity may be a crucial factor in resisting invasive species in restored prairies. Jake spoke about how growing multiple species of algae together results in higher levels of biomass that can be converted into biodiesel fuel. Tyler received third place in the Oral Presentations for Applied Research. Congratulations to Tyler!

Jake researches aqueous algal biofuels (left photo) and Tyler researches prairie restorations (right photo).

Mark Your Calendars- Happenings at KBS

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.

4/22: Earth Day. Kellogg Bird Sanctuary. Celebrate our planet with free admission to the Sanctuary! 9 a.m. - 5 p.m.

May

5/1: Ecotourism and birding in the tropics. A presentation by Costa Rican guide Mario Córdoba. Kellogg Bird Sanctuary. 7 – 8:30 PM.

June

Reciprocal Membership Month. Kellogg Bird Sanctuary. Grand Rapids Children's Museum members enjoy reciprocal membership at the Sanctuary during the entire month of June.

6/24 – 6/26: KBS K-12 Partnership Summer Institute. Email RSVP to Sara S. at parrsar1@msu.edu

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

July

Sanctuary Summer Science Camps, Kellogg Bird Sanctuary. Visit http://bit.ly/summersciencecamp for more information.

7/10: Wild Wednesday: Butterfly Bonanza. Kellogg Bird Sanctuary.

7/24: Wild Wednesday: Animals of the Night. Kellogg Bird Sanctuary.

August

8/20: Literacy Tea. W.K. Kellogg Manor House. A back-to-school fundraiser: Pinkies up for a good cause!

October

10/6: Share the Harvest. W.K. Kellogg Biological Station. Help us celebrate 50 years of aquatic ecology at KBS during our annual open house celebration.

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.

Room and board at Kellogg Biological Station paid by the BEACON Center for the Study of Evolution in Action at Michigan State University.
Travel costs paid by participants.
Limited to the first 20 applicants. Space is still available, but filling up quickly, so register soon!

BIOQUEST CURRICULUM CONSORTIUM

BEACON An NSF Center for the Study of Evolution in Action

A summer workshop for high school biology teachers

When:
June 28 – July 3, 2013

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

KBS K-12 Partnership

Issue 13 April 2013

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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