KBS K-12 Partnership

Winter Newsletter

Issue 14 Ecological Literacy in K-12 Classrooms November 2013

From the Directors

Dear KBS K-12 Partners,

Trees clothed in hues of yellow to deep auburn, brought on by cooler temperatures and waning light, signify the end of another beautiful Michigan summer – and the start to a brand new GK-12 fellow season!

A big thanks to all teachers and fellows who participated in the 2013 Summer Institute. We had excellent turnout paired with active participation in our fellow-led sessions; a winning combination for all!

This year we introduce five new fellows and four returning fellows to the partnership. You can read about the research they do at MSU and projects they've worked on in the districts in the following pages.

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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Summer Institute Review

By Joelyn de Lima, K-12 partnership correspondent

It was the last week of June and KBS was a hive of activity. The annual K-12 Summer Institute lasted just 3 days this year but was action packed. Sessions were conducted by the GK-12 fellows, both new and returning, and by the MSP research associates. Since the institute ran for just three days, we had a plenary session everyday!

Our first plenary speaker was Dr. Carolyn Malmstrom from the MSU Dept. of Plant Biology. She spoke on the topic of plant viruses and ecology. Although few of us often consider virus ecology, her topic was a great fit for us since one of her focal research questions is "How do we preserve biodiversity and ecosystem services in working landscapes"? Dr. Catherine Lindell from the Dept. of Zoology was our plenary speaker for Tuesday. She spoke on the ecosystem roles of birds in both tropical forests and Michigan food crops. Our last plenary speaker was Dr. Maren Friesen from the Dept. of Plant Biology. Her topic was ecological genomics of salinity adaptations in a legume.

Following 'tradition', our returning fellows and their partner teachers conducted concurrent sessions based on the BEST plots. They did a great job of making the ever-so-familiar protocols new and exciting. Of course, the cool titles that they came up with had a fair bit to do with the excitement. The new fellows designed their sessions around their own research, covering topics as diverse as landscape biodiversity, the genetics of adaptation, invasive species, and sex differences in aggressive behaviors.

The Math Science Partnership (MSP) was also in on the session action. Jenny Dauer, representing the Carbon Strand, conducted the session 'Keeling Curve-arama: understanding what is local versus generalizable about atmospheric carbon dioxide concentrations'. Jennifer Doherty, Biodiversity strand, gave the session 'Unifying Life: Placing tree diversity in an evolutionary context'.

In addition to our standard research sessions, Sara Syswerda, Cheryl Hach, and Nancy Karre conducted a session on the Next Generation Science Standards. Their aim was, to quote Cheryl, 'To comfort the afflicted and afflict the comfortable'! They reminded us that the NGSS are written as performance expectations and they will require contextual application of the three dimensions by students.

Our last activity was a 'KBS Trivia' game conducted by Kara Haas. It was a fun and candy filled finale. Thank you all for making this year's Summer Institute another great one!

KBS K-12 Partnership

Gobles and Vicksburg

By GK-12 Fellow Dustin Kincaid

Hi all, I'm Dustin Kincaid and I'm a second year GK-12 fellow and third year PhD student in the Zoology department at MSU. This year I am working with Mrs. Drayton and her general and earth science students at Gobles Middle School, as well as Mrs. Ratashak and her biology students at Vicksburg High School. Before enrolling at MSU as a graduate student, I spent time as a naturalist in northern Wisconsin teaching elementary, middle, 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 both Gobles and Vicksburg 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's used as a means to illuminate the unknowns in our world.

One unknown we're exploring at the Kellogg Biological Station (KBS) and with our partner school districts is whether we can grow plants for biofuel while maintaining biodiversity and improving soil quality. Fortunately, several years ago teachers and students in the region partnered with scientists and graduate students at KBS to create a network of research plots at each of the partner school districts. These plots were designed to explore whether we could grow switchgrass and/or mixed native prairie plants to produce biofuel. The objective was to collect annual data on plant growth (i.e., biomass), plant diversity, invertebrate diversity, and soil quality measures like pH and nitrogen content. The best part of this research is that the students in the GK-12 program collect the data from these plots. Once the data are collected the students have the opportunity to work with the database they've curated to explore their own interesting scientific questions.

I have been very impressed with the students at both school districts. When I asked the students to brainstorm reasons why biodiversity might be important to maintaining functioning ecosystems, they shared ideas that I've struggled to get college freshmen to articulate! Additionally, they have already managed to craft some of their own ideas for interesting scientific questions to explore. I look forward to doing science with the students and teachers at Gobles Middle School and Vicksburg High School for the rest of the academic year; I'm certain I'll learn as much knowledge as I attempt to impart.

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. These places are home to really interesting microbes that actively process and transform the materials (e.g., organic matter and nutrients, like nitrogen and phosphorus) that flow through and over our landscape. While I don't study these microbes directly, I do study the processes they mediate, like decomposing organic matter and removing nitrogen from the landscape.

Lucky for me, wetlands, streams, and shallow lakes are very abundant throughout southwestern Michigan. And because of their position in the landscape, a lot of materials pass through them en route to larger rivers, lakes, and eventually the ocean. The microbes and other decomposers that thrive on these materials do so in unique ways because of the oxygen dynamics in shallow waters. For example, because there tends to be very little or no oxygen available in the mud and sediments, microbes can use compounds like nitrogen, iron, and sulfur instead of oxygen to process their food. Therefore, I'm investigating how these processes affect water quality so that we can better manage and conserve these important features in our watersheds.

My research is motivated by a fascination with invasive plants. As anyone who has ever pulled weeds knows, invaders can flourish in the habitats they invade. But how does a plant become so successful when introduced to a novel habitat? There are many possible reasons for why invaders are successful, but I'm interested in the role that evolution can play in invasion success. Particularly, my research focuses on how gene flow within an invasive species can facilitate adaptation to novel environments. I'm also interested in how this concept—adaptation to novel environments—can be applied to restoration. If we can figure out how invaders (plants that we don't want in a habitat) become so successful, perhaps we can use that knowledge to more successfully introduce plants we do want to areas we want to restore.

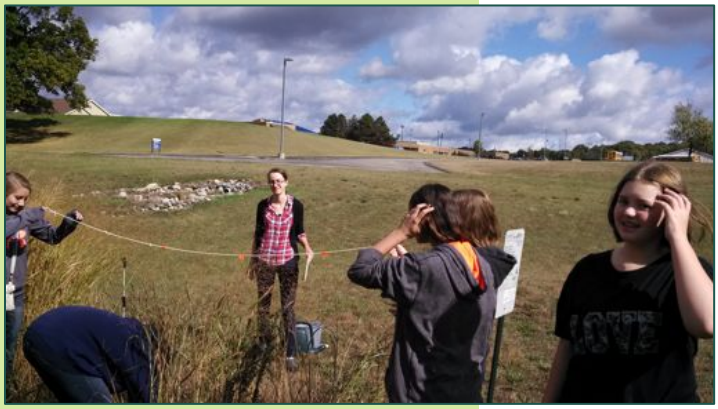
Parchment and Lawton

By GK-12 Fellow Susan Magnoli

Hi, my name is Susan Magnoli and I am a first-year GK-12 fellow and a third year PhD student at KBS. This year I am working with Marcia Angle at Lawton Middle School and Jodie Lugar-McManus at Parchment High School.

My days in the classroom have been spent doing lessons with hands-on activities that are (hopefully) getting kids excited about science and nature while giving them experience working with data. Because my research focuses on invasive species, Marcia, Jodie and I developed a lesson over the summer about how to identify invaders and why we should care about them. Most students seem to be able to name a few common invasive species in Michigan, but not many can pick an invasive species out of a line-up of both natives and invaders. One of the goals of our lesson is to give students the ability to identify species—i.e. using dichotomous keys. Students first learned how dichotomous keys work by keying out Jelly-Belly jelly beans (arguably the most popular part of the lesson), and then applied those skills to make their own dichotomous keys to identify invasive plants.

Marcia, Jodie and I also strive to incorporate graphing skills into the lessons we do. In our invaders lesson, students learned about invasive sea lamprey (sometimes referred to as the vampires of the sea), which are a major problem in the Great Lakes. We gave students real data from the Michigan Department of Natural Resources on lamprey abundance in Lake Michigan, which they graphed and drew conclusions from. Students also read several news articles about invasive species in Michigan, which was a great way to get them engaged in local environmental issues!



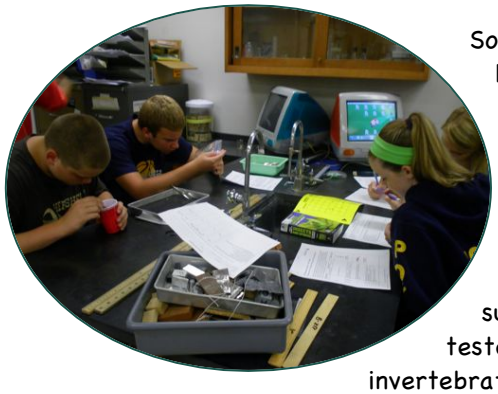
In the coming weeks both Marcia and Jodie's classes will be exploring the BEST plots. We're looking forward to taking the students outside to the plots to collect some data on plant and insect diversity.

KBS K-12 Partnership

Hastings

By GK-12 Fellow Dani Fegan

Hello everyone! My name is Dani Fegan and I am a first-year GK-12 fellow and third-year graduate student in the Plant Biology department and Ecology, Evolutionary Biology, and Behavior program at MSU. This year, I will be working with educators and students at Hastings High School. Before becoming a graduate student, I participated in a variety of experiences that involved working outdoors and studying the natural world we live in. It was because of these experiences and the supportive and excited people that I worked with that I decided to pursue a career in ecology. My hope is that I can serve as an accessible resource to students that are interested in science and give them the chance to get excited about nature by taking classwork outdoors.



So far, most of my time at Hastings has been spent working with Mr. Buehler's Honors Biology students. During my first week in the classroom, we focused on observational studies and then designed one of our own! Using the different habitat types surrounding the high school, we tested whether biodiversity of invertebrates was higher in forested or grassy areas. Before heading outside, we discussed different possible sampling methods, the importance of replication, and how to quantify biodiversity. The students then conducted sweep net surveys and set out pit traps and sticky traps to be collected later. After a few days, we collected the traps and students worked in groups to count and sort their collected specimens to Order. We wrapped up the lesson with a discussion about our findings.

This week, we are beginning the "Diversity in a Leaf Pack" lesson (from the Math Science Partnership). Working in an aquatic ecosystem, we will study how abiotic (non-living) factors in a stream can affect the diversity of the community of organisms that colonize our leaf packs. We plan to build the leaf packs in class and take a field trip to deploy them later in the week. We will measure abiotic characteristics of the areas of the stream where we place the leaf packs and return to collect them after a few weeks. After sorting the aquatic organisms that were able to colonize the leaf packs, hopefully we will be able to talk about some of the many reasons we saw different aquatic organisms colonizing in parts of the stream that varied biotically and abiotically. If everyone can stay warm and somewhat dry, it's going to be a lot of fun!

When we think about plants, we don't often think about them "moving around." However, like most other organisms, movement is important for population persistence, gene flow, and colonizing habitats. One way that plants move is through seed dispersal. Seeds come in many shapes and sizes that are adapted for different methods of moving – some have developed tiny hooks that stick to the fur of animals and eventually fall off, some are surrounded in delicious fruits that are consumed by birds and later deposited under the perches birds rest on, and some species (like the dandelion) have developed structures that allow their seeds to be carried on the wind. It is the latter that I am most interested in.

Stepping back, I am generally interested in plant community, landscape, and restoration ecology. I am interested in how habitat fragmentation affects plant communities and processes, such as seed dispersal. To explore these interests, I am studying seed dispersal in a large-scale restoration experiment in a longleaf pine community in South Carolina. Currently, I am evaluating whether or not restoration treatments, such as prescribed burning and overstory tree thinning, increase the overall density of seeds that disperse and/or have an effect on the distance that wind-dispersed seeds can move, which can have implications for population and community movement.

Harper Creek

By GK-12 Fellow Sarah Jones

Hi, I'm Sarah Jones and I'm a first year fellow. I'm working with Sandy Erwin at Harper Creek this year, helping teach high school students in her chemistry classes. Sandy and I started working together at a summer workshop this year, where we presented a lesson plan based on my research to teachers in Michigan. The teachers participated in a critical reading activity on articles from internet blogs and journals about human sex differences in competition and aggression. We then discussed biological and environmental causes of sex differences in behavior, and learned how scientists study animal behavior. The summer institute was a fun learning experience for me. I had some very interesting conversations with teachers about sex differences in human competitive behavior, and the teachers provided me with useful feedback in how I can make the lesson plan the most relevant for their classes. Since then, I've spent time settling into Sandy's classroom. I'm helping classes gain a deeper understanding of the scientific process by helping format labs in a way that emphasizes hypothesis testing through generating predictions and data. I've also introduced the class to an inquiry exercise in which they try to determine why termites will follow a line of ink written on a piece of paper. Students test hypotheses such as "the termite is drawn to dark colors" or the "termite is attracted to the indent made by the pen in the paper". In reality, the termites are actually drawn to a chemical in BIC pen ink that mimics a termite pheromone (chemical emitted by the termites that affects the behavior of other termites) which leads worker termites to food. We are now working on a science writing exercise in which students are researchers who are trying to prevent mosquito bites. Students have to write an argumentative essay in which they use evidence to convince a panel of "experts" (Sandy and me) to fund their solution to the mosquito problem. During my interactions with the students, I try to show them how chemistry is at the root of all human and animal behavior. For instance, I've talked to them about how chemistry is essential to the sense of smell, and how smell in turn can affect animal and human behavior in unexpected ways.

I'm interested in the biological basis of individual and sex differences in aggressive behavior. Males of most mammalian species are more aggressive than their female counterparts. For instance, men commit more violent crimes than women worldwide, and males of other mammal species often fight with higher intensity than females. Individuals also vary greatly in aggression, with some members of both sexes showing particularly high or low levels of aggression. Aggression can be essential to an individual's survival; however, it can also be detrimental, disrupting social bonds and causing bodily harm to both perpetrators and victims of aggression. Therefore, it is important to understand the biological basis of aggression and why males might be more prone to it than females.

My research focuses on a sex role reversed mammal – the spotted hyena. Spotted hyenas are unusual because females are much more aggressive than males in this species. I am trying to untangle the biological causes of this sex role reversal. For instance, brain chemicals such as serotonin and hormones such as testosterone help determine aggression levels in individuals and sexes across mammalian species. I am examining whether differences in such molecules can explain individual and sex differences in hyena aggression.

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Harper Creek and Olivet

By GK-12 Fellow Amanda Charbonneau

Greetings! I'm a third-year graduate student in the Genetics department at MSU. By day, I'm a mild mannered scientist studying weed evolution, and how plants invade new ecosystems. By night, I volunteer at Potter Park Zoo, where I teach about ecology and conservation and train the birds of prey.

My first love is nature, so the first few weeks of school at Harper Creek High School have been amazing. We've been studying how ecosystems are put together, and how nutrients cycle through them. I was even able to bring in some of my favorite detritivores to visit! I've also spent a lot of time working to convince the students that they can be scientists right now. When people imagine a scientist, they tend to picture someone in a lab coat surrounded by flasks of bubbling fluid, but we all use the scientific method every day. I'm trying to bring in open-ended experiments, where the students come up with their own questions to test, in addition to the more structured experiments with the BEST plots.

Speaking of BEST Plots, Ms. Hawkins, Dr. Subers and I have taken their Biology students out to do lots of protocols already this fall. We've all had a lot of fun identifying plants and insects, and trying to figure out how to improve biofuels. On the other side of the schoolyard, I've also teamed up with Mrs. Eckert at Harper Creek to collect insects with her CI class, and I'm planning to bring in some exciting live insects to visit them soon.

I also have a great partner teacher at Olivet High School. Mrs. Morton and I have created a new science club "Science Lunch" on Tuesdays. This is a student focused group where we explore science topics that they're interested in, with the option of doing an independent research project. We're still in the early stages, but I'm really enjoying exploring topics with the students and helping them to develop their ideas.

Beautiful gardens take a lot of work, all of the plants need to be specifically chosen for how much light there is, and need to be watered and tended. You need to spend a lot of time pulling weeds, or your garden will be overrun with dandelions and crabgrass.

Why is that? Why do the plants we enjoy seem to take so much work, when weeds seem to effortlessly live anywhere?

I'm trying to understand how weeds can cope with new environments by studying the evolution of weedy radish. Unless you're a wheat farmer, you've probably never heard of weedy radish, but it's one of the worst agricultural weeds in the world. Of course, not all radish are weeds, there are really 3 types: weedy, crop and natives. The weeds grow very quickly, and live only about 40 days, but the natives grow slowly and can live more than a year. The crops are in the middle, with some growing very quickly, and others acting more like natives.

By comparing the genomes and physical characteristics of these plants, I hope to determine which genes make the weeds different from the natives and where those genes came from. I also plan to compare these 'weed' genes to the ones in fast growing crop radishes, to see if radish breeders and natural selection used the same path to fast growth. My research will help us to better understand the origin of weeds, and may help us to find better ways to control them.

Just this past week the U.N.'s Climate Panel released a report that climate change is "unequivocal" and the panel is 95% certain that humans are the driving force. As our population continues to balloon and impact our surroundings, I believe it is simply in our own self-interest to become stewards of our environment, not only ethically but also economically. This belief has led me to begin researching an alternative fuel source that couples technological application and ecological theory to begin addressing the insatiable demand for energy from our increasing population demands. I have focused my graduate studies on developing an energy source that can be mass-produced at low costs, economically and environmentally, for we can no longer subsidize one of these while ignoring the costs of the other. I believe that a potential answer to this problem could be algae.

We know that algae make a wonderful fuel source, after all the fossil fuels we burn today are from pre-historic algae reserves. 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 available, 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.

Olivet and KAMSC

By GK-12 Fellow Jake Nalley

With furloughed employees from the recent government shutdown and with "the sequester" limiting grant awards it becomes quite easy to understand why I have returned for a second year as a GK-12 Fellow, financial security. But with all joking set aside, returning as a GK-12 fellow was not even a decision I had to think about, with all of the terrific times I had over the past year I knew that I had to return. I am fortunate to be working with Russ Stolberg for a second year at Olivet Middle School and excited to develop relationships with Chris Chopp and Cheryl Hach at the Kalamazoo Math and Science Center (KAMSC).

Olivet: Russ and I have hit the ground running, launching three new labs over the past three weeks. After getting acquainted with the new groups of incoming 8th graders, and already being branded "Jake from State Farm" (I knew I should not have worn those khakis), we investigated how to implement the scientific method through observing the behavior of termites to follow a line of pen ink when they encounter it. With this initial observation, students were able to test out their hypotheses about whether the termites were following the color, the indentation, or smell of the line through using various writing utensils ranging in colors, from BIC pens (blue and black), sharpies, pencils and highlighters. It turns out a drying agent in BIC pen ink is similar to a pheromone termites excrete, resulting in termites to follow the line of ink.

The last two weeks we have been investigating chemical changes through the process of making root beer. Through the use of yeast, an unhealthy amount of sugar, water, and root beer extract, we observed over a week that our bottles began pressurizing, with one exploding in the process. Students were introduced to how yeast will "eat" the sugar and through the process of fermentation release carbon dioxide. CO_2 then dissolves into the root beer forming carbonic acid, carbonating the root beer. Then the following week, prior to sampling the finished root beer and the sugar rush that would follow, students used molecular models to construct the carbonic acid and demonstrate how it decomposed (broke down) into carbon dioxide and water when we opened the bottles (see below).

$$H_2CO_3 \longleftrightarrow CO_2 + H_2O$$

Carbonic Acid $\longleftrightarrow$ Carbon Dioxide + Water

KAMSC: On October 9th, Chris Chopp's AP Biology course visited the Kellogg Biological Station (KBS) to get some hands on experience with looking at the biodiversity of algal species. Students used microscopes to get an up-close look at different groups of algae, like green algae, diatoms and cyanobacteria. Then we investigated the evolutionary history of these species through constructing a "tree of life" using their taxonomy. We look forward to partnering in the future to work on some amazing lab ideas.

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Plainwell
By GK-12 Fellow Sara Garnett

I'm glad to be back for another year as a GK-12 Fellow! I'm still in Plainwell, but this year I've moved to the middle school, where I'm working with Marty Green and Lisa Wininger.

The eighth-grade classes have spent the beginning of the school year reviewing in preparation for MEAP testing. This has also given me the opportunity to revisit many topics in science that don't necessarily apply directly to my research. I have helped out in the classroom while students reviewed topics like groundwater and photosynthesis. I also took a more active role in helping students review the metric system and genetics and Punnett squares (using the Toothpick Fish lesson), and put together some worksheets for students to review cell structure and function. I hope that these review activities stick with the eighth-graders as they take the MEAP exams, and I'm looking forward to working with them as we get more into Earth Science!

So far, most of my time with the sixth-graders has been while they work through the Systems and Scale unit of CarbonTIME. On my first visit to the classroom, they discussed combustion and started thinking about what might make some materials burn, while others do not. They also got to see me burn some ethanol. Students also watched a demonstration involving burning ethanol and a chemical called bromothymol blue, which changed color as carbon atoms left the ethanol during the combustion reaction. This helped them think about the idea that atoms are forever, and atoms that leave the ethanol must go somewhere. We also talked about the difference between organic and inorganic molecules. They also did a lab to look at how the mass of an item and the height from which it is dropped influence its potential and kinetic energy. They have been very excited to do these activities, and I hope to continue encouraging their enthusiasm for science throughout the school year!

I'm very happy to be at Plainwell Middle School, and I'm looking forward to the rest of the year with these classes!

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, but we see individuals put themselves at greater risk to predators or compete less intensely for food or mates when relatives are involved. Because relatives share at least some of the same genes, behaving in ways that help relatives survive and reproduce can be an effective strategy for an individual to pass its genes on to the next generation. This raises questions about when it is best for an individual to focus on itself vs. its relatives, as well as the strategies animals use to maintain this balance.

My research examines these questions using American toad tadpoles. They prefer to swim near siblings rather than non-siblings in their birth ponds, using chemicals in the water to tell them apart. I am investigating whether these chemicals might provide information that influence how quickly tadpoles grow and develop, or how intensely they compete for food. In particular, I am interested in whether they respond differently to siblings than non-relatives in different environments. 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.

I am fascinated by animal behavior and I love understanding why animals do the things they do. 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. I've already discovered female house wrens become more aggressive if they are more likely to lose their territories and that more aggressive females can keep their territories longer. I also hope to find if females must make a choice between aggression and parenting. Do the demands of parenting keep females from being as aggressive as males, or can aggressive females have it all?

Plainwell and Comstock

By GK-12 Fellow Cara Krieg

I'm Cara Krieg and I'm a second year GK-12 fellow in Plainwell and Comstock. In Plainwell I've been working with Sandy Breitenbach's AP biology class. It's been a blast helping out with labs I remember enjoying so much when I was in high school. In addition to helping out in the classroom, I'll be helping students have the experience of a scientist after school. Several dozen students have joined an after school research team. Over the rest of the semester these students will be carrying out experiments they design themselves. There is a wide variety of interests in this group. Some are interested in physics, some in dreams, others in microbes, and others in birds. I'm excited to see what kind of projects they create! We hope that some of the projects will be good enough to take to a science fair in the spring.

In Comstock I've been working Mr. Fisher's 7th grade students at Comstock North East Middle School to investigate plant biodiversity in the school yard plots. These plots were planted in 2010 with switchgrass and various native prairie species. Scientists hope that some of these species could eventually be harvested and turned into a biofuel source. Students take data from these plots every fall to find out if we can grow our fuel and still have a healthy environment. One measurement of environment health is the number and kind of species that live there.

The Comstock plots are doing quite well after a summer with plenty of rain. Some of the prairie plants are now taller than the students! All six classes visited the plots and identified the plant species they found. They found that the native prairie species like goldenrod, New England aster and wild bergamot are doing very well in the Comstock plots. After the data was collected, students were able to practice making graphs and drawing conclusions. Students compared the biodiversity in Comstock to other schools in the GK-12 program. They were able to use these comparisons to make recommendations on how to grow the most diverse field of biofuel.

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Thornapple Kellogg

By GK-12 Fellow Emily Dittmar

I am Emily Dittmar and this is my first year as a GK-12 fellow. I am currently at Thornapple-Kellogg middle school with Jamie Bowman. So far, we have gotten off to a great start with the BEST plots! The plots at Thornapple-Kellogg were seeded less than a year ago, so they are currently mostly weeds, but it will be interesting to watch succession occur as the perennial grasses begin to take over! It is exciting to start the process of collecting data!

The 7th graders will be doing the BEST plot protocols this year and working with them has been a ton of fun! We spent a class period discussing what biofuels were, the purpose of the BEST plots, and the big questions we are trying to answer. Since this will be part of the 7th grade curriculum, the class next-door joined us for the discussion. We had almost 60 7th graders in one room, but they all listened and gave really intelligent answers to some very tough questions! I was impressed!

We began our data collection by looking at plant and insect abundance and diversity. The students learned the randomization protocol and some recorded plant species, while others set out sticky traps and pitfall traps. The next week, we collected the insect traps and students recorded the number of individuals of each insect type.

The following week we did the data nugget on plant and insect diversity in the BEST plots using prior years' data. My hope was that doing that exercise would give students a better idea about why they collected the diversity data and what it might ultimately be used for.

I am interested in the process of adaptation and what genes are important to this process. How many genes are usually involved and do they typically cause big changes or little changes?

To address this, I study a group of wildflowers that grow on a soil type that is prevalent in California, called serpentine soil. It is a very harsh environment, and most normal plants can't grow on serpentine. The ones that do are often specialized to live there. I am studying the genetic changes that are involved in adapting to this habitat, including the number of genes and their individual effect sizes. In addition, I am investigating whether adaptation to serpentine reduces the ability to live on and compete on regular soil and if so, why?

My research involves many different methods, including field work in California, experiments in the greenhouse, and troubleshooting molecular techniques. I really enjoy the fact that I can combine all these activities into my research! My field season in California begins in January and goes through the spring, so it's coming up in a few months!

KBS Summer RET Program Hosts Teachers

By MSP Coordinator Sara Syswerda

During the summer of 2013, five teachers came to KBS for eight weeks as a part of the research experiences for teachers program. Funded by the National Science Foundation, the Research Experience for Teachers Program supports the active participation of K-12 teachers in research and education projects with the intent of facilitating professional development for these teachers as well as the scientists they work with through strengthened partnerships between institutions of higher education and local school districts.

Lisa Wininger enjoys the view by the Plainwell Dam on the Kalamazoo River

In the past we have had teachers working on both science research and education projects on a wide variety of topics, and this summer our teachers got to experience field and laboratory work, as well as curriculum development work. Cheryl Hach from Kalamazoo Area Mathematics and Science Center and Katie McKinley from Mattawan High School came to work in Dr. Jeff Connor's lab on plant evolution and genetics. Lisa Wininger from Plainwell Middle School came to work with Sara Syswerda on a project using geographic information systems to map the Kalamazoo River Watershed and develop curriculum for middle school students (see more from Lisa on following page). Jodie Lugar McManus from Parchment High School worked with Dr. Steve Hamilton looking at invasive plants in local freshwater bodies. Matthew Hawkins from Gull Lake's Gateway Academy (now at Gull Lake's Ryan Intermediate School) worked on a curriculum design project with Kara Haas, Tomomi Suwa, and education intern Rachael Wilber.

KAMSC Collaboration

"I had a great RET experience in Jeff Conner's lab! Jeff and the grad students and post-docs were so helpful and I am especially grateful to Cindy Mills, the lab manager. I think she knows everything!! Part of my time was spent gathering data for groups of radish cultivars displaying sexual dimorphism.

Using the computer to measure the length of tiny filaments on small blossoms quickly became pretty routine, but it was very interesting to see the variation of only one anatomical feature across a large number of plants. Much of my time was spent developing activities that I can use in my classroom. I continued working on an activity that Sandy Breitenbach from Plainwell High School began during her RET in the same lab, field-testing a paternity test for Wisconsin Fast Plants from seed to pollination to offspring. I will use this in my upcoming Human Genetics class.

Katie McKinley (left) and Cheryl Hach (right) work on experimental plants in the Conner lab. Photo by Carly Rhodes.

I also worked to streamline an activity that will allow students to extract their own DNA, amplify a segment of their mitochondrial genome and compare similarities and differences in their sequence to others in the class and even others around the world using a BLAST server. I modified a technique to cast agarose on microscope slides for a quick electrophoresis separation. I have even more ideas for the future and am so grateful for the opportunity to learn and work on curriculum that I can share with my students."

-**Cheryl Hach**, Kalamazoo Area Mathematics and Science Center

Summer RETs (con't)

Plainwell Middle School Collaboration - Telling the Story of a River.

Lisa Wininger

"The overarching goals of the project are two-fold. First, the project will allow middle/high school students to become informed about watersheds and water science. This includes mapping a specific river (for my project, the Kalamazoo River), understanding the dynamics of a watershed, and evaluating water quality, river morphology, and related issues such as changes in land use, contaminated segments such as Superfund sites, and structural issues like dam removal. The second goal of the project is to teach students and their teachers how to use ArcGis Online from ESRI to construct and interpret geographic and scientific knowledge using maps and data.

The project is designed so that other educators and classes could use the methodology to complete this project for watersheds and/or rivers in their region. In terms of major components, the projects has four parts, as follows: The **first** step is to create a physical inventory of the river with photographs and data and creating a StoryMap using ArcGis Online. The **second** step is to create an interactive web map with multiple data layers. Students will work through a prepared scenario with instructions about how to manipulate layers and their contents to answer a series of analytical questions about the watershed. The **third** step is intended for 6th grade students. Based on a series of guided instructions, students will create an interactive web map of a small tributary or short river segment, mapping the river with geographic coordinates, and entering data. The **fourth** step is a longer term project intended for 8th grade Earth Science or high school Environmental Science students. These students would select a lesser studied tributary and map it using ArcGis, identify available data sets to import, collect data, and make conclusions about their findings. I plan to invite participation from experts in the Michigan ESRI community to help with student instruction and project design. I am presenting on the project at the KBS workshop this November."

- **Lisa Wininger**, Plainwell Middle School

Matt Hawkins surveys plants. Photo credit: GLBRC

Gateway Collaboration

"This collaboration started in the fall of 2012 when KBS visiting scholar, Dr. Nalini Nadkarni, shared her passion for environmental education with my students at Gull Lake Gateway Academy. Her presentation on forest ecology and her demonstration of tree climbing were a break from the normal day of strictly computer based curriculum at my "alternative" high school. Our goal was to develop hands-on activities that supplemented online curriculum, but the challenge was to create these modules for a classroom environment that does not include direct instruction from a teacher. A four person team was put together that included myself, Kara Haas, Tomomi Suwa, and education intern Rachael Wilber.

We first completed the online courses as if we were students and then determined the units that hands-on activities would best enhance the learning experience. Each activity was built "in a box," complete with all materials, instructions, and a how-to video to guide instruction. Activities that were created include the use of microscopes, investigating plant heredity and fertilizer use, natural selection, and experimental design. The best part of the summer was spending time shadowing KBS staff in the field. At first it was all very new, but was a great challenge each day to try to learn as much as possible and be ready with many questions!
The project was sponsored by Great Lakes Bioenergy Research Center, Perrigo Foundation, Gull Lake Community Schools Foundation, and an anonymous donor."

-**Mr. Matt B. Hawkins**, Ryan Intermediate, Gull Lake Community Schools

Mark Your Calendars- Happenings at KBS

November

11/13: KBS K-12 Partnership Workshop – Integrating Water Cycling and Ecosystems. 8AM – 4PM. RSVP with Sarah at bodbyl@msu.edu

11/13: Manners at the Manor – 4:30 – 6PM. Cost: $13/student 5 to 13 years old. Learn proper greetings, table manners, phone etiquette, and behavioral tips for different social situations from a local expert. Call 269-671-2400 or e-mail conference@kbs.msu.edu to RSVP.

11/16: Fall Waterfowl Identification Class. 9 – 11AM. Kellogg Bird Sanctuary. $25/members, $35/nonmember. Call 269-671-2510 or visit kbs.msu.edu/visit/birdsanctuary to RSVP.

11/19: Floral Wreath Class – Boxwood wreath. 6PM. Kellogg Bird Sanctuary's Spruce Lodge. $50. Call 269-671-2400 or email conferece@kbs.msu.edu to RSVP.

December

11/29 – 12/21: Holiday walks at the Manor House. Every Friday and Saturday from noon to 5PM. $7/ea. or $5/student or senior. Call 269-671-2160 for reservations or visit kbs.msu.edu/visit/manor-house.

12/4 – 12/22: Holiday Teas, Brunches, and Luncheons. Come and enjoy holiday themed, decadent meals at the Manor House. Includes a tour and program. Fees apply. Call 269-671-2160 for reservations or visit kbs.msu.edu/visit/manor-house.

April

4/23: KBS K-12 Partnership Workshop. RSVP with Sarah at bodbyl@msu.edu

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KBS K-12 Partnership

News and Notes

Wednesday, November 13 WORKSHOP

We're excited to announce our first school-year workshop of the 2013-2014 K-12 Partnership at KBS on Nov. 13 from 8AM to 4PM. Our workshop theme is: **Integrating Water Cycling and Ecosystems**. The GK-12 Fellows, MSP leadership, and the GLBRC are working hard to prepare some great new sessions. To whet your appetite, some session teasers include: the influence of global precipitation cycles on African biota, contamination effects on aquatic organisms, the role of wetlands in watersheds, new tools and activities for teaching global Carbon cycling, and how to study watersheds using GIS! Please rsvp to Sarah at bodbyl@msu.edu if you plan to attend. We look forward to seeing you!

GK-12 Lessons available online

Former GK-12 Fellows Melissa Kjelvik and Raffica LaRosa worked this summer on a lesson archiving project to bring you instant, online access to all Fellow and teacher produced lessons spanning the GK-12 program. Their efforts resulted in an amazing 97 lessons available for classroom use! Lessons can be accessed from the GK-12 website at http://kbsgk12project.kbs.msu.edu/lessons/ and can be easily searched using the interactive table tool on the right side of the main page (see photo at right). Please spread the word about this great resource!

MICHIGAN STATE UNIVERSITY | Kellogg Biological Station

Kellogg Bird Sanctuary

Students only $1
Chaperones $3
Teachers FREE!

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Augusta, MI 49012
(269) 671-2510
birdsanctuary@kbs.msu.edu

kbs.msu.edu/birdsanctuary

REGISTER FOR A FIELD TRIP TODAY!

Fall & Spring programs for 2nd-5th

Engage your classroom in the outdoors
Tours customized to meet MI GLCES
Learn about real MSU research projects

Bird Tours: 1.5 hour, volunteer guided (Winter, Spring or Fall)
Body parts/characteristics
Species adaptation and survival
How energy moves through a food web

Agriculture & Ecology Student Activity Trail:
1.75 hour, volunteer guided (open April 1—October 31)
Plants needs, water cycle, use of tools, asking scientific questions, science careers and more!
More information: http://bit.ly/agecologyteachersguide

New lesson plans to help prep your class before and after your visit:
http://bit.ly/sanctuarylessonplans

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Tom Getty, Co-Director
Tom is a Professor of Behavioral Ecology and the chair of 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.

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.

Sara Syswerda, MSP Coordinator
Sara has a PhD in Crop 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 has a PhD in Ecology and Evolutionary Biology at the University of Kansas. Her interests are in mating system evolution, particularly in plants and birds, restoration, conservation, and science education. Sarah meets with fellows, visits schools, manages the K-12 Partnership web pages, and coordinates workshops.

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