An Introduction to
The KBS GK-12 Bioenergy Sustainability Project

May 2011

KBS GK12 Project

THE KBS GK-12 BIOENERGY SUSTAINABILITY PROJECT

BEST Plots | Insider's Page | Publications | Resources | Participants | News | Lessons | Home | Data Nuggets

Search

Kellogg Biological Station's GK-12 Program

In 2010, we were awarded a grant from the National Science Foundation for a new GK-12 (Graduate STEM Fellows in K-12 Education) Program called the **KBS GK-12 Bioenergy Sustainability Project**. You can find an overview and introduction to our project at https://www.msu.edu/user/getty/GK-12_introduction.pdf . This program is part of a national network of GK-12 sites funded by the National Science Foundation (NSF) with the common goal of providing science graduate students with skills that will broadly prepare them for their future careers, particularly communicating science with varied audiences. Through interactions with teachers and students in K-12 schools, graduate students are expected to improve communication and teaching skills while enriching science instruction in K-12 schools. For more information about the GK-12 program and links to GK-12 projects in other states, visit the National GK-12 website.

Our GK-12 project has partnered with twelve rural school districts in SW Michigan, all of whom are part of the ongoing K-12 Partnership at Kellogg Biological Station. In fall of 2010 we established a network of schoolyard research plots (see the BEST Research Network tab) at 22 schools in these 12 districts. The plots mimic those used at the Great Lakes Bioenergy Research Center to conduct experiments testing the sustainability of bioenergy crops like switchgrass and native prairie. Students and teachers at our partner schools will are asking the question "Can we grow our fuel and our flowers and butterflies too? Please contact program director Tom Getty (getty@msu.edu) or program manager Robin Tinghitella (hibbsr@msu.edu) for more information on the new **KBS GK-12 Bioenergy Sustainability Project.**

Menu

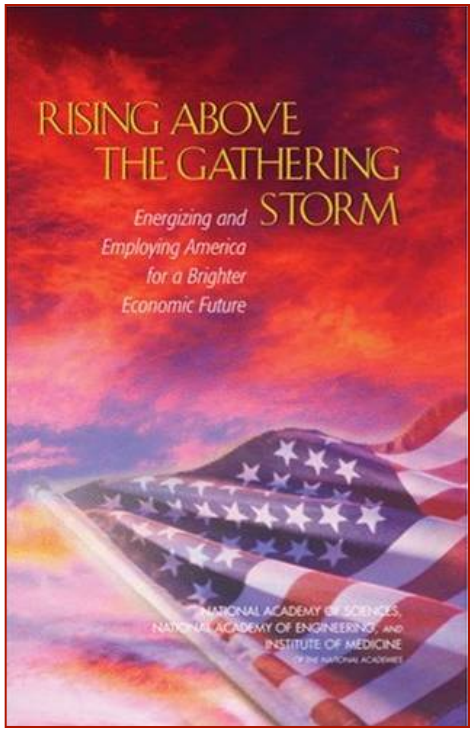
- News
- Insider's Page
- Publications
- Resources
- Participants
- BEST Plots
- Home
- Lessons

Meta

- Log in
- Entries RSS
- Comments RSS

Some Posts – Literature

There is a pressing national need ...

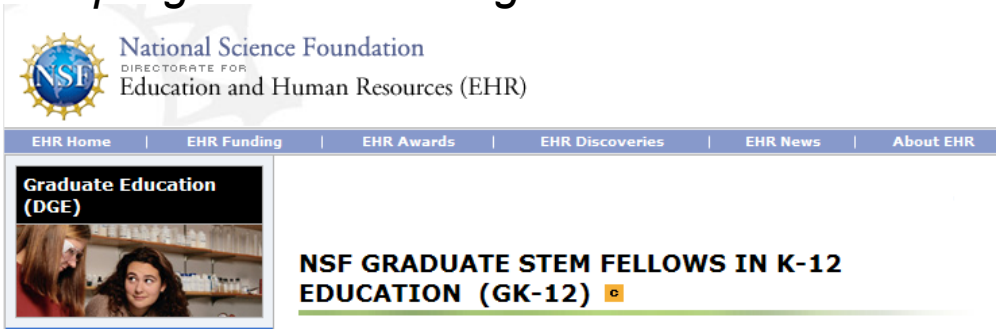


Rising Above the Gathering Storm*:*
Energizing and Employing America ***for a Brighter Economic Future***.
2007. Committee on Prospering in the Global Economy of the 21st Century (U.S.), Committee on Science, Engineering, and Public Policy (U.S.). National Academies Press, USA.

... **four recommendations**
... to create high-quality jobs and
focus new science and technology efforts
on meeting the nation's needs,
especially in the area of clean, affordable energy:

1) Increase America's talent pool
by **vastly improving K-12 mathematics and science education**;
2) **Sustain and strengthen** the nation's commitment to **long-term basic research**;
3) **Develop, recruit, and retain top students, scientists, and engineers**
from both the U.S. and abroad; and
4) Ensure that the United States is the premier place in the world for **innovation**.

One program addressing this need is ...



This program provides funding for graduate students
in NSF-supported science, technology, engineering, and mathematics (STEM) disciplines
to bring their leading research practice and findings into K-12 learning settings.

Expected outcomes include:

1) *For graduate fellows*
Enhanced understanding of their own research subject area,
and its societal and global contexts;
improved communication skills ... with technical and non-technical audiences,
leadership, team building, and teaching capabilities.

2) *For K-12 education*
Professional development opportunities for teachers
in both STEM content and pedagogy; and
enhanced learning and STEM career interest for students.

3) *For institutions of higher education*
Transformation of graduate programs;
strengthened and sustained partnerships with local school districts, ... and
enhanced institutional impact of graduate education to society.

NSF GK-12 GRADUATE STEM FELLOWS IN K-12 EDUCATION

http://www.gk12.org/

HOME ABOUT US NEWS MEETINGS RESOURCES CONTACT US SEARCH

PROJECT LOCATOR

Find a GK-12 Project by State:

Select One

> Find

> See Map

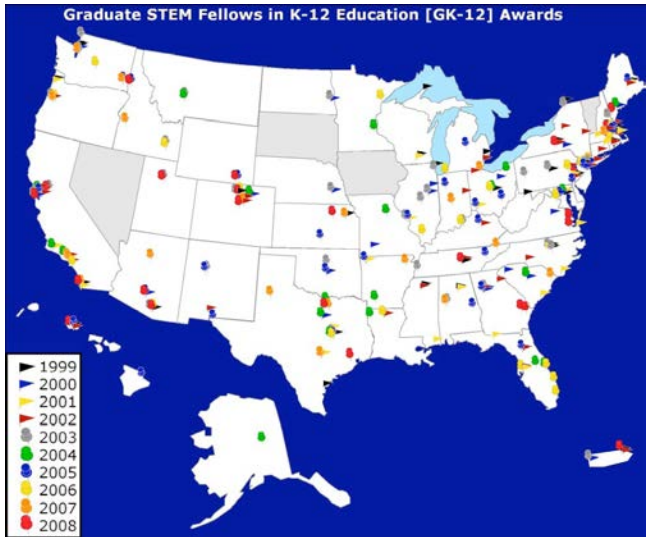
> Advanced Search

WHAT'S NEW

> Portland State Highlights Environmental Sustainability

> Southern Mississippi GK-12 Hosts Biology Day

> Northwestern GK-12 on Big Ten Network



NEWS&ANALYSIS

SCIENCE EDUCATION

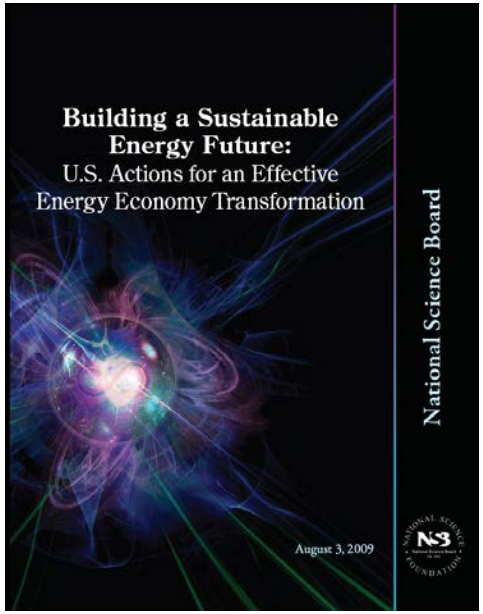
Outrage Greets NSF Decision to End STEM Fellows Program

Alas – the 2010 cohort of new five year projects will be the closing act.

GRADUATE STUDENTS

to integrate current scientific research
into K-12 settings; act as
role models to K-12 students and
stimulate their interest in STEM careers;
enhance K-12 teachers' STEM content
knowledge and pedagogy;
to have enhanced understanding
of your own research subject area,
and its societal and global contexts;
have improved communication skills,
leadership, team building,
and teaching capabilities;

Another pressing national need ...



Priority Recommendation

The U.S. Government should develop, clearly define, and lead a nationally coordinated research, development, demonstration, deployment, and education (RD3E) strategy to **transform the U.S. energy system to a sustainable energy economy** that is far less carbon intensive.

Priority Guidance for NSF

The National Science Foundation (NSF) should continue to increase emphasis on innovation in sustainable energy technologies and education as a top priority.

Guidance 2: *Strengthen Systems Approaches in Research Programs*

- Develop and strengthen **interdisciplinary "systems" approaches for research programs that focus on basic science, environmental, social, and economic issues** in a sustainable energy economy.

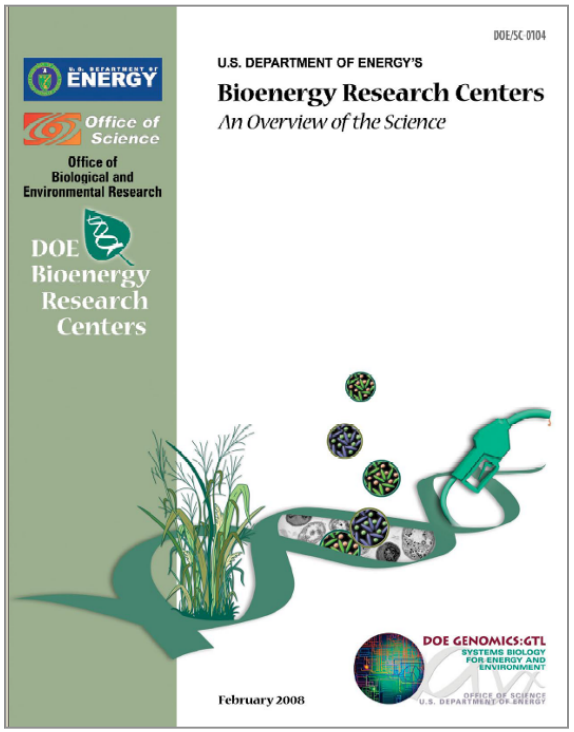
Guidance 4: *Support Education and Workforce Development*

- **Promote interest in science and energy fields during K–12 education** by supporting the development and dissemination of programs and curricula designed to **teach students about energy, the environment**, and related economic issues.

Conclusion

... ensure stewardship and continued vitality of the environment.

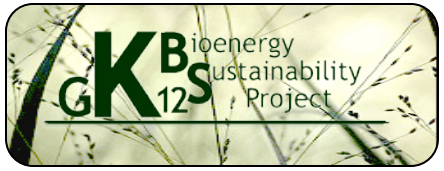
One program addressing this need is ...



THRUST FOUR — Development of a Sustainable Bioenergy Economy 4

For a bioenergy economy to positively impact the U.S. energy sector, it must be integrated into agricultural, industrial, and social systems. The GLBRC will develop economically and environmentally sustainable best practices for the entire biofuel production cycle.

The GLBRC leader of Thrust Four is **Philip Robertson**, Department of Crop and Soil Sciences, Kellogg Biological Station.



Our New GK-12 Project addresses several of these challenges ...

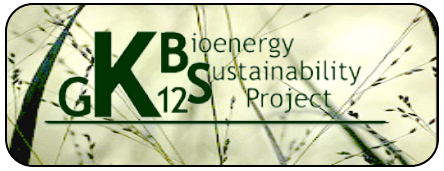
From our proposal to NSF:

The intellectual focus of our project is on graduate student research at KBS
that bears on the STEM Dimensions of Bioenergy Sustainability:
whether and how we can create and manage cellulosic bioenergy production
that is ecologically sustainable.

This is a pressing national need
that draws on the research of all of our core faculty and their grad students.

Our activities include creating a network of schoolyard science research plots
that support a collaborative research and education network
of MSU faculty and grad students, K-12 partner teachers and students,
and project partners in the GLBRC Sustainability Research Group
and the KBS Long-Term Ecological Research (LTER) project ...

Fellows will work collaboratively with each other, their advisors,
KBS, GLBRC and LTER research and education faculty and staff,
and our K-12 partners
to incorporate their own research into K-12 research and inquiry activities
that address state and national science education standards.



From the NSF reviews of our proposal:

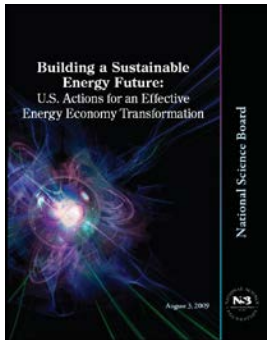
The GK-12 competition received 143 proposals in 2009
... 22 proposals have been recommended for awards.

... they were reviewed by STEM experts and subsequently discussed at panel meetings in the following major areas: Biology, Engineering, Computer Sciences, Mathematics and Physical Sciences, and Geosciences.

Each proposal was reviewed by at least three reviewers.
We had 5 reviews; all five gave us the highest possible score: **excellent**.

The individual reviewers then convened as a group
... each panel included reviewers with expertise in graduate education as well as reviewers knowledgeable about K-12 STEM education, and project evaluation.
Following the panel discussion ... the panel wrote a summary documenting the strengths and weaknesses of the proposals in regard to the two NSF merit review criteria and GK-12 program specific review criteria as described in the program solicitation (NSF 09-549).

From the NSF review panel: "**This is an outstanding proposal in all respects**"

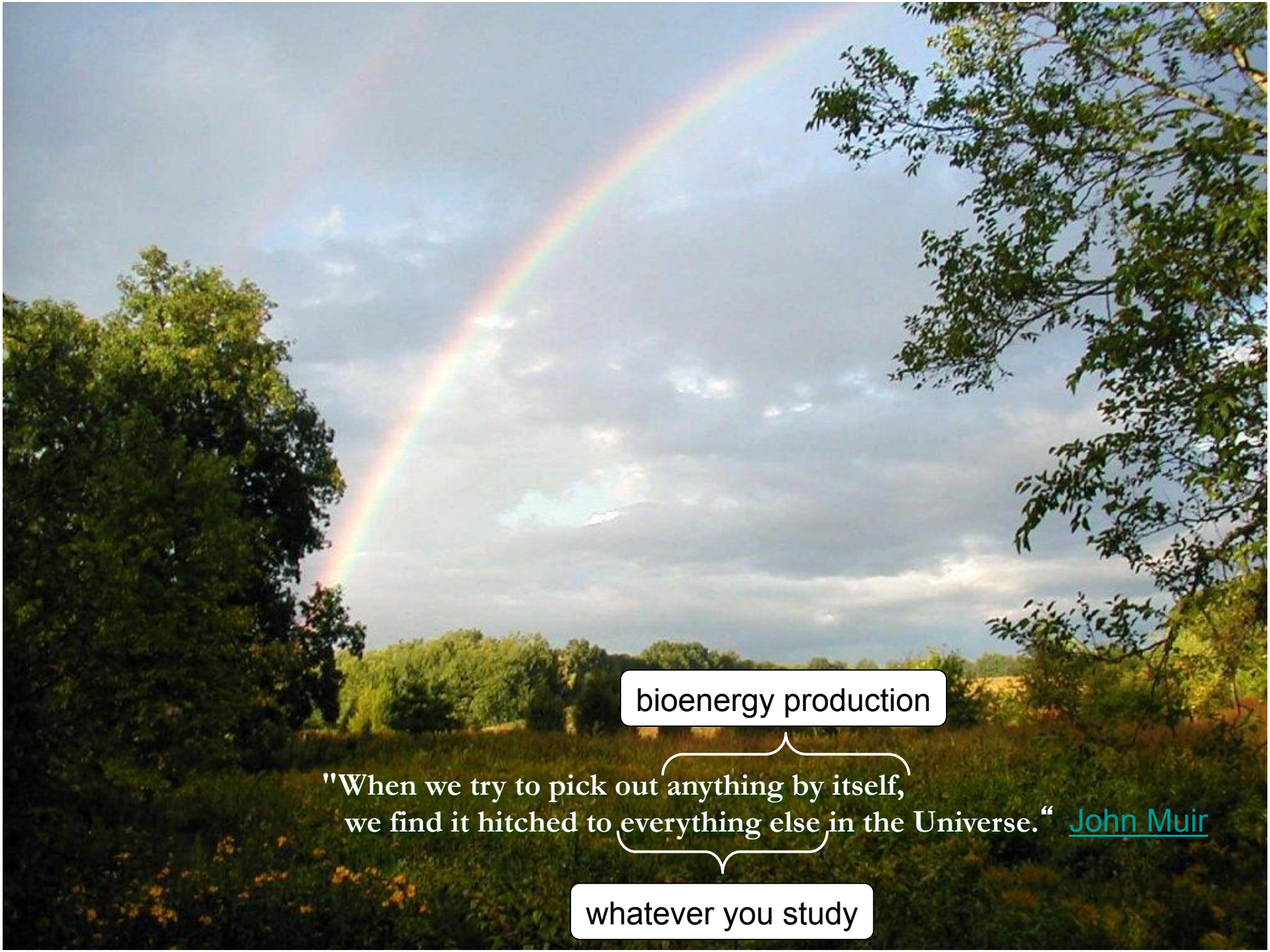


… ensure stewardship and continued vitality of the environment.

GK12 Bioenergy Sustainability Project

will put the spotlight on Sustainability,[1]
which depends on **ecology** broadly construed
across rural landscapes of human-coupled systems

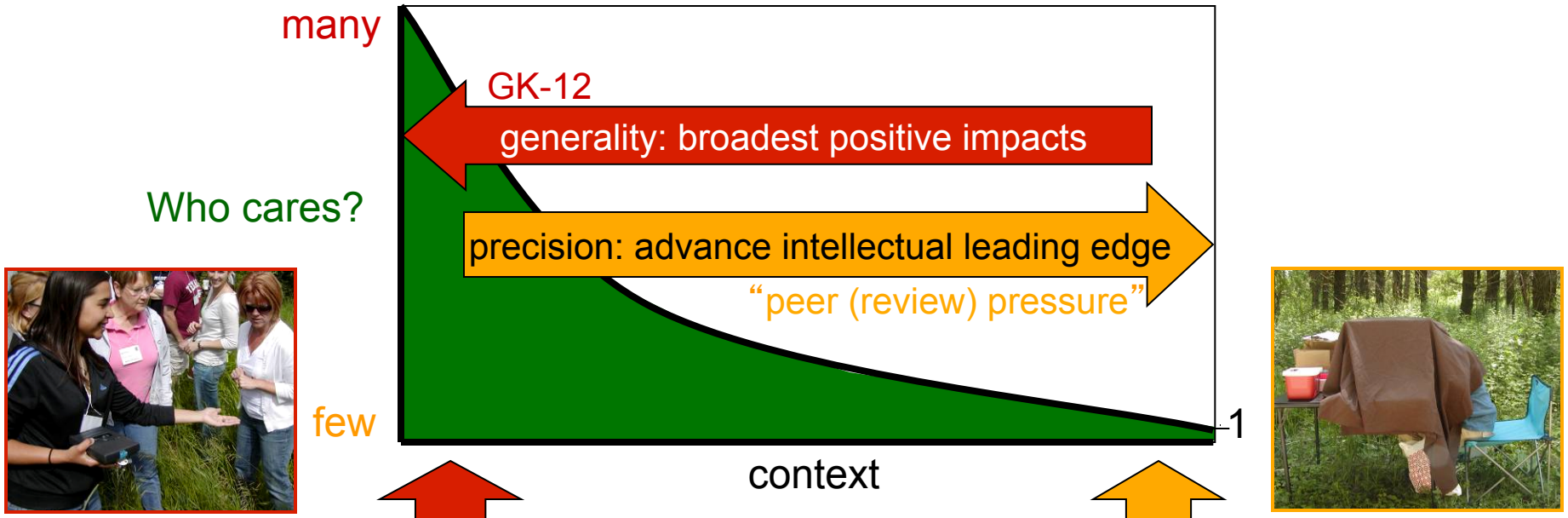
[1]In ecology, [**sustainability**] describes how biological systems remain diverse and productive over time.


bioenergy production
"When we try to pick out anything by itself,
we find it hitched to everything else in the Universe." John Muir
whatever you study

National Science Foundation
WHERE DISCOVERIES BEGIN

1) For graduate fellows

Enhanced understanding of their own research subject area, and its societal and global contexts; improved communication skills ...

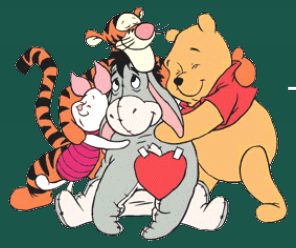


Population growth and biodiversity depend on how organisms respond to environmental and landscape changes like global climate change, conversion to bioenergy production, rural landscape development, etc.

Female house wrens at Lux Arbor adjust their reproductive effort (clutch size, sex ratio, hormones ...) to the marginal fitness returns this year relative to an average year.

The **New GK-12:**
Using the STEM[1] Dimensions of Bioenergy Sustainability to Bring Leading-edge Graduate Research to K-12 Learning Settings
will work in partnership with the KBS K-12 Partnership

The KBS K-12 Partnership



- our big, happy, synergistic partnership

- MSU W.K Kellogg Biological Station
- NSF LTER Ecology of Ag Landscapes
- DOE GLBRC Sustainability Research
- NSF Math and Science Partnership
- NSF GK-12 "The BS Project" [2]
- NSF BEACON STC: Evol. in Action

Comstock
Delton-Kellogg
Galesburg-Augusta
Gobles
Gull Lake
Harper Creek
Hastings
Lawton
Martin
Olivet
Parchment
Plainwell
Vicksburg

[1] **S**cience, **T**echnology, **E**ngineering & **M**ath

[2] coPIs: Tom Getty, Andy Anderson, Kay Gross, Jen Lau, Phil Robertson, Robin Tinghitella

KBS K-12 Partnership

Winter Newsletter

Issue 8 Ecological Literacy in K-12 Classrooms January 2011

From the Directors

Dear KBS K-12 Partners,

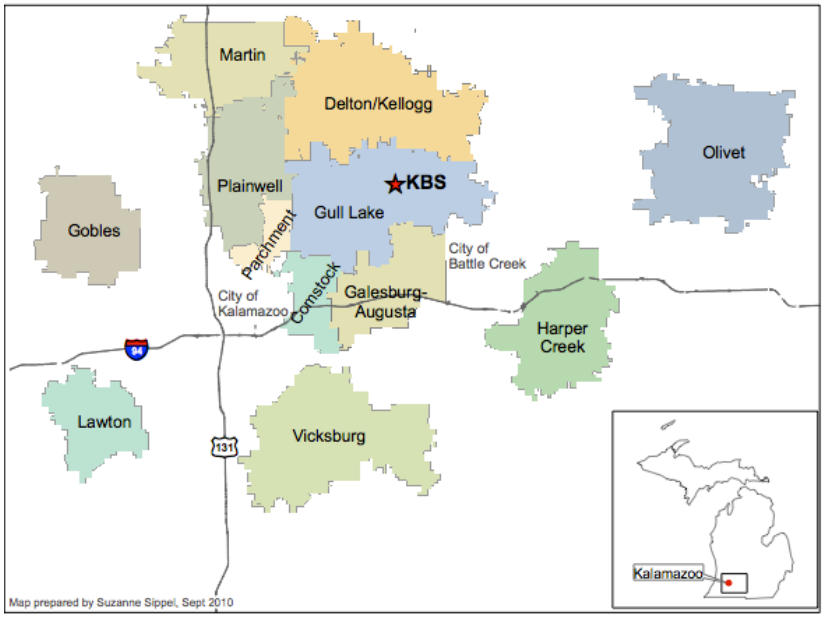
This has been another busy fall for the KBS K-12 Partnership! Our professional development workshops have been lively and full of new teachers (including from Parchment and Hastings who recently joined the ranks), and our nine graduate student fellows began work in partnership classrooms in September. Perhaps the fellows' biggest accomplishment thus far has been installing and planting over 300 research plots at 22 partnership schools in six counties, as part of the BEST (BioEnergy SusTainability) research network (p.2). Partner teachers also began piloting Teaching Experiments in biodiversity, water, and carbon as part of the Math Science Partnership this fall. We are also excited to announce that Andy Anderson's research group at MSU received another grant from the National Science Foundation in which they'll partner with National Geographic to produce web-based environmental literacy resources and tools. Finally, we are pleased to welcome our Teacher In Residence, Sue Zygadlo, who will assist project staff in working with elementary school teachers and students (p.3). Until next time,

Phil Robertson, Tom Getty, Andy Anderson
Sara Syswerda, & Robin Tinghitella

Inside

The KBS K-12 Partnership is supported, in part, by Michigan State University, and the National Science Foundation. Opinions expressed in this publication are those of the authors and do not necessarily reflect the views of these institutions.

Kellogg Biological Station
K-12 Partnership School Districts



KBS K-12 Partnership

Issue 8 January 2011

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.

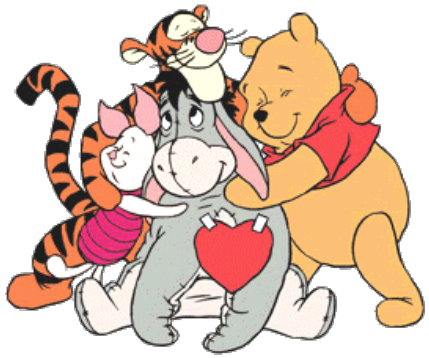
Tom Getty, Co-Director
Tom is a Professor of Behavioral Ecology in the Department of Zoology at MSU. His research focuses on the role of information in various aspects of behavior, ecology, and evolution including: mate choice, aggression, cooperation, predator-prey interactions, and habitat choice.

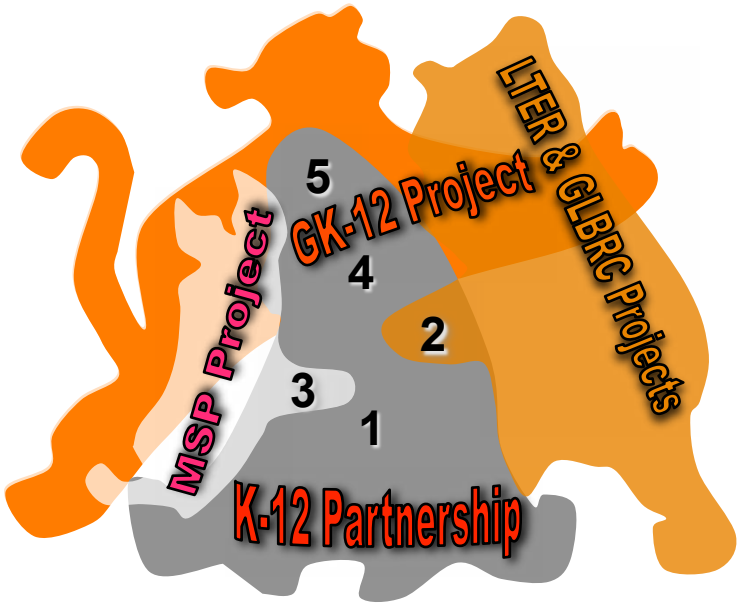
Charles (Andy) Anderson, Co-Director
Andy is a Professor of Science Education in the Department of Teacher Education at MSU. His research centers on the classroom teaching and learning of science. He studies how students' prior knowledge, language, and social relationships affect their engagement in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

Robin Tinghitella, GK-12 Coordinator
Robin earned her PhD in Evolution, Ecology and Organismal Biology at the University of California-Riverside. Her interests are in behavioral ecology, particularly sexual signaling and mate choice, and science education. Robin recently finished a post-doctoral position at University of Michigan. She meets with fellows, visits schools, manages the K-12 Partnership web pages, and coordinates workshops.

Possible levels of teacher participation in K-12 Partnership:





1. K-12 Partner Teacher: attends some workshops for professional development opportunities; workshops also incorporate GK-12, MSP and GLBRC activities.

2. K-12 Partner + GLBRC: also works with the Great Lakes Bioenergy Research Center staff on biomass plots and bioenergy curriculum.

3. K-12 Partner + MSP (DRK12): also works with the Math Science Partnership on culturally relevant ecology, learning progressions and environmental literacy.

4. K-12 Partner + GK-12: also works with the GK-12 graduate fellows on GK-12 research and education initiatives.

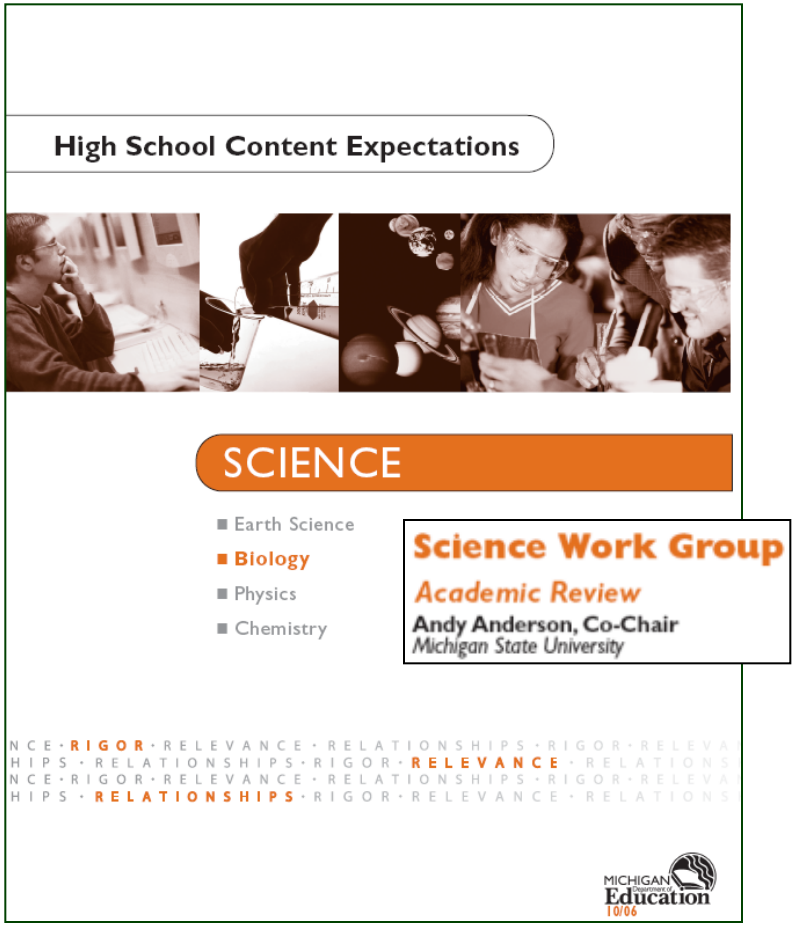
5. GK-12 Partner Teacher: includes 1, 2, 4 and possibly 3, w/ stipend to support participation in GK-12 activities.

School Year Workshops & Summer Institute

2010-2011 Workshop Topics:

1. Establishing a K-12 Research Network in SW Michigan
2. Sampling Native Michigan Ecosystems
3. Using Learning Progressions to Learn about Student Thinking
4. Creating Authentic Research Experiences for your Students

Our K-12 Teacher partners,
are looking for
“news they can use”
to address state standards:



Biology Content Statement Outline

STANDARD B1 Inquiry, Reflection, and Social Implications
- B1.1 Scientific Inquiry
- B1.2 Scientific Reflection and Social Implications

STANDARD B2 Organization and Development of Living Systems
- L2.p1 Cells *(prerequisite)*
- L2.p2 Cell Function *(prerequisite)*
- L2.p3 Plants as Producers *(prerequisite)*
- L2.p4 Animals as Consumers *(prerequisite)*
- L2.p5 Common Elements *(prerequisite)*
- B2.1 Transformation of Matter and Energy in Cells
- B2.1x Cell Differentiation
- B2.2 Organic Molecules
- B2.2x Proteins
- B2.3 Maintaining Environmental Stability
- B2.3x Homeostasis
- B2.4 Cell Specialization
- B2.5 Living Organism Composition
- B2.5x Energy Transfer
- B2.6x Internal/External Cell Regulation

STANDARD B3 Interdependence of Living Systems and the Environment
- L3.p1 Populations, Communities, and Ecosystems *(prerequisite)*
- L3.p2 Relationships Among Organisms *(prerequisite)*
- L3.p3 Factors Influencing Ecosystems *(prerequisite)*
- L3.p4 Human Impact on Ecosystems *(prerequisite)*
- B3.1 Photosynthesis and Respiration
- B3.2 Ecosystems
- B3.3 Element Recombination
- B3.4 Changes in Ecosystems
- B3.4x Human Impact
- B3.5 Populations
- B3.5x Environmental Factors

STANDARD B4 Genetics
- L4.p1 Reproduction *(prerequisite)*
- L4.p2 Heredity and Environment *(prerequisite)*
- B4.1 Genetics and Inherited Traits
- B4.2 DNA
- B4.2x DNA, RNA, and Protein Synthesis
- B4.3 Cell Division – Mitosis and Meiosis
- B4.4x Genetic Variation
- B4.r5x Recombinant DNA *(recommended)*

STANDARD B5 Evolution and Biodiversity
- L5.p1 Survival and Extinction *(prerequisite)*
- L5.p2 Classification *(prerequisite)*
- B5.1 Theory of Evolution
- B5.2 Molecular Evidence
- B5.3 Natural Selection

A KBS K-12 Partnership Activity

Do Herbivores Prefer Local or Exotic Foods?

Testing the Enemy Release Hypothesis

Marcia Angle & Liz Schultheis

OVERVIEW

Students will examine herbivory on exotic vs. native tree species planted into plantations in the Kellogg Forest. We will use our data to test the Enemy Release Hypothesis, which posits that exotic species escape from specialized natural enemies in their invaded range, contributing to their success. Students will develop predictions, design experimental sampling methods, collect data, and create graphs to summarize data.

OBJECTIVES

At the conclusion of the lesson, students will be able to:

- Give reasons why invasive species are so successful in their introduced range and can displace native species
- Compare ecosystem processes acting on native and exotic species
- Identify new plants species and different types of herbivore damage
- Present data in visual format for interpretation

LENGTH OF LESSON

To complete the lesson would take two class sessions. The first session would be used to identify the questions of the study and provide relevant background information. Teachers will present the species to be used in the study and describe the Enemy Release Hypothesis and the success of invasive species. Students would practice identifying the species and the types of herbivore damage, without being told which species were exotic or native. At the end of the first lesson, students would go out and gather leaves. During the second session, students would measure herbivore damage and record and share their data with the class. The teacher will make a graph of class averages and discuss, based on the data, which species the class predicts is the exotic species.

GRADE LEVELS

Upper elementary, middle school, high school

STANDARDS COVERED

S.IP.E.1 Inquiry involves generating questions, conducting investigations, and developing solutions to problems through reasoning and observation.

S.IA.E.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research, and investigations.

B3.4x Changes in Ecosystems. Human Impact. Humans have tremendous impact on the environment. Sometimes beneficial and sometimes detrimental.

B3.5C Predicting the consequences of an invading organism on the survival of other organisms.

B5.3d Explain how evolution through natural selection can result in changes in biodiversity

MATERIALS

Ziploc bags (3 per group x 5 groups = 15)
Clipboards (5)
Calculators (5)
Measuring tapes (5)
Pens and sharpies
Handouts (included)
Data sheets (included)

BACKGROUND

Classes of species:

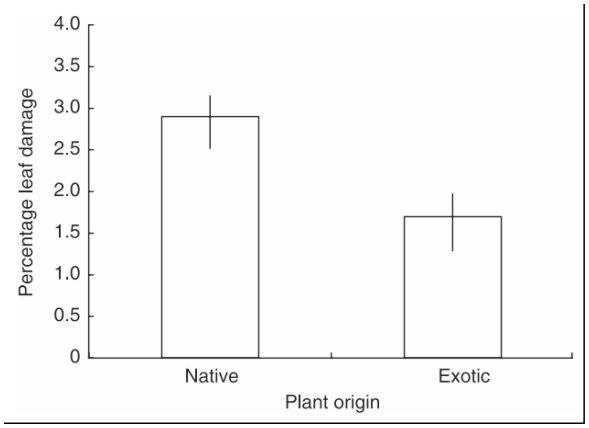
- *Invasive species* – Species that have been introduced to an environment where they are not native, and that subsequently become a nuisance through rapid spread and increase in numbers, often to the detriment of native species and ecosystem processes.
- *Exotic species* – Species that have been moved to an area outside their natural range, usually by human transport.
- *Native species* – Species that occur naturally in an area.

Herbivory – the consumption of plants.
Enemy release – release from natural enemies when an exotic or invasive species is introduced to a new range.
Biocontrol - Control of invasive species by the introduction of natural predators, parasites, or pathogens from their native range.

Where they invade, invasive species cause damage to ecosystems – lowering biodiversity by displacing native species and changing ecosystem processes, such as nutrient cycling and hydrology. For this reason, it is of great interest to scientists and land managers to discover the mechanisms behind the success of invasive species.

One of the predominant hypotheses explaining the success of invasive species is the Enemy Release Hypothesis. This hypothesis posits that when exotic plants invade new regions, they escape their natural enemies. As a result, herbivores and pathogens that may limit population growth rates (and distributions and abundances) in the native range are often absent in their new range. Accordingly, exotic plants enjoy increased success compared to native plant competitors, which are still battling all their enemies AND competing with the novel invaders.

A recent experiment (Carpenter & Cappuccino, 2005 Ecology) illustrates this pattern. They found that exotic plants suffered significantly lower levels of herbivory damage when compared to native plants, and that the most invasive species experienced the greatest "release" of all (see Figure).



The plantations in the Kellogg Forest provide excellent venues to test the Enemy Release Hypothesis. In these plantations, foresters have planted a wide variety of tree species into common habitats. Many of these species are native to Michigan, but many others are exotic. We will use the oak plantation and record herbivore damage and diversity on native versus exotic species. The oak plantation contains 3 oak species—two native (red oak and white oak) and one exotic (English oak).

ACTIVITIES OF THE SESSION

1. Distribute handout to students (included).
2. Introduce students to why invasive species are of concern to scientist and land managers, discussing issues they cause for native species and ecosystems.
3. Define terms needed to understand the lesson (provided in background).
4. Ask students, in small groups, to brainstorm about characteristics of species that would make them better invaders, or aspects of ecosystems that would make them vulnerable to invasion. Discuss answers as a class.
5. Introduce the Enemy Release Hypothesis and why reduced herbivory in exotic ranges contributes to invasive plant success.
6. Explain an example of biocontrol and why this is relevant to enemy release.
7. Share plants that will be used in the study, and teach students how to distinguish them.
8. After observing leaves, have students choose three types of herbivore damage that they will measure out in the field (ex. galls, leaf miners, leaf removal).
9. Label bags. Distribute data collection sheets (included).
10. Take students out into the field. Introduce students to proper sampling methods, such as randomly selecting plants to sample, and consistency between groups' sampling methods.
11. Break them into small groups and have each group collect 10 leaves from each species used in the study. Provide each group a Ziploc bag for leaves (one for each species used in the study).
12. Measure diameter at breast height (DBH) of each tree where leaves were collected. Observe tree height.
13. Bring students back to the classroom to identify herbivory on leaves. Have students estimate the amount of each kind of herbivore damage, and the diversity of herbivores attacking each leaf (how many different kinds of damage each leaf has).
14. Have everyone average their results and draw graph of the individual group results.
15. Submit group averages to teacher.
16. Discuss biodiversity and photosynthesis process tools.
17. Average the class results for each species, and present herbivory damage as a bar graph. On graph for each kind of damage.
18. Have students predict which species they think is the exotic, and which is native, based on the data collected. Why?
19. Share with students which species is exotic, and discuss as a class why your data may have supported or not supported predictions.
20. Have the students think as land managers. Based on the results from this study, would you recommend that people be allowed to plant the exotic oak species in their yards? What do you think would happen to the population of the exotic and native oaks over time? What would happen to the population of herbivores over time?

RESOURCES

Literature on the Enemy Release Hypothesis

Keane, R.M. & M.J. Crawley (2002) Exotic plant invasions and the enemy release hypothesis. Trends in Ecology & Evolution, 17(4) 164-169.

Website to look up native and exotic plants in Michigan

http://plants.usda.gov/
http://www.wildflower.org/plants/
http://www.carsoncity.k12.mi.us/~hsstudent/wildflowers/index.html

EXTENSIONS & MODIFICATIONS

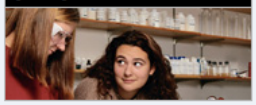
This project could be modified to include any plant species the teacher chose to use. Teachers can explore the habitats around their school and identify native and exotic species that occur together and might have comparable types of herbivore damage.

The Bioenergy Plots established at each school for the GK-12 program could also be used for this project. We will be planting in native prairie species into the high diversity plots, but exotic and invasive species will invariably enter the plots from the seed bank and surrounding habitats. Teachers could select species found in these plots to use in the study.

National Science Foundation
DIRECTORATE FOR
Education and Human Resources (EHR)

EHR Home | EHR Funding | EHR Awards | EHR Discoveries | EHR News | About EHR

Graduate Education (DGE)



NSF GRADUATE STEM FELLOWS IN K-12 EDUCATION (GK-12)

From the PROGRAM SOLICITATION

All fellows will spend a maximum of fifteen hours per week directly involved in GK-12 projects. {~half-time college TAship}

It is recommended that fellows spend ten of the fifteen hours in a physical location where learning takes place.

"a physical location where learning takes place" includes K-12 classrooms, schoolyard research plots, KBS workshops, institutes and discussion groups ...

This will allow us to
focus on "quality time" in the K-12 classroom,
(when teachers, students and fellows will all benefit)
supported by preparation, planning and development wherever that is best done.

Can we grow our fuel and our flowers and butterflies too?

Students and science teachers in K-12 Partner Districts are working with graduate students at the Kellogg Biological Station (KBS) to plant the seeds for the "BEST" BioEnergy SusTainability Schoolyard Research Network.

The network includes over 300 research plots at 22 schools in 12 districts in six counties in southwest Michigan.

The schoolyard research plots will mimic research at the KBS Long Term Ecological Research (LTER) site and Great Lakes Bioenergy Research Center (GLBRC).

KBS faculty, staff, and graduate students are collaborating with teachers on experimental design, research protocols, and curriculum development for the research network.

The experimental design involves three factors:

1. mixed prairie vs switchgrass
2. not fertilized vs fertilized
3. not harvested vs harvested

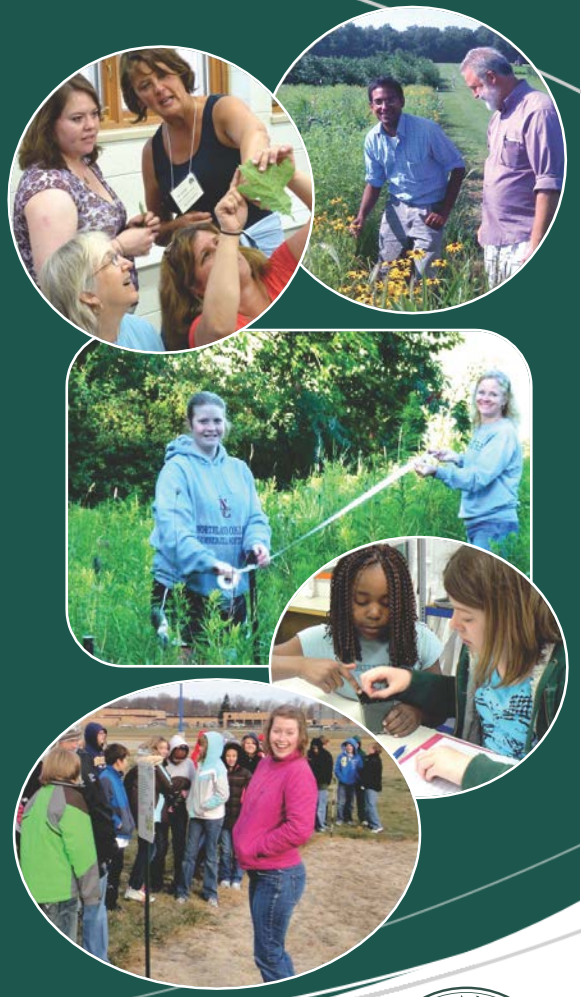
Over the next five years, and beyond, students will make observations and take measurements about the biodiversity, productivity, and soil quality on these plots to answer the question:

Can we grow our fuel and our flowers and butterflies too?

This GK-12 project is supported by the National Science Foundation Division of Graduate Education. (NSF DGE 0947896)

Fall 2010-G

GK-12 Bioenergy Sustainability Project



THE KBS GK-12 BIOENERGY SUSTAINABILITY PROJECT
W.K. KELLOGG BIOLOGICAL STATION
MICHIGAN STATE UNIVERSITY
HICKORY CORNERS, MI 49060-9516
PHONE: (269) 671-2354
EMAIL: kbsgk12project@kbs.msu.edu

GREAT LAKES BIOENERGY RESEARCH CENTER

NSF

MICHIGAN STATE UNIVERSITY Founded 1855

KBS LTER Kellogg Biological Station Long-term Ecological Research

From our proposal to the National Science Foundation (NSF)

We will create a collaborative research network of schoolyard science research sites that will

(a) serve as arenas for inquiry science activities that mimic aspects of GLBRC, LTER and fellows' thesis research, while addressing Michigan Science [standards] in Biology, Chemistry, Physics, Earth Science and Mathematics.

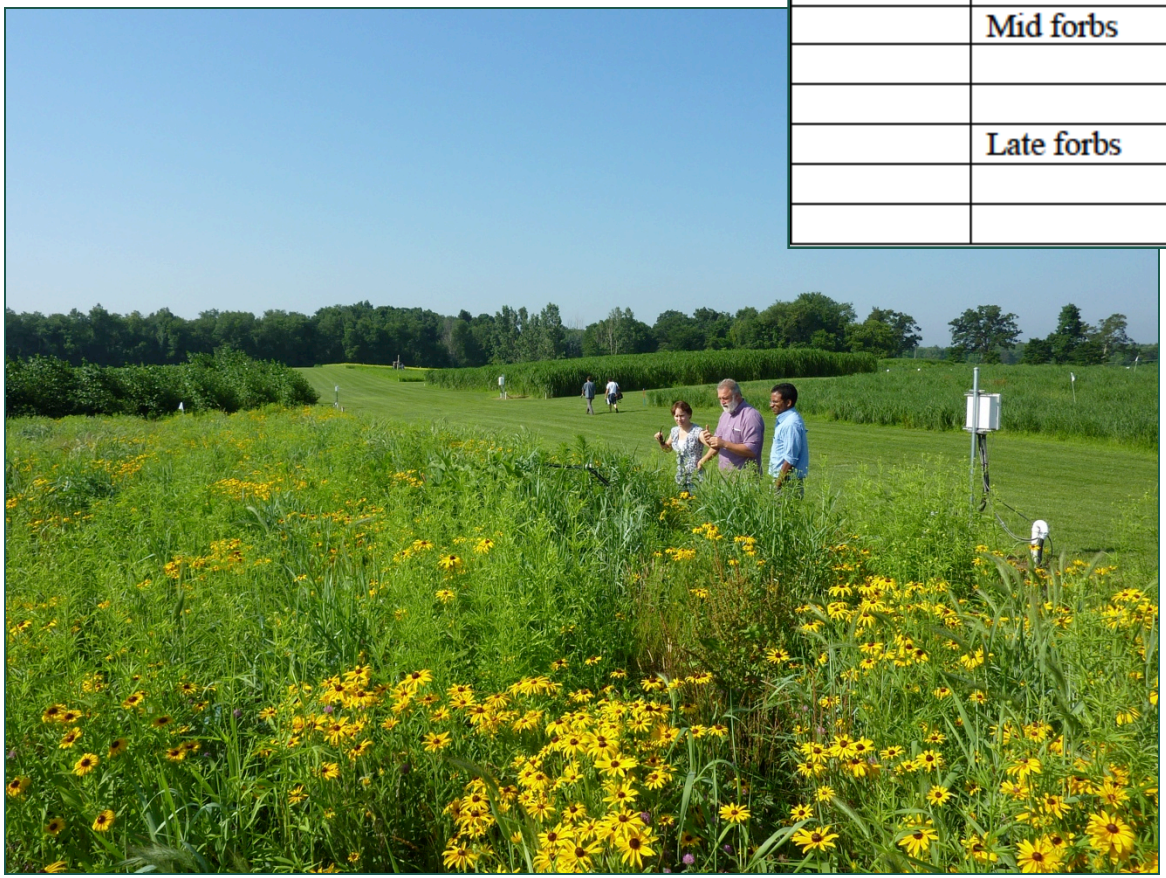
(b) allow K-12 classes to develop their own research initiatives,

(c) facilitate cross-district research collaboration, and

(d) encourage further interaction with GLBRC and LTER researchers and their K-12 partners across the national networks.

GREAT LAKES BIOENERGY RESEARCH CENTER

G10	Graminoids	*Panicum virgatum* (switchgrass;C4)
		Elymus canadensis (Canada wildrye; C3)
		Andropogon gerardii (big bluestem; C4)
		Schizachyrium scoparium (little bluestem; C4)
		Sorghastrum nutans (Indiangrass; C4)
		Koeleria cristata (prairie Junegrass; C3)
	Legumes	*Desmodium canadense* (showy ticktrefoil
		Lespedeza capitata Michx (roundhead lespedeza)
		Baptisia leucantha (white false indigo)
	Early forbs	*Rudbeckia hirta* (blackeyed Susan)
		Anemone canadensis (Canadian anemone)
		Asclepias tuberose (butterfly milkweed)
	Mid forbs	*Silphium perfoliatum* (cup plant)
		Monarda fistulosa (wild bergamot)
		Ratibida pinnata (pinnate prairie coneflower)
	Late forbs	*Solidago rigida* (rigid goldenrod)
		Solidago speciosa (showy goldenrod)
		Aster novae-angliae (New England aster)



Basic Research Protocols and Lesson Plans have been drafted; the 2011-2012 fellows will need to test, refine and embellish them.

Spring 2011

EARLY WEEDS

Introduction

Protocols

GK12 Bioenergy Sustainability Project

The BeSt schoolyard Bioenergy Sustainability Experiment

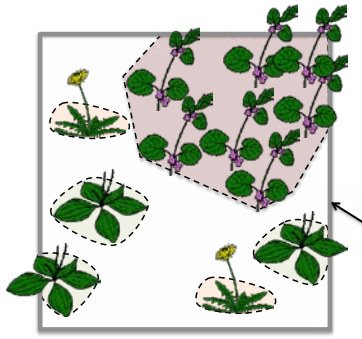
Early Weeds Protocol

To establish our BEST Schoolyard Research Plots, we began by imposing an intense disturbance: we used a chemical to kill the established plant community. Then we scattered mixed prairie or switchgrass seeds across the plots. In spring, you may have noticed many plants beginning to grow in the plots. While some may be from the seeds we planted, many are likely to be **weeds**.

In this protocol we will

(1) sample the weeds in our BEST plots,
(2) identify the three most common ("dominant") weeds in each plot,
(3) compare the dominant weeds in each block of plots to the "source pool" of plants in the local surrounding landscape, and
(4) examine the extent to which we can explain differences in the dominant weeds across districts and blocks by knowing differences in the dominant weeds in the different local landscapes.
(*) Later, you might want to see if there are relationships across the research network between soil quality and the dominant weed community.

Background information

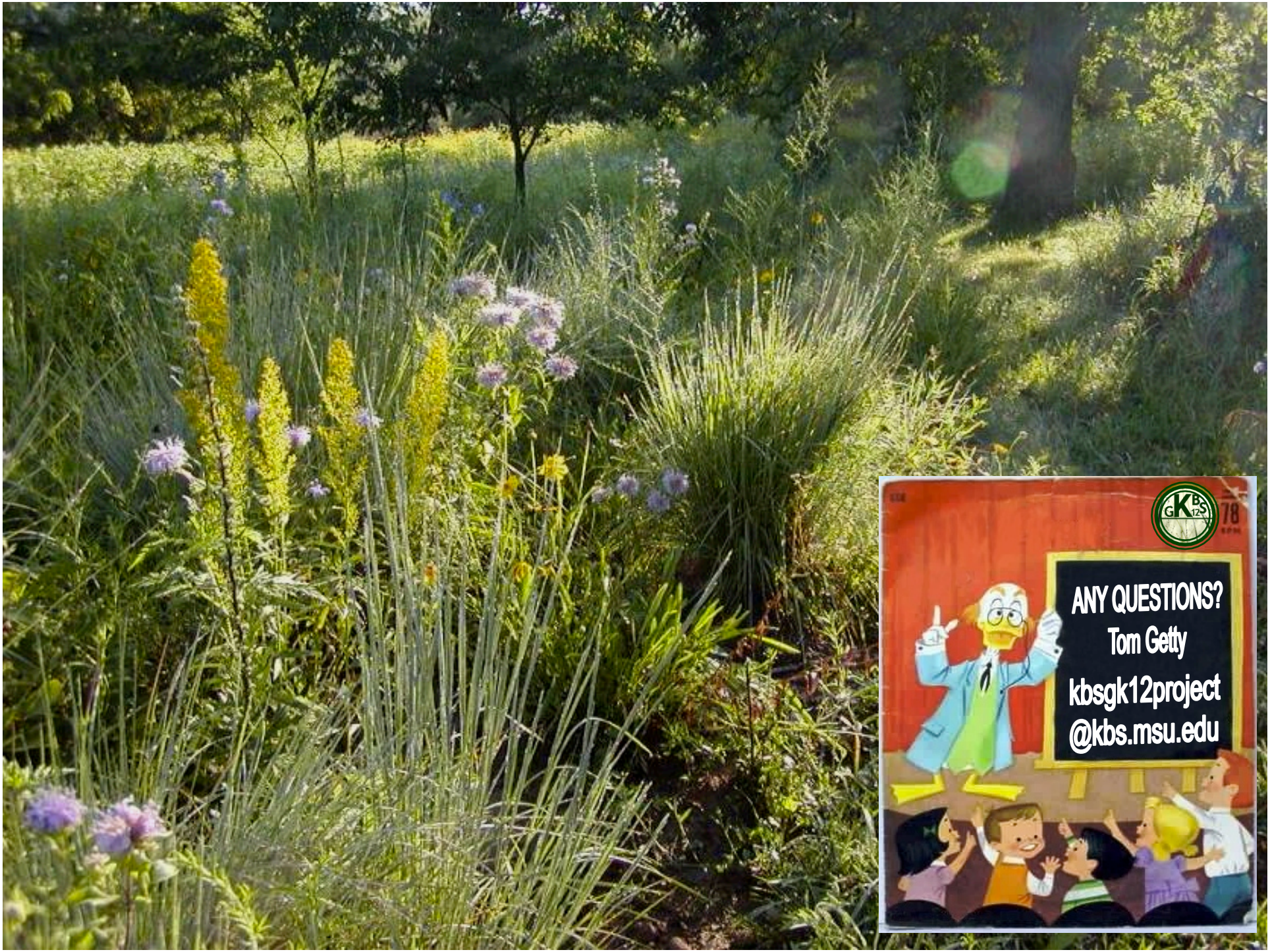


0.5x0.5m quadrat randomly placed in plot

Cover Class	Percent Cover
1	1-5%
2	5⁺-25%
3	25⁺-50%
4	50⁺-75%
5	75⁺-100%

Generic HS, block 2, layout 6 (GHS2(6)), plot treatment: Prairie-Fertilized-notHarvested (PF-)

Weed species	% Cover	Cover Class
A (ground ivy)	25⁺-50%	3
B((plaintain)	5⁺-25%	2
C (dandylion)	1-5%	1


ANY QUESTIONS?
Tom Getty
kbsgk12project
@kbs.msu.edu