K-12 Education

Outreach and Support

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Education & outreach roadmap

- **Research**
- **Synthesis**
- **Outreach & Education**
- **Outcomes**

**Ecosystem Services**
- Biogeochemical
- Biodiversity
- Socio-economic

**Modeling**
- Biophysical
- Socio-economic
- Alternative futures

**Engage and Teach**
- Environmental literacy
  - K-12 students, teachers, & administrators

**Dialogue**
- Undergraduate and graduate students
  - Active citizens, e.g.:
    - Farmers
    - Land managers
    - Ag professionals
    - Media
    - Policy makers

**Listen and Respond**
- Relevant and expanded research and outreach

**Regional & national policies**
- Improved delivery of ecosystem services
- Improved citizen decision-making
- Farm & landscape design
What I’ll Talk About

1. KBS K-12 Partnership
2. GK-12 Bioenergy Sustainability Project
3. Science education research and development: Math-science Partnership and Carbon TIME projects
4. Future directions
Environmental Science Literacy

The capacity to understand and participate in evidence-based decision-making about socio-ecological systems.
KBS K-12 Partnership
The Partnership

• Serves teachers in 14 rural Southwest Michigan School Districts
• Has been in operation since 1999
• Is the primary use of sLTER funds
• Has leveraged other grants that support Partnership activities (Teacher enhancement, GK-12, MSP, DRK-12)
Attendance at Summer Institutes and Workshops

K-12 Partnership Teacher Attendance

Number of Teachers

- Summer Institute
- Fall 1
- Fall 2
- Spring 1
- Spring 2

Color codes:
- Blue: 2012-2013
- Red: Average 2006-2012
Website and Newsletters

http://www.kbs.msu.edu/community-outreach/k-12-partnership

http://kbsgk12project.kbs.msu.edu/newsletters/
Institute and Workshop Activities

- Plenary speakers
- Concurrent sessions
- District planning
Effects on Schools

• Connie High, Teacher, Delton-Kellogg Schools: “It is nice to see KBS help us be more proactive than just getting our activities into the classroom, but helping us work with our students to see the value of explaining and effectively communicating data and supporting it with evidence. THANK YOU, THANK YOU, THANK YOU for this great opportunity.”

• Sue Wakefield, Superintendent, Plainwell Community Schools: ”This is such an awesome program and it certainly a key component to our success in science.”
GK-12 Bioenergy Sustainability Project:  
[http://kbsgk12project.kbs.msu.edu](http://kbsgk12project.kbs.msu.edu/)

Tom Getty  
Principal Investigator

Sarah Bodbyl  
Project Director
2012-13 GK-12 and BEACON Fellows
Fellows Working in Schools
BEST Plots: 38 Sites at Partnership Schools
Can we grow our fuel and our flowers and butterflies too?

Dependent variables include: plant biomass  plant diversity  invertebrate diversity

Independent variables include:

- Fast effects
- Slow effects

- seed, harvest & fertilizer treatment effects within blocks
- block effects between blocks within a schoolyard/location
- soil & landscape effects across locations
Creating BEST Plots
BEST Plot Protocols

• Introductory materials
• Fertilization
• Biomass and biodiversity
• Landscape
• Soils
• Best plots lesson plans
Data Nuggets

- Developed by GK-12 Fellows
- Based on fellow and LTER research
- Students interpret quantitative information and make claims based on evidence
- Adapted to reading and graphing skill levels

**Does plant diversity promote more invertebrate diversity?**

Everyday we consume a large amount of energy to drive our cars, to heat or cool our homes, and to use electronic devices. Most of this energy is produced by burning fossil fuels. However, burning fossil fuels releases carbon dioxide, the number one greenhouse gas contributing to climate change. Scientists are trying to figure out alternative ways to produce energy. For example, biofuel is a type of a fuel produced from plant matter. Using plants as fuel can help reduce human impact on climate change because plants take up carbon dioxide as they grow. Plants do release carbon dioxide...
Math-Science Partnership: Pathways to Environmental Science Literacy

Sara Syswerda, KBS Project Manager

Jennifer Doherty, Senior Researcher
Organizational Framework

LTER Sites:
- BES
- KBS
- SBC
- SGS

Participants:
- Researchers
- Postdocs
- Graduate Students
- Undergrads
- RETs & TIRs

Research Strands

- Professional Development
- Citizenship, Culture & Place and QR

Professional Development

Citizenship, Culture & Place and QR

Biodiversity
- Citizenship
- Quantitative Reasoning
- Culture and Place
- PD

Carbon

Water
Strands of Environmental Science Literacy

- **Carbon.** Carbon-transforming processes in socio-ecological systems at multiple scales, including cellular and organismal metabolism, ecosystem energetics and carbon cycling, carbon sequestration, and combustion of fossil fuels.

- **Water.** The role of water and substances carried by water in earth, living, and engineered systems, including the atmosphere, surface water and ice, ground water, human water systems, and water in living systems.

- **Biodiversity.** The diversity of living systems, including variability among individuals in population, evolutionary changes in populations, diversity in natural ecosystems and in human systems that produce food, fiber, and wood.
Learning Progressions

“Learning progressions are descriptions of the successively more sophisticated ways of thinking about a topic that can follow one another as students learn about and investigate a topic over a broad span of time.” (NRC, *Taking Science to School*, 2007)
Scientific Account of Carbon Cycling and Energy Flow

Matter: CO₂, H₂O, and minerals

Photosynthesis

Energy: Sunlight

Matter: Organic matter & O₂

Biosynthesis, digestion, food webs, fossil fuel formation

Energy: Chemical potential energy

Movement of CO₂, H₂O, and minerals

Combustion, cellular respiration

Energy: Work & heat
Learners’ Accounts “Matter and Energy Cycles”

- This is really about actors and their actions.
- People are the main actors, then animals, then plants
- Everything else is there to meet the needs of actors
Carbon TIME

Jenny Dauer
Project Director
Carbon TIME Curriculum

Systems and Scale
Teacher’s Guide

How our systems depend on Carbon and chemical energy: Finding chemical change in life and lifestyles

Plants and the Carbon Cycle

How seeds grow to trees and plants transform Carbon

Animals and the Carbon Cycle

How animals use and change Carbon and chemical energy

Combustion

Photosynthesis
Biosynthesis
Cellular respiration

Digestion
Biosynthesis
Cellular respiration
# Carbon TIME Curriculum

## Decomposers and the Carbon Cycle
- **How decomposition changes**
- **Carbon** and chemical energy

## Ecosystems Teacher Guide
- **How ecosystems store**
- **Carbon** and chemical energy

## Human Energy Systems Teacher's Guide
- **How humans use chemical energy**
- **stored in Carbon bonds**

## Processes
- **Decomposition**
- **Biosynthesis**
- **Cellular respiration**
- **All processes except combustion in ecosystems**
- **Combustion of fossil fuels for energy**
Lesson 1: Pretest and Discussion on Burning Ethanol

What happens to ethanol when it burns?

Lesson Overview

Students complete the unit pretest, observe a demonstration of ethanol burning, and discuss their initial ideas about what is happening to the ethanol as it burns.
Recent Education Research Publications

A Framework for K-12 Science Education (NRC Report)

Learning progressions content based on KBS Partnership research
Looking Toward the Future

- MSP project concluding
- Continuing work funded by sLTER, GK-12, Carbon TIME
- Responding to *Next Generation Science Standards*
- Commitment to continuing KBS K-12 Partnership