UD's GK-12 Project: Improvement of science education in vocational technical high schools through collaborative learning and coteaching

Katie Skalak

GK-12 fellow

GK-12 Project Leaders

George Watson

Physics

Kate Scantlebury

Chemistry

Amy Quillen

NCCVT

Deborah Allen

Biology

John Madsen

Geology

Richard Donham

MSERC, Biology

2006 GK-12 Fellows

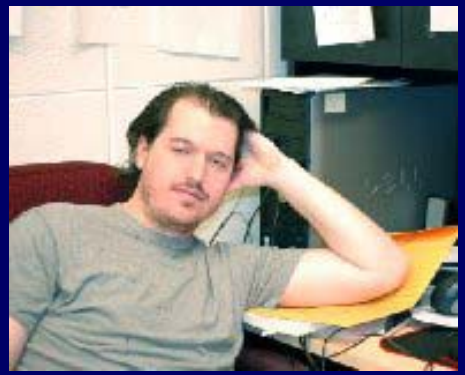
2007 GK-12 Fellows

Mary Boggs
Biology

Tom Ekiart
Physics

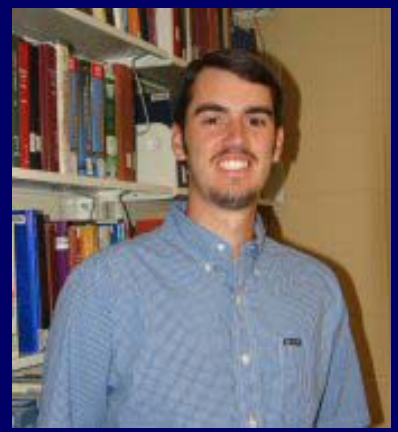
Erin Foster
Biology

Kristy Longsdorf
Biochemistry



John Meyer
Physics

Nate
Nazdrowicz
Entymology



Chris Russell
Physics

Jeff Spraggins
Biochemistry

2006 Teachers

Dr. Ralph May
Department Chair
Chemistry &
Integrated Science

Mrs. Ingrid Anderson
Biology
& Physical Science

Mrs. Carol Buswell
Integrated Science
& Physical Science

Mr. Mike Kittle
Biology &
Physical Science

Mr. Ronney Bythwood
Physics
& Physical Science

Mrs. Sharon Horrocks
Special Education Science

Mr. Brian Gross
Biology

Mr. Brian Heeney
Biology

2007 Teachers

Mr. Dan Hailey
Department Chair
Physics &
Physical Science

Mr. Kevin Madigan
Integrated Science& Physical Science

Mrs. Elizabeth Nowak
Integrated Science

Ms. Tara Saladyga
Physical Science

Mr. Brian Gross
Biology

Mrs. Phyllis Meyer
Biology

Ms. Krista Webb
Physical Science

Mr. Brian Heeney
Biology

Purpose

- Through this experience, graduate students can gain a deeper understanding of their own STEM research.

- In addition, the GK-12 program provides institutions of higher education with an opportunity to make a permanent change in their graduate programs by incorporating GK-12 like activities in the training of their STEM graduate students.

Anticipated Outcomes

Fellows:

- **communication,**
- **teaching,**
- **collaboration**
- **team building skills**

- **Teachers: professional development opportunities**
- **Students: enriched learning**
- **Strengthened and sustained partnerships in STEM between institutions of higher education and local school districts.**

NSF GK-12

- The program has been in operation for 9 years
- Funds approximately 600-900 fellows/year
- Throughout its history has worked with
  1. more than 6,000 graduate students
  2. over 8,000 teachers
  3. and more than 550,000 students

Delaware GK-12 Grant

- $1.7 million over three years
- Funding up to nine UD graduate students
- Paired with high school science teachers in NCCVT district
- To create a learning community of teaching teams to examine and reflect on current issues in education while addressing critical needs in science education in vocational technical high schools.

Fast Facts about NCCVT District

- Number of Schools: 4
- Student Enrollment: 3,386 (49% female; 39% minority)
- % of Special Education Students: 14.8%
- Average Daily Attendance: 95.3% (State = 92.6%)
- Graduation Rate: 96.1% * (State = 83%)

- *All students at NCCVT take the full academic requirement needed to meet the requirements for a high school diploma.*

- *Students who meet the criteria also earn career program of study certificates.*

CAREER PROGRAMS OF STUDY

BUSINESS, COMMUNICATION, AND COMPUTERS CLUSTER

Academy of Finance

Business Software Applications

Business Technology

Computer Network Administration

Digital Media

Graphic Arts

Retail Careers Technology

Web and Print Technology

CONSTRUCTION CLUSTER

Carpentry

Electrical Trades

General Construction

Heating, Ventilation, and Air Conditioning

Industrial Mechanics/Millwright Technology

Masonry

Plumbing

Sheet Metal Fabrication

Welding/Fabrication Technologies

CAREER PROGRAMS OF STUDY

HEALTH SERVICES CLUSTER

Dental Assisting

Dental Lab Technology

Emergency Medical Services

Medical Assisting

Nursing Technology

Physical Therapy Services

Practical Nursing

PUBLIC & CONSUMER SERVICES CLUSTER

Cosmetology

Culinary Arts

Early Childhood Education

Legal Administrative Assistant

Production and Imaging Technology

Public Service

CAREER PROGRAMS OF STUDY

SCIENCE, ENERGY AND DRAFTING TECHNOLOGIES CLUSTER

Academy of Manufacturing and Pre-Engineering

Biotechnology

Chemical Lab Technology

Electronics

Environmental Landscaping

Technology

Power Plant Technology

Technical Drafting

TRANSPORTATION CLUSTER

Auto Body

Auto Technology

Aviation Technology

Engine Technology

Career Areas at Howard High School

- Academy of Finance
- Carpentry
- Computer Network Administration
- Cosmetology
- Culinary Arts
- Dental Assistant
- Electrical Trades
- Nurse Technicians
- Public Service

Delaware GK-12 Activities

- In summer workshops, teaching teams are introduced to a number of innovative teaching strategies, including problem-based learning (PBL).
- During the academic year, Fellows engage in coteaching with their teacher partners.
- Fellows gain a better understanding and appreciation of the complexities and nuances of teaching science in high school.
- Teaching teams have the opportunity to develop PBL activities, aligned with curricular needs, for students to experience the benefits of guided-inquiry learning environments.

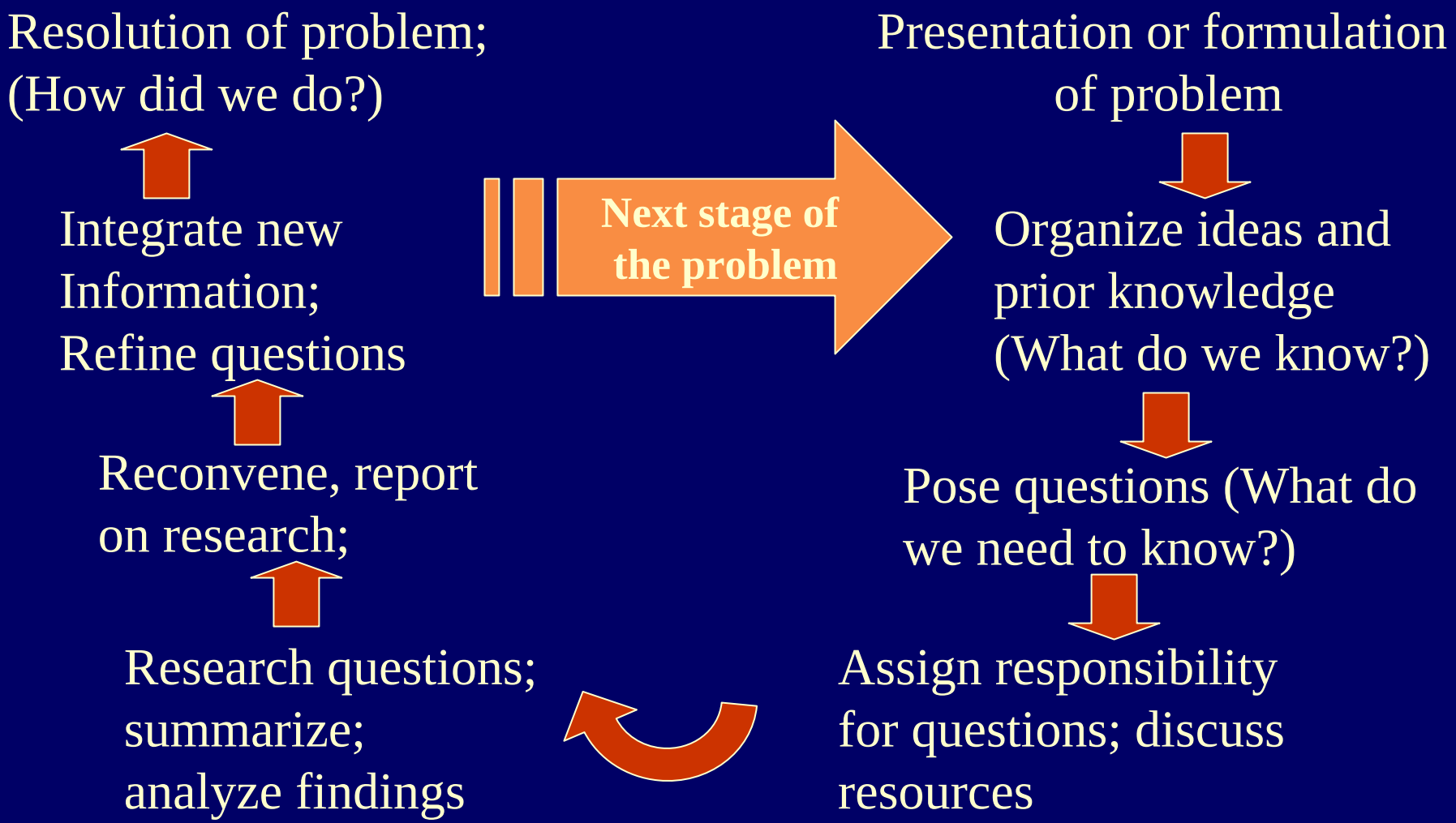
What is Coteaching?

- Teaching at the elbow of the other, with multiple teachers
- Focus on learning of ALL students
- Supportive environment for analyzing and critiquing practice
- Opportunity to learn aspects of teaching that are not easily verbalized
- Link between theory and practice

What are the Common Features of PBL?

- Learning initiated by a problem.
- Problems based on complex, real-world situations with no single ‘right’ answer.
- All information needed to solve problem is not given initially - students identify, find, and use appropriate resources.
- Students work in permanent groups.
- Students gain new information through self-directed learning.
- Instructors act as facilitators and designers of learning experiences and opportunities.

PBL: The Process



Effective PBL Activities…

- Relate to real world, motivate students
- Require decision-making and analysis
- Are designed for group-solving
- Pose open-ended questions that encourage discussion
- Incorporate course content objectives
- Provide opportunities to develop thinking, communication, research, and other skills
- Connect to students' prior knowledge and understandings (and extend them)

We Use PBL to:

- Motivate learning by connecting science course content to real world situations
- Assess content understanding to inform future instruction
- Foster development of reasoning, communication, information retrieval, and team-building skills

My role as a GK-12 fellow

- 2006 – coteaching with Carol Buswell in Physical Science and Integrated Science
- 2007 – lesson study and data collection at Howard High School
- Other fellows engage in coteaching at Delcastle

2006 Goals

- Incorporate actual research into the classroom setting
- Higher level transfer through problem-based learning strategies
- Targeting these activities to the DE state standards

General Activities

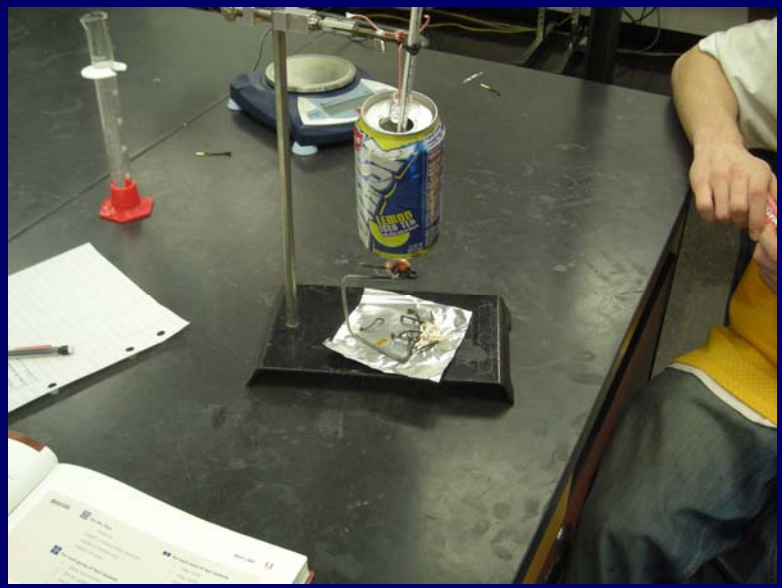
- More labs, hands-on activities, demonstrations, presentations

- Transfer tasks:
  1. Inquiry
  2. Material Separation lab
  3. Plate tectonics
  4. Astronomy Museum exhibit
  5. Ecology: Hg contamination

- Journaling

Newton’s 1st Law

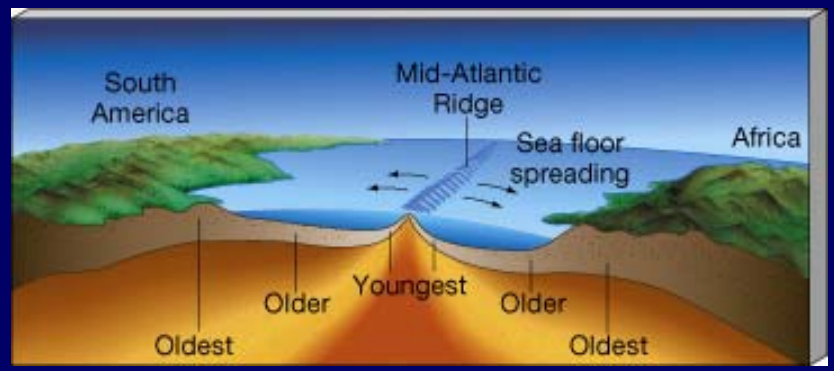
Newton's 3rd law



Comparing Energy Sources

Presentations

- Fundamentals of geology and plate tectonics



- Rapa Nui as a model for resource exploitation and ecological disaster

Transfer Tasks: *Inquiry*

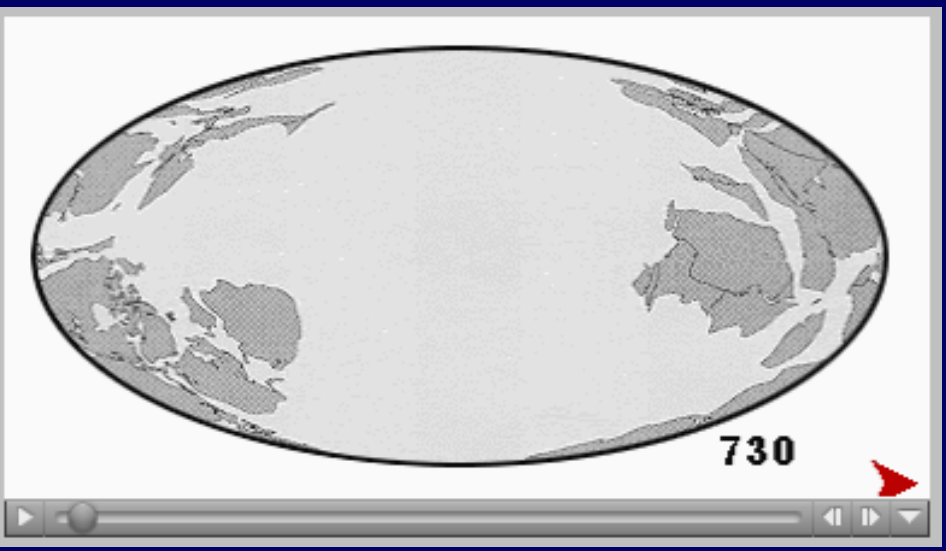
Goals:

- Devise an experiment that will test the effects of salt on temperature
- Write their own procedure, materials, etc.

Transfer Tasks:
Material Separation

- Student put in role of coastal geologist
- Must separate a “contaminated mixture” into components
- Student devise their own materials and methods

Plate tectonics



Quicktime animation with guided questions

Transfer Tasks: *Astronomy exhibit*

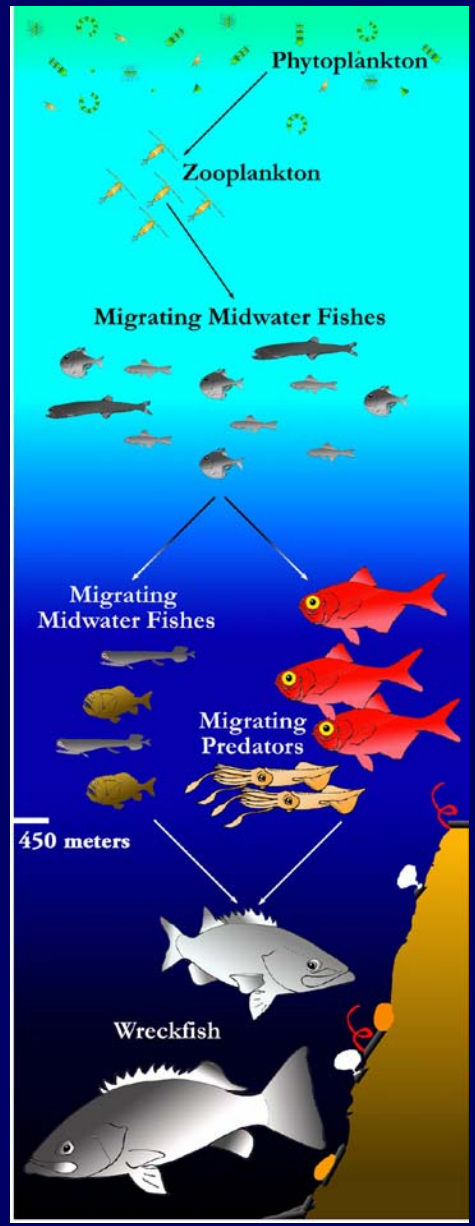
Goals:

- Understand basic astronomy principles
- Assessed on: ability to work in groups, understanding of principles, creativity, thoughtfulness
- Peer assessment

Transfer tasks:

Food webs and Hg cycling

- Scenario: Hg contamination of a recreational water source
- Food webs, conservation of mass, human impact, water as a resource
- Various roles for students to select:
  1. Doctor
  2. Citizen
  3. Scientist
  4. Environmentalist
  5. Industry employee
  6. Mayor
- Town hall meeting, concept map



Hg in the environment

- Students are initially presented with a medical mystery
- Presented with Hg contamination problem, select a role
- Facilitated by presentations and guided research
- Present findings, engage in debate
- Lanscape concept map of water cycle, food webs, bioaccumulation, and human impact

Journaling

- Organized, focused journaling
- Prompt assessment
- Emphasizing critical thinking and writing skills
- Provides students with an opportunity to reflect (self-assessment)

Lesson Study

Lesson study is a Japanese approach to instructional improvement. It is a cycle in which teachers work together

1. To consider their long-term goals for students,
2. Bring those goals to life in research lessons,
3. Conduct the lesson (with one team member teaching and others gathering evidence on student learning and development)
4. Collaboratively observe, discuss, and refine the lessons.
5. Teach the revised lesson in another classroom to study and improve it again.

Lesson Study Steps

1. Form a lesson study group
   - Members, schedule, ground rules
2. Focus the lesson study
   - Theme, subject area, unit
3. Plan the research lesson
   - Long-term goals, data collection plan
4. Teach and observe the lesson
5. Discuss and analyze the lesson
   - Focused discussion on data, revisions
6. Reflect and plan
   - Re-teach the lesson

Data collection

- Focus on the classroom as research opportunity
- Collect data on student understanding, misconceptions
- Formative assessment probes to address misconceptions
- Videotaping lessons, journaling, blogging, interviews
- Summary report to teachers
- Publication?

Reflections on GK-12 experience

- Communicate science
- Understand how students learn
- Work with experienced educators
- Engage and motivate high school students
- Learn and implement effective teaching strategies

Future of GK-12

1. Continued focus on graduate students with STEM research
2. Continue regional meetings
3. Disseminating information through partnerships and workshops (also websites).
4. Fellows activities – integrating research into the classroom.
5. International component to projects

Acknowledgments

The students

The GK-12 project leaders

George Watson, Kate Scantlebury, John Madsen, Deborah Allen, Richard Donham, Amy Quillen

NSF for funding

Howard High school teachers

Carol Buswell

Delcastle High school teachers

2006 and 2007 GK-12 fellows

Research advisor: Jim Pizzuto