# Dr. Daniel King

Chemical Education

Using technology and climate change topics to improve student learning in general chemistry

## **Chemical Education**

#### Practice

 development and/or implementation of teaching strategies

#### • Research

- assessment of effectiveness of teaching strategies
- use of teaching strategies or assessment to answer research questions



## **Research Topics**

- incorporating environmental data into curriculum
- assessment of effectiveness of active learning techniques and technology
  - clickers/gender studies/etc.
  - online vs. in-person resources
- real-world, in-class demonstrations/activities
- relationship between course resource usage and student attitudes towards science

### Climate Change Concepts and POGIL

• NSF TUES DUE-1044344



- creation of in-class POGIL activities that use climate change context to teach general chemistry topics
- investigation of student conversations during group activities
- 5-member authoring team
- 8 institutions involved



## What is POGIL?

Process Oriented (cooperative learning): conscious commitment to development of important process skills

Guided Inquiry (constructivism): learning cycle activities

Process Oriented Guided Inquiry Learning Learning Cycle (Karplus, Piaget)



- Parallels the "scientific process"
- Provides context for introduction of new terms
- Explicitly provides opportunities for critical thinking

•Karplus, K. & Thier., H.D. (1967). *A New Look at Elementary School Science.* Chicago: Rand McNally and Co.

•Piaget, J. (1964). Part I: Cognitive development in children: Piaget development and learning. *J. Res. Sci. Teach.*, *2*, 176-186.



#### **POGIL** activities

- logistics
  - groups of 3 or 4 students
  - assigned roles
    - e.g., manager, presenter, recorder, reflector
    - rotate roles each class/week
  - full class period (50 minutes)

#### advantages

- students actively engaged
- students learn from each other
- all students participate/present to class
- increased comprehension



# Sample Activity

**Chemistry Content** 

• phase diagram

Climate Change Context

• carbon sequestration

#### Sample model – Phase Diagram



- What are the four phases of  $CO_2$  shown on the phase diagram?
- If a sample of CO<sub>2</sub> is held at a constant pressure of 10 atm and the temperature is increased from -57°C to 31°C, what phase change(s) would be observed?
- In what phase would you expect the majority of a sample of CO<sub>2</sub> to exist if it were at a temperature of 35°C and a pressure of 80 atm?

#### Sample model – Phase Diagram



- What is the pressure (in MPa) at a depth of 250 m? at a depth of 800 m?
- In what phase would you expect to find carbon dioxide at a depth of 250 m? at a depth of 800 m?
- Propose an explanation for why carbon sequestration would be more effective at 800 m than at 250 m.



- Identify all of the locations in which carbon sequestration could be done.
- What information other than aquifer depth could you use to determine if a location is appropriate for carbon sequestration?
- Choose one location, and identify 2 pieces of information about that location you would want to know before you voted to allow a company to sequester carbon there.

#### Sample model – Phase Diagram

	Maryland/Delaware	New Mexico	Texas
unemployment rates	6.7%	6.2%	6.2%
(November 2012)			
average home value (2012)	\$333,200	\$211,900	\$169,300
farm real estate value (per acre) (2012)	\$7600	\$560	\$1,800
population density (inhabitants per square mile) (2011)	530	17	98

 Each member of the group should use the data presented to identify which location is the best choice for the construction of a carbon sequestration plant.

# Potential project

- Assessment of effectiveness of technology
  - Does the use of clickers increase student learning?
  - How does "flipping the classroom" impact student learning?
  - Is there specific content that technology benefits?
  - Are there differences in the use/effectiveness of technology based on gender/major/etc.?
- Student work:
  - spreadsheet calculations
  - error analysis



# Potential project

- Hands-On, Everyday Chemistry Experiments
  - funded by Camille & Henry Dreyfus Foundation
  - in-class, small group activities
  - related to everyday phenomena
  - Do these activities impact attitudes towards science?
- Student work:
  - development of new activities
  - spreadsheet calculations
  - survey analysis



## Questions?