

# Teaching Scientific Methods Through Civic Engagement (*and vice versa*)

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SENCER Summer Institute  
August 8, 2009

## Topics

- Introduction
  - Institutional context
  - Approaches to service-learning and civic engagement
  
- Biology 113 - *The Nature of Science*
  - Course Objectives and Design
  - Sample Activities
  - Evaluation and Assessment
  
- Group Activities
  - Experimental design
  - Identifying topics for your courses
  - Designing curriculum elements



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## Institutional context – Who we are

- Private, urban, primarily undergraduate institution
- Campuses in downtown Chicago and suburban Schaumburg, Illinois
- 7,500 students: 45% minority, 63% female, and >50% adults
- Growing number of traditional-aged undergraduates
- Ranked 10<sup>th</sup> in diversity among 4-yr institutions in US
- Many students work part- or full-time to support themselves
- Many are the first members of their families to attend college
- Many transfer to Roosevelt from City Colleges of Chicago and suburban community colleges



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## Departmental context – What we do

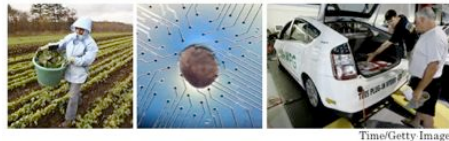
- Biology, Chemistry, Allied Health undergraduate majors
- Biotechnology and Chemical Science MS program
- Active and engaged faculty
  - research in discipline
  - scholarship of teaching and learning
  - 12-member SENCER team (!)



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## Social justice in the biology classroom

- Social justice is a defining characteristic of Roosevelt education
- Recognized need to explicitly bridge science course content to societal and public policy issues
- Goals
  - Improve student learning, interest and retention in science and mathematics courses
  - Increase science and math majors' sense of civic engagement and appreciation of the social relevance of science



Time/Getty Images



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## Renewing the biology curriculum

- Target specific “core” courses and develop new courses
- Encourage faculty to create their own transformational experiences as appropriate for their courses
- Move toward collaborative, department- and university-wide implementation
- Support from
  - SENCER
    - NSF/NCSCE sub-awards
    - Fellowships
  - Mansfield Institute for Social Justice and Transformation
    - McCormick-Tribune Foundation service-learning grants
    - Service-learning resources



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## Biology 113 – *The Nature of Science*

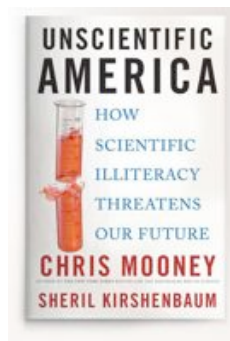
- 3 credit hour (no lab) course for general education
- Offered in online format and on two campuses
- Two instructors, three offerings through Spring 2009
- Open framework for content and pedagogy development by individual instructors
  
- Course objectives focused on student learning outcomes
  - Equip students to be savvy consumers of information on sci/tech
  - Recognize local/global impacts of advances in sci/tech
  - Become thoughtful contributors to the conversation on the role of science in society



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## Science as Human Endeavor

- Description of role of *scientists* in society
- Understand scientific process as well as product
- Students need to leave classroom with understanding of “who”, “how” and “why” of science, not just a small sliver of “what”



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## Biology 113 course activities

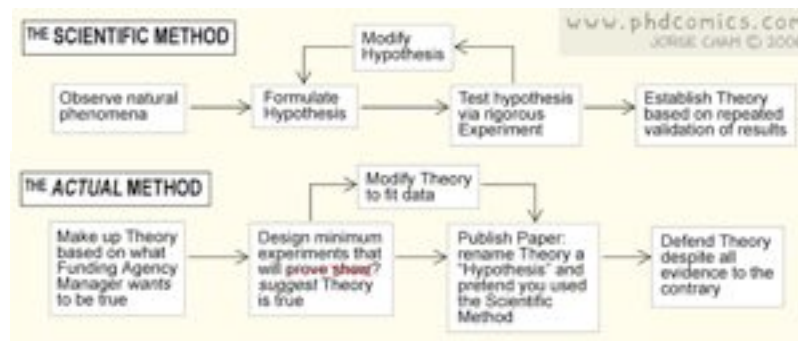
- Text, lecture and discussion on philosophy and practice of science
- Extensive use of online resources
  - Publicly available journal articles (1° source)
  - Science blogs and news sites, newspapers (2° source)
  - Wikipedia and other encyclopedias (3° source)
  - Blackboard learning system (content management)
- Analysis of scientific findings as presented in multiple formats
- Outside speakers
- Student-led discussions of current topics in sci/tech
- Disciplinary service learning through the Science Engagement Project



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## Course design part 1: Teaching Scientific Method

- observation, explanation, hypothesis, prediction, experimental test, revisit hypothesis



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## Course design part 1: Teaching Scientific Method

- Example – The Walking Robot
- Observation
- “Why?” question
- Explanations
- Hypothesis/Prediction
- Experimental Test
- Evaluation of hypothesis



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## Course design part 2: Current Topics discussions

- Textbook readings and end-of-chapter examples
- Science news discussions throughout semester
- Analyze “real data” from research studies
- Case studies, in-depth topics at end of semester
  - Summary/overview by instructor
  - Students identify information sources, answer questions and evaluate information



ISBN-13: 978-0534584504



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## Course design part 2: Current Topics discussions

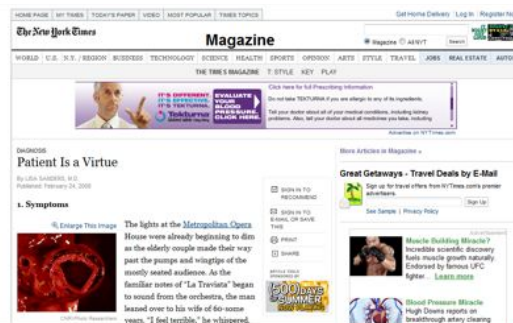
- Examples – alternative fuels, global climate instability, autism/ vaccination link, [Penta water](#)
- News article and the scientific process



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Using this article from NYT magazine  
Students.....

- 1) Examined it for explanations
- 2) Identified null hypothesis and potential alternatives
- 3) Identified diagnosis in steps (what were the lines of evidence and symptoms and did they support any of the hypotheses)
- 4) Explored how many instruments and/or experts were used in the final diagnosis and treatment (reflect on inter-disciplinary actions)
- 5) Science and literacy



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## Course design Part 3: Science Engagement Project

- Students carry out individualized, community-based scientific inquiry projects
  - Gain experience with experimental design and data interpretation
  - Appreciate connections between research and impacts on health and well-being
  - Report incorporates “reflective piece” as discussion part of scientific paper
- “Community” defined by students as a population that can benefit from or be informed by their scientific inquiry
- Semester-long project involves review of topic, formation of hypothesis, investigation, analysis and presentation of results



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## Course design Part 3: Science Engagement Project

- Sample projects
  - STD awareness and education in a Hispanic neighborhood
  - Gas prices and driving habits
  - Survey of parental attitudes about school “healthy food” programs



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# Skin Bleaching Phenomenon in Jamaica: The Perceived Opinions of Skin Bleaching by the Opposite Sex

Whitney Browning  
Roosevelt University  
Biology 113  
April 30, 2009



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## Hypothesis

- There is a difference between the ratio of answers given by men and women on the reasons why they think the opposite sex bleaches their skin.



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## Skin Bleaching

- Skin Bleaching- The use of bleaching products to alter the normal color/state of the skin.
- Has become more prevalent over the years
- Causes Cancer



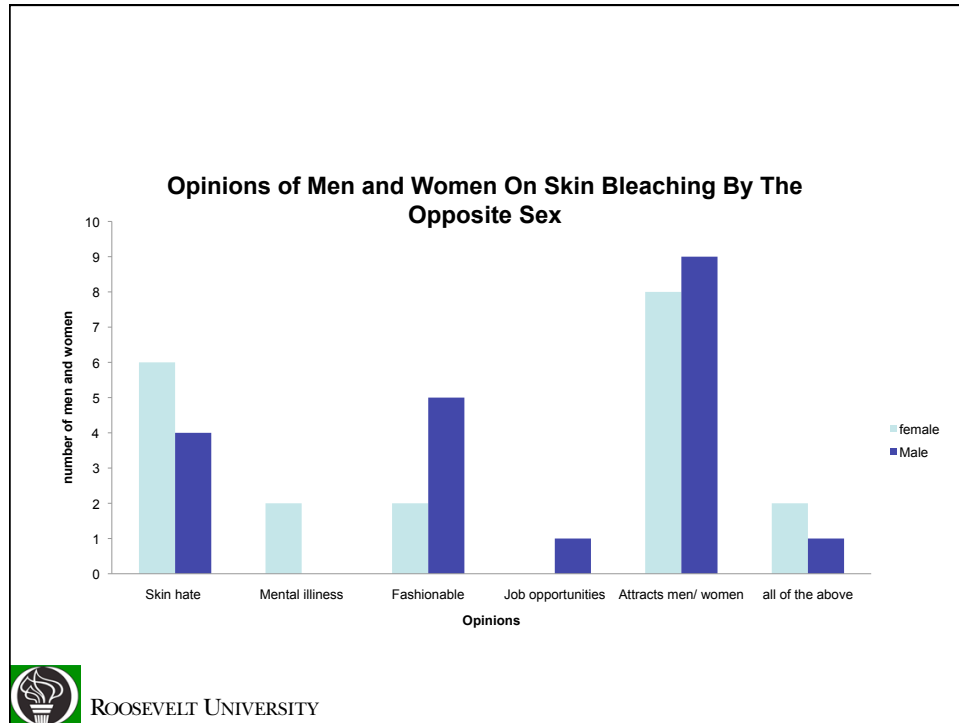
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## Materials and Methods

- Four Question Survey
- Facebook
- Jamaicans, ages ranged from 14 - 50



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## Results

- Because chi-square calculated (.4) is less than chi-square critical (at alpha 0.05, 3.84) we fail to reject our null hypothesis and conclude that there is no significant difference in the distribution of answers given by males and females for their reason why they think the opposite sex bleaches their skin.
- Chi square calculated (27.78) is greater than chi square critical (at alpha 0.05, 11.07), we conclude that there is a significant difference between the options chosen by males and females. The main factor was the attraction of males and females.

## Conclusion

- More questions added to survey.
- Educational skin care programs in school for younger children and teens.



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## Keith Hunter's transportation study

### CRUNCH TIME

In Seiser's class, The Nature of Science, sociology major Keith Hunter (right) was required to design an experiment involving his community. Hunter, who lives in Chicago's Uptown neighborhood,



tested four different means of transportation – bus, car, "L" and taxi – that he took between his home and Roosevelt University.

Hunter used a stopwatch on each of his rides and took notes on everything from cost delays, the comfort level involved, weather and the time his commute took before ranking his travel modes.



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## Keith Hunter's transportation study

While the bus and "L" cost him the same amount, Hunter deemed the "L" to be a better option because delays on it stretched no longer than 10 minutes. As a bus passenger, he experienced delays at times of a half-hour or more. He also found that the bus had tighter quarters than the "L," increasing his chances of catching a cold or the flu, a factor he rated important in light of his busy schedule.

While he had to deal with traffic delays from the comfort of his car, his driving delays weren't nearly as time-consuming as being stuck in traffic on the bus. "I might as well be in the car," he concluded, "because at least I could dodge traffic and cut down sometimes by half the travel time it was taking me on the bus." However, Hunter found that driving, with parking and gas, cost him nearly five times more than public-transit commuting.

"This experiment really got me thinking about how much I was spending for gas and to park," said Hunter, who has kept driving to a minimum ever since. What surprised him most, though, was his experience with taxis, which he rated the least efficient of all. "Being an African American and trying to get a taxi was amazingly difficult. It didn't matter whether I was wearing a suit or jeans. It took 45 minutes for me to flag down a taxi."



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## Biology 113 – SENCER SALG Assessment

- Use a modified version of the online SENCER Student Assessment of Learning Gains (SALG)
- Responses given on Likert scale
- Compare Biology 113 to Biology 150, a similar and established course for Biology majors
- Analyze data from three semesters (approx. 40 respondents from each course)



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## Biology 113 – SENCER SALG Assessment

- HOW MUCH did the following aspects of the class HELP YOUR LEARNING?
  - Addressing real-world issues
  - Interplay between science and civic issues
  - Gathering scientific data in labs or in the field
  
- As a result of your work in this class, what GAINS DID YOU MAKE in the following?
  - Placing other science classes into context
  - Thinking about science classes in a different way
  - Relating the scientific method to real-life experiences and situations
  - Understanding the Roosevelt University commitment to social justice



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## Summary of SALG results

- Biology 113 students were *equally* likely to:
  - Recognize role of science in civic and political issues
  - Understand scientific methodology
  - Distinguish between scientific and pseudo-scientific arguments
  
- Biology 113 students were *more* likely to:
  - Benefit from use of online resources and discussion of current topics
  - Recognize social justice issues in the course
  - “Think about science courses in a different way”
  
- Biology 113 students were *less* likely to:
  - Recognize that the Science Engagement Project was a form of scientific investigation



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