Science Education and Civic Engagement

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Dedicated to Robert T. Sheardy: April 26, 1919 – March 1, 2009

“May the four winds blow you safely home”
Texas Woman’s University

- Largest public university primarily for women in the United States
- Approximately 12,200 students at three campuses: Denton, Dallas and Houston
- Approximately 42% graduate and 58% undergraduate student populations
- Has nationally ranked programs in Nursing and Health Sciences
- Requires all students to take at least six credits of science courses with laboratory
Department of Chemistry and Physics

- Is a unit in the College of Arts and Sciences
- Offers BS degrees in Chemistry (ACS certified), Biochemistry, Chemistry Teaching and an MS in Chemistry
- Offers chemistry, biochemistry and physics courses for science majors
- Offers science courses for non-science majors
  - Physical Science
  - Earth Science (I and II)
  - Science, Mathematics and Technology
  - History of Modern Science
  - Introduction to Environmental Chemistry: Global Perspectives
  - Climate Change: A Human Perspective
What is SENCER?

Science Education for New Civic Engagements and Responsibilities
What is SENCER?

SENCER is a program funded by the National Science Foundation dedicated to improving science education at all levels by:

- Engaging students in science learning through connection with real world issues
- Supporting the development of science courses (for both science majors and non-science majors) that have a civic engagement component
- Providing a platform for student assessment of learning gains
SENCER Goals

- Get more students interested and engaged in learning in STEM courses.
- Help students connect STEM learning to their other studies.
- Strengthen students' understanding of science and their capacity for responsible work and citizenship.

From: www.SENCER.net
Why is SENCER unique?

- Ties community issues to science
- Makes science learning important to students because these issues are already important to students
- Uses science knowledge to benefit our community via civic engagement
- Improves science literacy and enhances social responsibility
Introduction to Environmental Chemistry: Global Perspectives

- Developed at TWU by Cynthia Maguire in 2004-2006
- Approved by the undergraduate curriculum committee in 2007 to satisfy natural science and global perspectives core requirements
- Offered for the first time in Fall 2007
- Formatted as two lecture hours per week and six laboratory hours every other week
- Initially incorporated lectures, laboratories, field trips and readings with class discussions for learning experiences
- **Was not originally designed as a SENCER course**
Lectures

- Discuss how basic chemical principles apply to everyday environmental issues
- Use the ACS text *Chemistry in Context*
- Demonstrate how chemistry is a tool to understand the science of environmental problems
Chemistry Content

- behavior of atoms, ions, molecules
- properties of gases
- absorption of energy by atmospheric gases
- writing and balancing chemical equations
- stoichiometric relationships
- calculating strengths of solutions
- physical/chemical properties of matter
Environmental Issues Discussed

Sustainability:
- recycling
- climate change
- water quality
- water usage (major issue in Texas!)
- air quality
- energy
Field Trips

- Tour a wastewater treatment plant, potable water production facility and landfill
- Collect surface water samples for analysis
- Explore impacts of human development on nearby natural areas
Laboratories

Are not chemically “rigorous” but illustrate basic principles:

- Analyze gases in a breath of air
- Analyze of water samples collected at water shed visits
- Measure UV protection of various products
- Measure energy content of various fuels
Guest Lecturers

- Dr. Ann Staton, Dean of the College of Arts and Sciences, talked about global citizenship
- Professor Michiko Hayhurst (School of Management) talked about the impact of the environment on macro economics
- Dr. David Rylander (School of Management) lectured about sustainable business practices
- Professor Barbara Presnall (Department of History and Government) discussed the importance of civic engagement
- David Burns (NCSCE) talked about science education and civic engagement
Conducted a campus wide survey on recycling practices and attitudes

Coordinated efforts with the University Leadership Institute

Generated a report of the findings which was ultimately submitted to Facilities Management

TWU began Phase 1 of a new campus paper recycling program fall 2008
Class Projects (Fall 2008)

- Four groups of students investigated a variety of environmental issues—water, energy, recycling, food
- Collected science information on their topic
- Conducted on-campus surveys about attitudes on various environmental issues
- Reports were in poster form, used to educate others during the TWU Chancellor’s Student Research Symposium in April 2009
Assessment

- SALG [Student Assessment of (their own) Learning Gains] is an evaluation tool to measure gains in knowledge and changing attitudes.

- “The SENCER-SALG is an on-line, customizable assessment instrument and reporting system that is available free to faculty interested in encouraging students to assess and report on their own learning.”

  http://salgsite.org/
Outcomes

Figure 1: Presently I understand the following main concepts that will be [or were] explored in this class:

- 1.1.1 Sustainability;
- 1.1.4 How to use the mole concept in chemical calculations;
- 1.1.7 Why there is concern about our water supply;
- 1.1.11 The relationships between all these main concepts.

Response choices for each statement selected for inclusion were on a scale of agreement as follows: 1-not applicable, 2-not at all, 3-just a little, 4-somewhat, 5-a lot, and 6-a great deal. Data are reported as the numerical mean of all responses to each statement.
Outcomes

Figure 2: Attitudes.
Presently I am:

- 3.1 Knowledgeable about important environmental issues;
- 3.4 Interested or planning to take additional courses in science.

Response choices for each statement selected for inclusion were on a scale of agreement as follows: 1-not applicable, 2-not at all, 3-just a little, 4-somewhat, 5-a lot, and 6-a great deal. Data are reported as the numerical mean of all responses to each statement.
Climate Change: A Human Perspective

- Developed at TWU by Jennifer da Rosa in 2008-09
- Approved by the undergraduate curriculum committee in 2009 to satisfy natural science and global perspectives core requirements
- Will be offered for the first time in Fall 2009
- Formatted as two lecture hours per week and two laboratory hours per week
- Will have at least one field trip
- Was originally designed as a SENCER course
Course Objectives

- **Defining climate change**
  - Climate change versus climate variability
  - Acquaintance with geologic time scale
  - Positive and negative feedback mechanisms

- **Climate change evidence**
  - Paleontological indicators
  - Geology
  - Reconstructing past climates

- **Past Climate Change**
  - Natural forcing
  - Rates of Change
  - Case studies
Course Objectives

- Recent Climate Change
  - Anthropogenic forcing
  - Recent Changes
  - Case Studies
- Future Climate Changes
  - Monitoring the status of climate
  - Effects of future climate change
  - State of Knowledge
- Coping with Climate Change
  - Carbon Cycle – removing carbon from the atmosphere (advantages/disadvantages with each technique)
  - Reducing fossil fuel usage
  - Improving land management practices
  - Adapting to climate change
  - What can you do?
Earth Science Content

- Radiation laws and solar radiation variability
- Earth’s energy balance and the greenhouse effect
- Global carbon cycle
- Atmospheric science
- Precipitation patterns and desertification
- Climate classification
- Climatology data collection
- Ocean circulation
- Earth’s orbital variations
- Plate tectonic theory
- Geologic time
- Sedimentary rocks
- Glacial processes and Ice Ages
- Coastal processes and sea level change
Class Project

- **Climate Change and Culture Project**
- Students work on cultural case study
- Addresses the following:
  - What cultural practices are sustainable?
  - What cultural practices are synchronized with the environment to minimize the demand on resources?
  - What cultural practices are likely to encourage climate change?
  - What cultural practices repeal climate change?
  - How is this culture prepared for climate change?
  - How has this culture adapted to climate change in the past? or failed to adapt?
What Others Have Done

- Roosevelt University: Analytical Chemistry lab students collect water samples from Chicago River for analysis
- Oxford College: non-science majors chemistry course students collect air samples for ozone analysis
- University of Montana: non-science majors chemistry course students collect air samples for analysis of pollutants – work with local junior and high schools students for sample collection
- St. Mary’s College of California: linked a sociology course to a general science course to focus on a Superfund site
Keeping the Momentum Going at TWU

- Funded with SENCER Implementation Sub-Awards
- Got other disciplines interested and involved, such as
  - Department of Dance
  - Department of Visual Arts
  - School of Management
- Organized SENCER symposia at the national meeting of the American Chemical Society (August 2008, August 2009)
- *Science Education and Civic Engagement: The SENCER Approach*, an ACS Symposium book, to be published this year
- Got Denton ISD interested
- Are developing a minor/certificate program titled: Science and Civic Engagement
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  - Jennifer da Rosa
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