

# SENCER 101

Theo Koupelis, UW-Marathon

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For references please check the handouts



# What is SENCER?

- Science Education for New Civic Engagements and Responsibilities
- **A national dissemination program (NSF supported)**
- Aims to strengthen learning in STEM disciplines
- **Works to support faculty development and campus leadership through activities and programs**
- Engages student interest in the sciences and math by supporting courses and programs that teach “to” science and math “through” complex, capacious, and unsolved public issues --- that have significant “scientific” dimensions and where some comprehension of science would greatly improve decision making in both public and personal spheres.



# Why SENCER?

- Is there a need for SENCER?
- What does it offer?
- Why should we get involved? What is our role?
- Physics Cluster Goals and the SENCER Ideals
- How to get involved
- What do we mean by Civic Engagement?
- Can it be done in “my” discipline? (Physics?)
- What would the cost be?



# The need...

In a strong curriculum

- “... learning is experiential and steeped in investigation from the first course...”
- “learning is personally meaningful for students and faculty,... and makes connections to different fields...”
- “...learning takes place in a community where students are partners in learning...”

PKAL, “What Works...”, 1991



# The need... (cont.)

A quality undergraduate education provides students access to:

- “instruction that generates enthusiasm and fosters long-term learning...”
- “a curriculum that is relevant, flexible and within their capabilities...”

Sigma Xi Report, 1989



# The need... (cont.)

- “We must collaborate effectively in moving toward sustainable transformation of the STEM learning environment.”
- “It is a fundamental responsibility of a modern nation to develop the talent of its citizens.”

NSTC Report, 2000



# The need... (cont.)

We can no longer be satisfied with incremental improvement in a world of exponential change. Faculty should:

- “Build into every course inquiry, the processes of science, a knowledge of what STEM practitioners do and the excitement of cutting-edge research...”
- “Use pedagogy that develops communication skills, teamwork, critical thinking, and lifelong learning in each student...”
- “Build bridges to other departments, seeking ways to reinforce and integrate learning...”

NSF Report, 1996



# SENCER?

- There is a sense of urgency related to higher education's ability to offer quality education to all students through a creative and innovative curriculum.
- Such a curriculum is required in order to sustain the country's competitiveness and help create an alert and skeptical citizenry necessary for an effective democracy.
- There is an emphasis on the need for an interdisciplinary approach to learning, one that is active and problem-based, engaging and rigorous, well-grounded in science and math but also inclusive of the humanities and the social sciences.



# SENCER!

SENCER is the best current national program that addresses the needs documented in all the reports and also, as a national dissemination program, the only one that offers multiple ways toward addressing the needed training and support for faculty to implement the necessary curricular changes.



# What does SENCER offer?

- Major Areas
  - The SENCER Summer Institute
  - The SENCER Featured Models
  - The SENCER Clusters
  - The SENCER Virtual Community
  - The SENCER Leadership Initiatives



# What does SENCER offer? (cont.)

- The SENCER Summer Institutes are annual, invitational, intensive, residential, team-based learning opportunities for faculty, academic leaders and students;
- The focus is not only on what students should learn, but how that learning might be accomplished.



# What does SENCER offer? (cont.)

- The SENCER featured models are field-tested courses, programs, and learning communities.
- They take rigorous interdisciplinary approaches to teaching basic science and strengthening students' capacities to become engaged citizens.



# What does SENCER offer? (cont.)

SENCER courses demonstrate a record of achieving two goals:

- teaching basic scientific knowledge
- demonstrate both the utility and the limitations of scientific knowledge in connection with matters that are open to public deliberation

SENCER courses are rigorous and challenging. They require students to engage in serious scientific reasoning, inquiry, observation, and measurement. They connect scientific knowledge to public decision making, policy development and the effective “work” of citizenship; they require students to engage in research, to produce knowledge, to develop answers, and to appreciate the uncertainty and provisionality of knowledge.



# What does SENCER offer? (cont.)

For model courses check: <http://www.sencer.net/models.cfm>

- 1) Science, Society, and Global Catastrophes  
Univ. of Wisconsin-Marathon
- 2) Chemistry and the Environment  
Santa Clara University
- 3) Mysteries of Migration  
George Mason University
- 4) Biomedical Issues of HIV/AIDS  
Rutgers University
- ...
- 27) Computer Ethics  
Southern Connecticut State University



# What does SENCER offer? (cont.)

The Clusters:

## (Disciplinary)

Math and CS, Physics, Chemistry, Biology and Life Sciences, Environmental Sciences

## (Interest)

Integrated/Interdisciplinary Sciences, Learning Communities, Health, Pre-Service Teacher Education, Conservation Sciences



# What does SENCER offer? (cont.)

## Assessment of Learning:

- SENCER has sponsored the development of the SENCER-SALG (Student Assessment of Learning Gains) Instrument.
- This is an online, validated pre-/post-course assessment tool that may be customized by faculty who are using it.



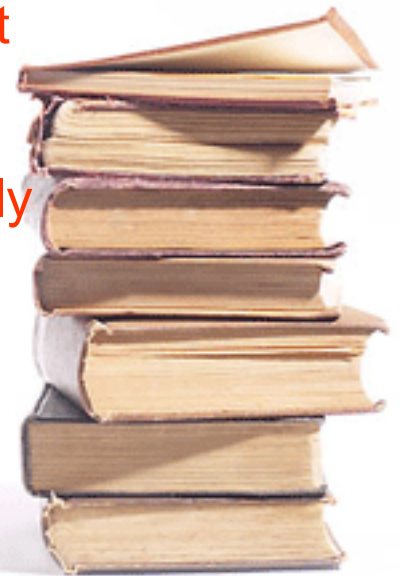
# Why should we get involved?

- Need for high quality science and quantitative education; emphasize interdisciplinary (IS) approaches
- Some degree of scientific literacy is a requisite part of a liberal education, an education that seeks to develop abilities in critical thinking, analysis, numeracy, and inquiry that involves discovery and exploration.
- Such competency in scientific reasoning and its related sensibilities are necessary for all leaders in a robust democracy



# Why should we get involved? (cont.)

- Students learn better by doing. Education is a function of experience and connecting what one reads and hears with ongoing observation and experiences.
- As faculty we seek to influence our students not just give information. Civic Engagement (CE) is a vehicle to effect change because it readily engages the emotions and spirit, which is deeply motivating. With a reflection component, the learning can be guided and integrated into coursework.



# Why should we get involved? (cont.)

- Benefits include the development of higher thinking skills, understanding problems in a more complex way, a more motivated and inquiring attitude toward education, learning and the world, plus community involvement and a heightened consciousness of citizenship. Also, students will likely seek out more information independently; thus IS/CE promotes life-long learning.
- Students show heightened interest in, and more meaningful and sustained learning of course material.



# Why should we get involved? (cont.)

- Paths to knowledge are diverse; IS/CE learning provides a framework whereby varied learning styles can be accommodated.
- CE learning can be a vehicle to greater community participation. An institution has a responsibility to the community from which it is funded.
- “Thinking begins in what may fairly be called a forked-road situation; a situation which is ambiguous, which represents a dilemma” (Dewey, 1938). It is much harder to replicate a forked road situation in the classroom, and theoretical dilemmas are not generally as motivating.



# Why should we get involved? (cont.)

- Both the structure of knowledge used and the social conditions of its use may be more fundamentally mismatched than we previously thought. The general, widely usable skills and principles which we teach are not always relevant to the situation-specific competencies needed in the world of work, and this pedagogical practice often avoids ethical issues.

E.g., Ernest Boyer (1987) noted that physics students at Cornell cannot relate what they learn to the outside world, which can bring serious consequences. IS/CE opportunities can promote connections between students' learning and the application of that learning in the real world, with all of its moral and ecological implications.



# Physics Cluster Goals

- Give interested faculty, academic administrators and graduate students a place to “join” in SENCER activities; all that is needed is an interest to get affiliated with the cluster.
- Prepare institutions that want to make “strong commitments” to participate in future SENCER Summer Institutes to take full advantage of what the Institutes offer.
- Use the SENCER Summer Institutes to help organize and plan annual cluster activities.



# Physics Cluster Goals (cont.)

- Engage in follow-up activities with teams that increase the likelihood that innovations begun will be supported and sustained.
- Create durable networks of faculty and others with similar interests and goals to support SENCER reforms.
- Influence disciplinary organizations to consider SENCER approaches.
- Identify courses and programs that embody SENCER ideals and help make them known.
- Provide feedback for formative evaluation.



# The SENCER Ideals

- SENCER robustly connects science and CE by teaching “through” complex, contested, capacious, current, and unresolved public issues “to” basic science.
- SENCER invites students to put scientific knowledge and scientific method to immediate use on matters of immediate interest to students
- SENCER helps reveal the limits of science by identifying the elements of public issues where science doesn't help us decide what to do



# The SENCER Ideals (cont.)

- SENCER shows the power of science by identifying the dimensions of a public issue that can be better understood with certain mathematical and scientific ways of knowing
- SENCER conceives the intellectual project as practical and engaged from the start, as opposed to science education models that view the mind as a kind of “storage shed” where abstract knowledge may be secreted for vague potential uses



# The SENCER Ideals (cont.)

- SENCER seeks to extract from the immediate issues, the larger, common lessons about scientific processes and methods
- SENCER locates the responsibility (the burdens and the pleasures) of discovery as the work of the student
- SENCER by focusing on contested issues, encourages student engagement with “multidisciplinary trouble” and with civic questions that require attention now. By doing so, SENCER hopes to help students overcome both unfounded fears and unquestioning awe of science



# Getting Involved

- Clusters
- Nominating Models
- Summer Institutes
- Regional Meetings
- SENCER Backgrounders
- Virtual Community
- SENCER House Calls
- SENCER Visiting Scientists
- Utilizing Course Links and Models
- SENCER: <http://www.sencer.net>
- Physics Cluster: <http://www.uwmc.uwc.edu/physics/sencer/>



# Civic Engagement

- CE learning: experiential learning, rooted to the specific goals of a course with the purpose of providing not only meaningful learning experiences for the students but also meaningful service to the community.
- Students learn and develop through thoughtfully organized service: conducted in and meets the needs of a community, coordinated with the institution and the community; helps foster civic responsibility; is integrated into and enhances the academic curriculum; includes structured time for students to reflect.



# Civic Engagement (cont.)

- It combines service with academic instruction as it focuses on critical, reflective thinking and civic responsibility. The process always includes an intentional and structured educational / developmental component for the students.
- **Experiential learning: Engage our students directly in the phenomena being studied. Service learning falls within the continuum of experiential learning. One major difference: the focus on EL is often on the benefit to the students, whereas the focus in SL is twofold. It is reciprocal beneficial, with meaningful service provided to the community and meaningful learning experiences provided for the student.**



# Four Myths

The myth of terminology: CE is the same as community service.

The myth of conceptualization: CE is just a new name for internships or pre-professional practicum.

The myth of synonymy: experience such as in the community, is synonymous with learning. (Reflective part of experience is where learning occurs.)

The myth of marginality: CE is the addition of service to a traditional course. (It must be connected to course objectives.)



# What would the cost be?

- Does CE learning detract from the rigors of classroom/laboratory learning? It does not have to be so!
- The learning activities should complement each other. As faculty we need to relinquish the notion that the only worthwhile academic pursuit happens in the classroom. If we focus on student learning, CE learning will become less of a competitor for instructional time and more of a tool to enhance learning.



# What would the cost be? (cont.)

- In order to make time for CE learning, we need to establish our priorities. CE faculty learn to trust a process which gives students more responsibility for their own learning, yet institutes a structure of accountability for the quality of work.

Combining course material with CE experiences takes time to develop, but there are many prototypes and sample materials currently available. (SL Clearinghouse Project, CE Network, etc.)



# Can it be done in my discipline?

Well...

If it can be done in Physics ...

(but check references ...)



# Can it be done in Physics?

## 1) Energy

Energy awareness audit. Note the ways we use energy during one day, listing direct uses such as car travel, heating, electric appliances. Make a second list of indirect uses such as energy-intensive foods (frozen foods, meats), packaging, non-recycled items. Are there ways to lower energy consumption without lowering quality of life? Are there ways to lower energy consumption while enhancing quality of life?

## 2) Thermodynamics: energy transfer

Energy transfer by conduction---Habitat for Humanity experience



# Can it be done in Physics? (cont.)

## 3) Thermodynamics:

Non-renewable energy sources, energy flow rates for gasoline-fueled cars, comparison to electric vehicles, gasoline-electric hybrid cars, hydrogen combustion cars, fuel cell cars, transportation efficiencies, steam electric power plants, etc.

Tie classroom discussion with learning from locally available opportunities (e.g., Weston Power Plant; coal)

Tie with population growth



# Can it be done in Physics? (cont.)

## 4) Electromagnetism

Global warming.

## 5) The Nucleus and Radioactivity

Local nuclear power plants, radiation risks (biological effects of radiation, hospital visits), radioactive waste, nuclear weapons.

