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# Making the Broader Impacts in K-12 Science Education

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# Messages

- We will all succeed or fail together in making US science and technology successful (chemists, physicists, mathematicians, engineers, educators, ….)
- There are many opportunities for the university to engage with K-12 science education
- K-12 education deserves the same quality of thought and effort that our research and teaching do.
- Description of one particular sustained engagement - The Science House at North Carolina State University

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# Broader Impacts

National Science Foundation employs two criteria in the merit review of proposals: What is the intellectual merit of the proposed activity? What are the broader impacts of the proposed activity?

- Advance discovery and understanding while promoting teaching, training, and learning
- Broaden participation of under-represented groups
- Enhance infrastructure for research and education
- Broaden dissemination to enhance scientific and technological understanding
- Benefits to society



http://www.nsf.gov/pubs/2007/nsf07046/nsf07046.jsp

# It's a Tough World For Science

Didn't my students learn anything in high school?

Why can't I hire the qualified technical staff that I need?

Why does the public disagree with my views on (stem cells, global warming, the International Space Station,…)?

Why can't we attract new technology-based industries to our country?

Congress seems to have forgotten science and technology.

## Does anyone understand MY needs?

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# Goals of K-12 Education Engagement

- Improve K-12 science and mathematics education
- Encourage a larger and more diverse group of students into science careers
- Enhance the science literacy of the general public
- True engagement changes scientists and the university

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# What Does Engagement Look Like?

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# What Does Engagement Look Like?

Attracts your attention

Makes you react

Takes unexpected forms

Messy

Fun

Builds your circle of friends

You learn together

No one has all the answers

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# How Do You Stay Engaged?

- By meeting your own needs and making an impact on others
- By supporting the goals of your campus or business
  - Undergraduate teaching
  - Research
  - National recognition
  - External funding


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Scientists bring to K-12 education an abiding interest and fundamental knowledge of science and the scientific process.

How can we put those qualities to the best uses?

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# Roles for Scientists in K-12

Resource

Partner

Advocate

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# Resource -> Partner -> Advocate

- Visit some schools to recruit students
- Demonstration programs for teachers
- Science course for teachers
- Science on the Road demonstrations
- Science teaching conferences
- Science teaching publications
- Collaboration on teacher training proposals and programs
- Membership in education organizations
- Education boards and commissions
- Leading K-12 Education Outreach programs
- Helping other scientists do the same

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# What Motivates Scientists in K-12?

- Federal research funding initiatives
- The need for scientists in the future
- Our own children
- Concern for the public welfare
- Fun

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# How Can We Make a Difference?

- Alignment with K-12 goals
- Understanding of K-12 Issues
- Partnerships and Leverage
- Personal Interactions (Politics)
- Quality

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# How Do We Keep It Going?

- Alignment with institutional goals
- External funding
- Impact on recruiting of students
- Impact on teacher training
- Enhancement of university student opportunities
- Scholarly activity
- Engagement with the community

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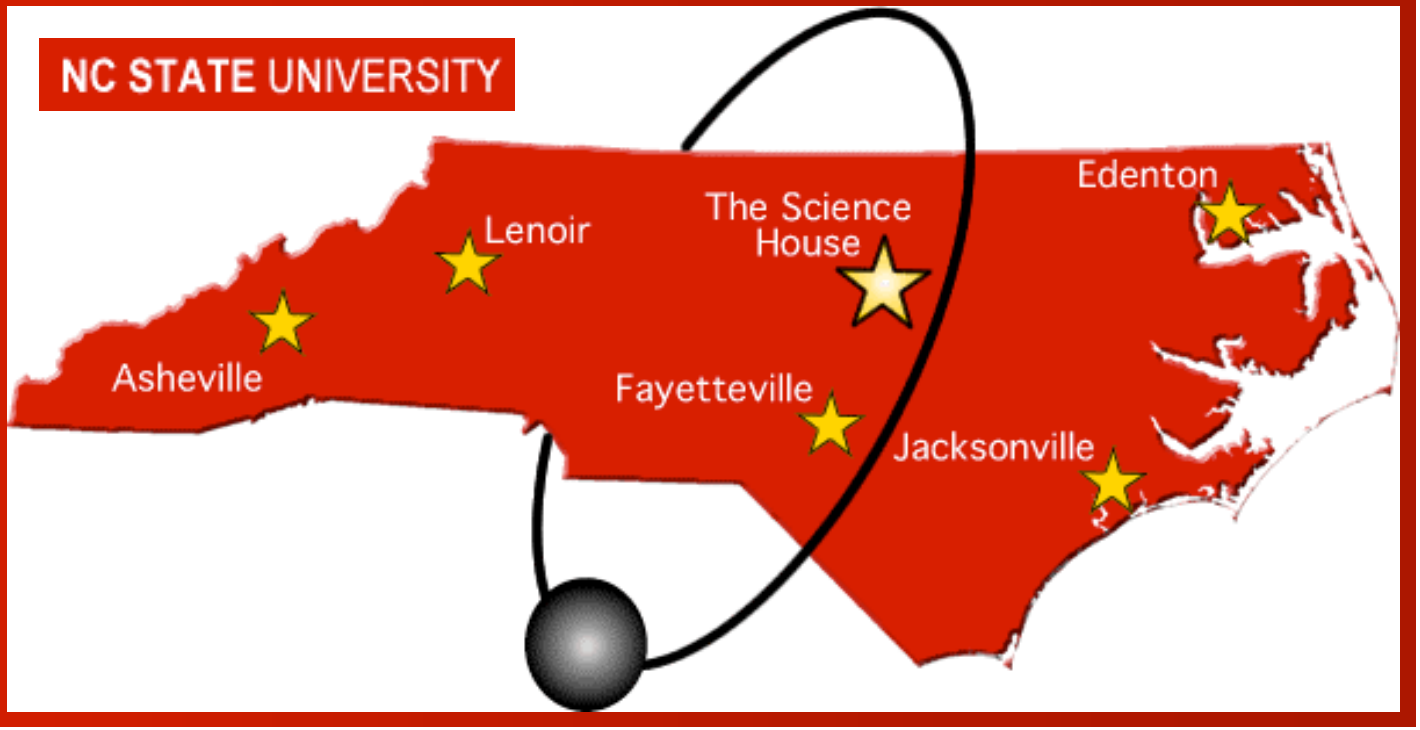
# The Science House
# NC State University

- Our mission is to partner with K-12 teachers to increase student enthusiasm for science and mathematics by promoting hands-on inquiry-based learning activities.

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# The Science House - NC State University

- Founded in 1991 by Dean of College of Physical and Mathematical Sciences (a chemist)
- Director from the science faculty/ Teacher co-Director
- Collaborations with all NCSU Colleges, including Education, and many UNC campuses
- College support and external partnerships
- Presently about 13 full-time staff, 6 offices, numerous part-timers
- Reaches about 3,000 teachers and 20,000 students per year
- Emphasis on rural schools and underrepresented groups
- Programs in NC, VA, SC, TX, GA, KY, AZ, IN

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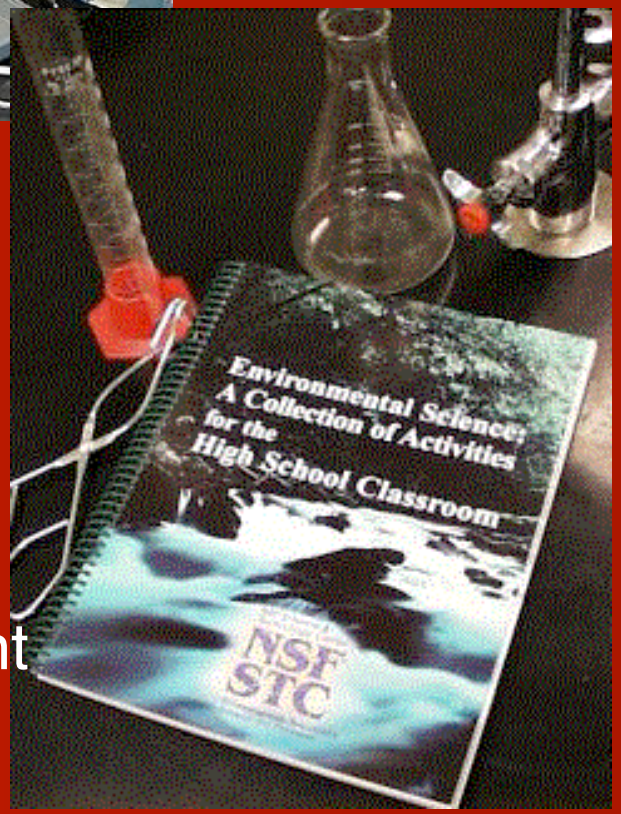
## Student Science Programs

## Teacher Training


## Curriculum Development and Dissemination

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# Teacher Training


Teaching With Technology
Rural Schools Programs
Countertop Chemistry
Physics from the Junk Drawer
K-5 Inquiry
Teacher Pioneers
Math and Science Partnerships

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# Student Science Programs

Envirotech Camps

Girl Scout Science Camps

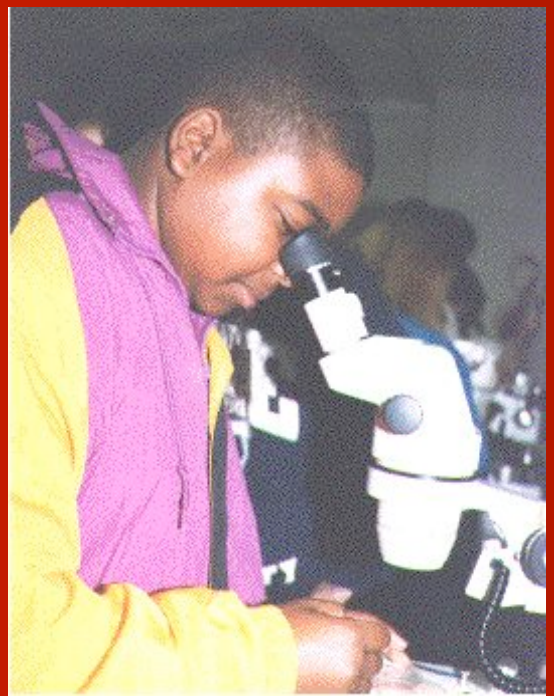
Expanding Your Horizons

Imhotep Academy

Photonics Explorers

Photonics Leaders

Girls Collaboratives



IMHOTEP Academy

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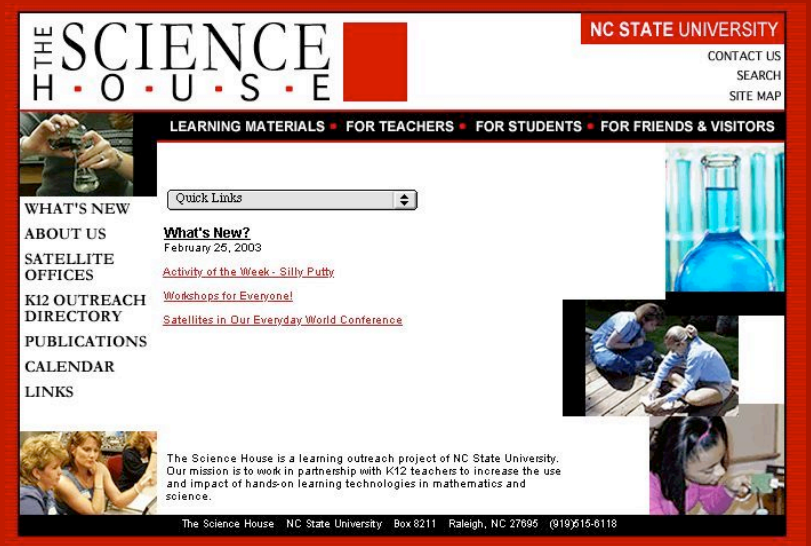
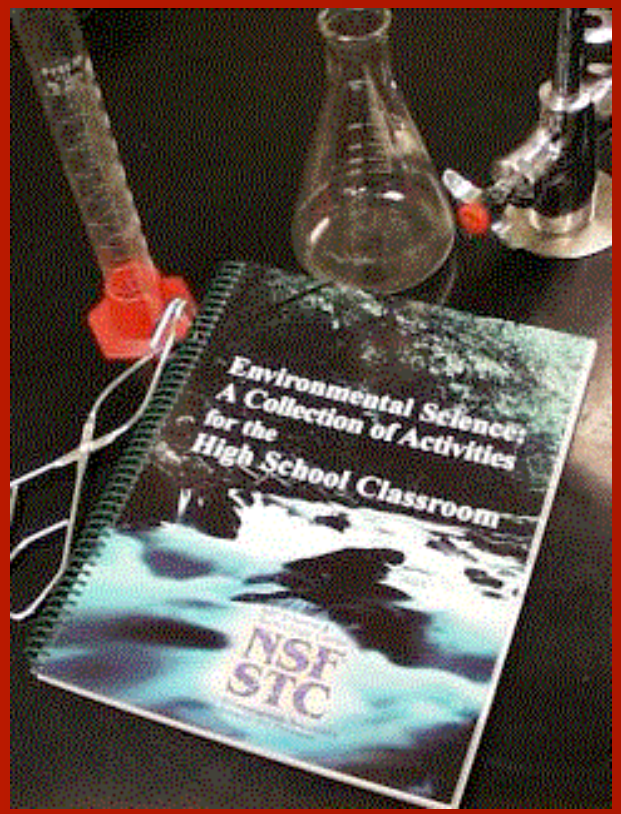
- Outreach from NSF Center for Environmentally Responsible Solvents and Processes
- Outreach from NSF Rice Blast Genomics Project
- Conferences on K-12 Outreach
- High-volume Web Site





## Curriculum Development and Dissemination

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# Science on the Road

We Go Anywhere!


Chemistry

Physics

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# Teaching with Computer- and Calculator-based Laboratory Equipment



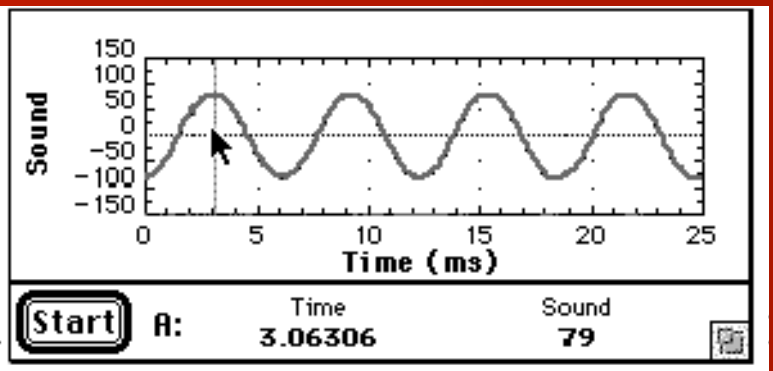


Figure 1

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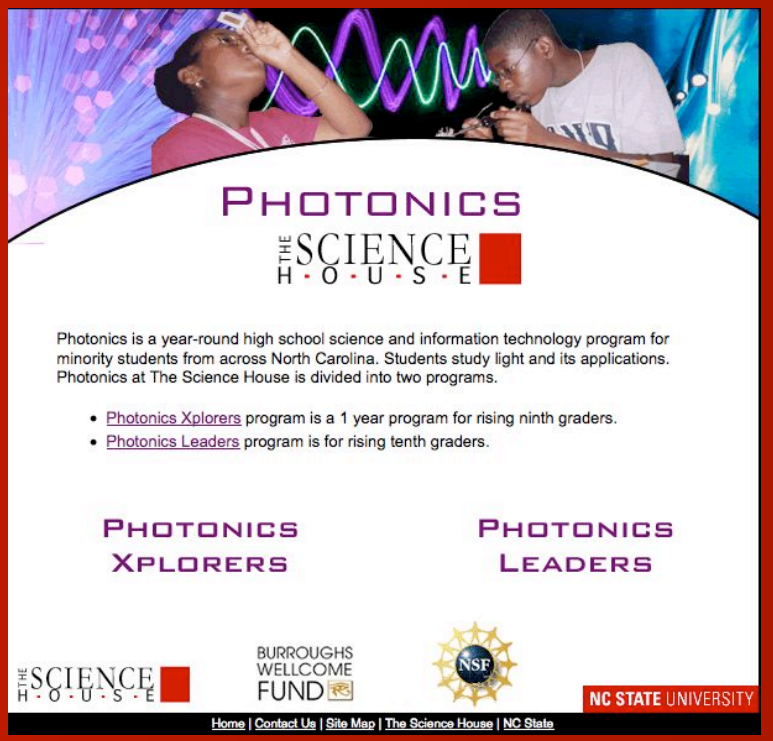
# The "Imhotep Continuum"

- Imhotep Academy (MS)
- Algebra Camps (MS)
- Photonics Xplorers (9-10)
- Photonics Leaders (11-12)




IMHOTEP Academy

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# Service to Rural Schools - Underserved Students


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# Expanding Your Horizons/ National Girls Collaborative

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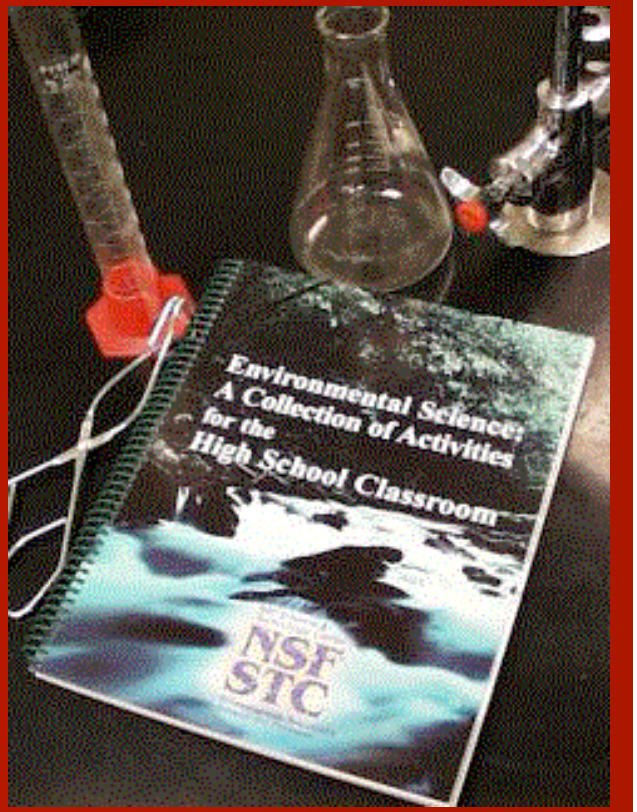
# Outreach from NSF Center for Environmentally Responsible Solvents and Processes

- Teacher Training Programs (NC, TX, GA)
- Curriculum Development
- Scientists in the Classroom
- Focus on a Scientist website

NSF Science and Technology Center
Environmentally Responsible Solvents and Processes
K-12 Outreach

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# Benefits to Our Partners

- Better qualified teachers
- More laboratory teaching
- More investment in laboratory equipment
- Science expertise
- Students motivated to learn science

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# Importance to Our University

- Enhance NC K-12 education
- Provide outreach functions for research programs
- Recruit students
- National recognition
- Public relations across the state
- Better undergraduate teaching

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# What The Science House Does That Benefits University Scientists

- Education about K-12 education
- Help the scientists succeed with K-12
- Help the scientists get credit for their efforts
- Build scientist communities for K-12 engagement
- Connecting to K-12 schools, programs
- Support for Broader Impacts projects - small and large

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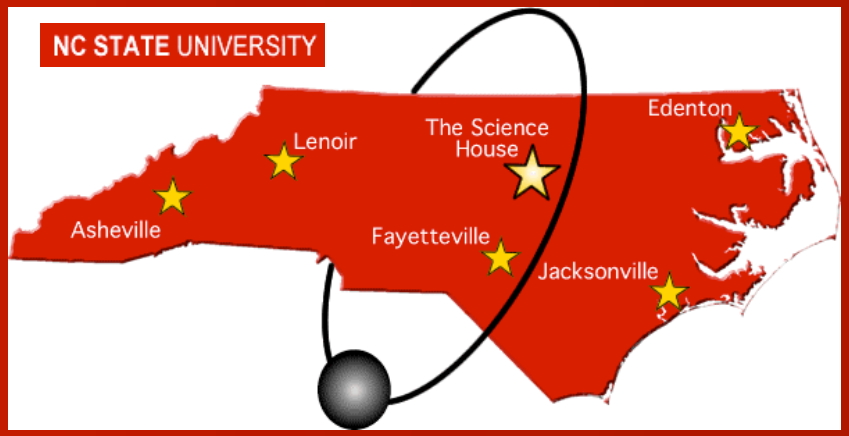
# How does a Science House keep going?

- Administrative buy-in
- Clear mission
- Entrepreneurship
- Rigorous goals and standards
- Disciplinary ecumenicism
- A faculty constituency
- Partnerships, partnerships, partnerships…..

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# Lessons Learned: What Worked

- We became engaged: a part of the education community
- We found a niche - science and technology expertise
- Doing the research about education
- Sensitive to the university agenda
- Enthusiasm for science
- High quality programs

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# Teaching Staff at The Science House

- Mostly former teachers
- Almost all have science degrees
- Close links to communities
- Assets as important as the buildings and programs

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# What We Have Learned:
## *It turned out just like we planned*

- Hands-on science and math
- Opportunities for students
- Partnership with teachers
- Science faculty and students involved
- Excellent public relations and recruiting for the university

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# What We Have Learned:
## *It turned out quite different than we planned*

- Many, many partners
- K-12 science and mathematics education has changed much and often since 1991, so did we
- Emphasis on rural schools and underrepresented groups
- True engagement with schools and teachers, and all of the sciences.

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# Obstacles to Effective, Sustained Programs

- Focus on one science discipline
- “Grant and gone” syndrome
- Lack of flexibility and imagination
- Failure to integrate into the campus and the schools
- Underestimating the difficulty and importance of K-12 engagement

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# Things I Never Dreamed I Would Learn About ….

- Rural sociology and needs of rural areas
- Politics of state and local school systems
- Education professional associations
- Principals of adult education and distance education
- Partnerships with education foundations
- Education and economic development
- Under-represented groups and socio-economic groups

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- NSF
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http://www.science-house.org/conf


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