

# **What Is Science and What Are the Pressing Issues Facing Science Education?**

**June 23, 2007**

**Kansas City, Missouri**

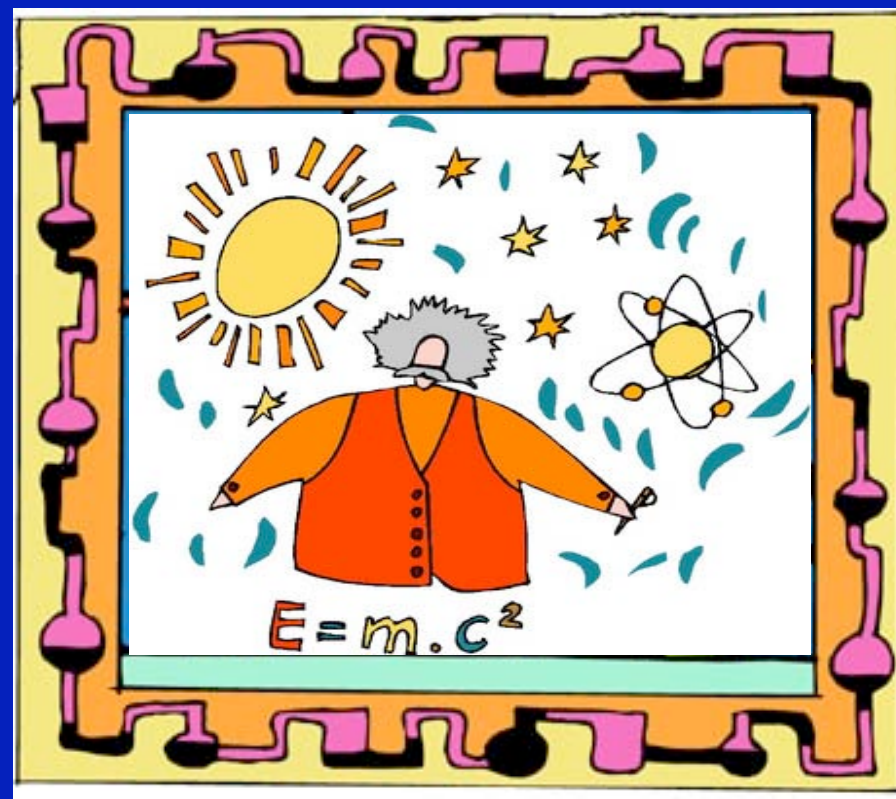
**Joan Abdallah, Program Director**

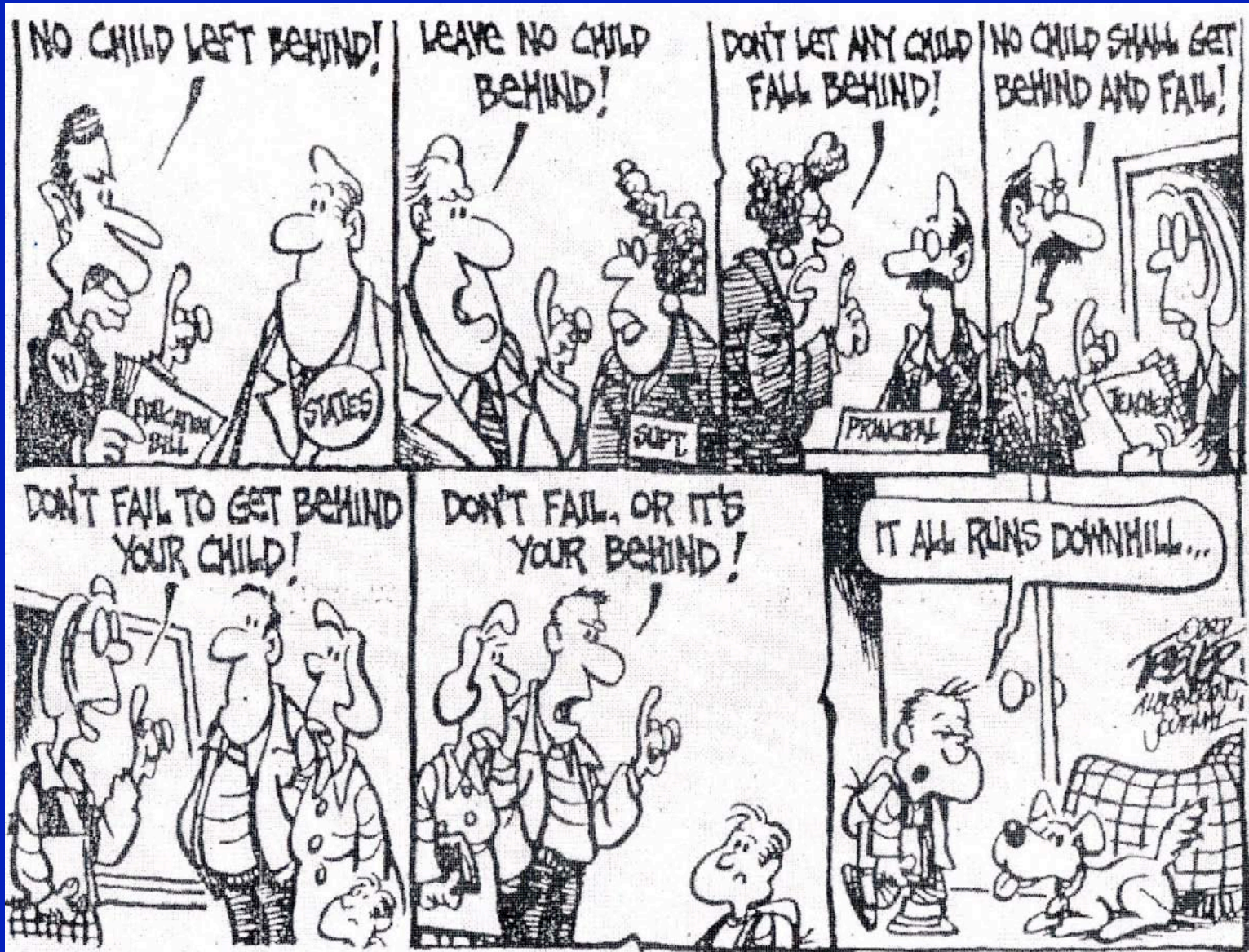
**Education and Human Resources Programs**



ADVANCING SCIENCE. SERVING SOCIETY

# What Is Science?





## Overview of the Talk

- What is science?
- Why science?
- Current landscape
- Current and emerging issues

Science is....

Understanding the physical,  
biological, and designed world  
and thinking about such  
questions as...

## The Physical World

### Planets

How do planets differ from stars?

How far is the moon?

How do stars form, and are there patterns that they form?

How many stars are in the sky?

How can we see them better?

What causes different stars to appear in the sky at different times of the year?



## The Earth

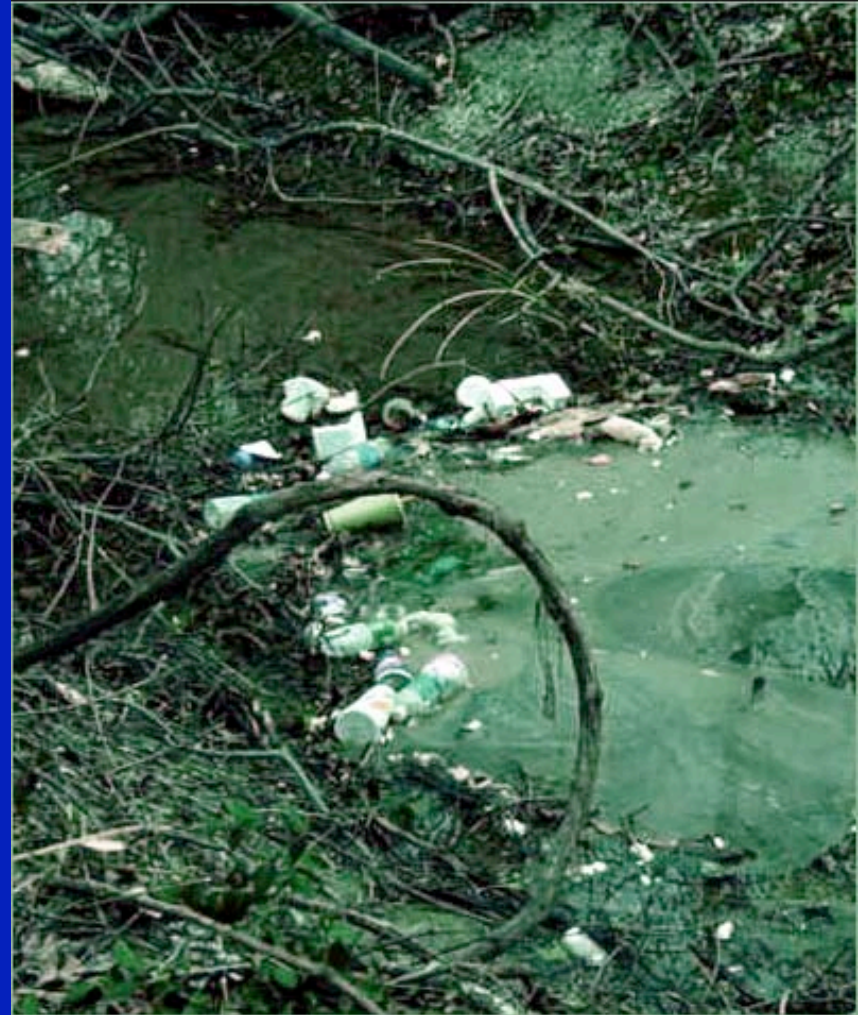
What causes the seasons?

How do hurricanes form?  
And tornadoes?

What can we do to protect  
ourselves from the forces of  
nature?

What causes climate change?

What are the effects of pollution  
on our lives?



## Structure of Matter

Atoms and molecules

What are the characteristics of objects? How do they differ? How are they similar? How do they work?

What happens to discarded televisions? Tires? Plastic items?

How are buildings constructed?  
What materials can be used?  
What's safe?

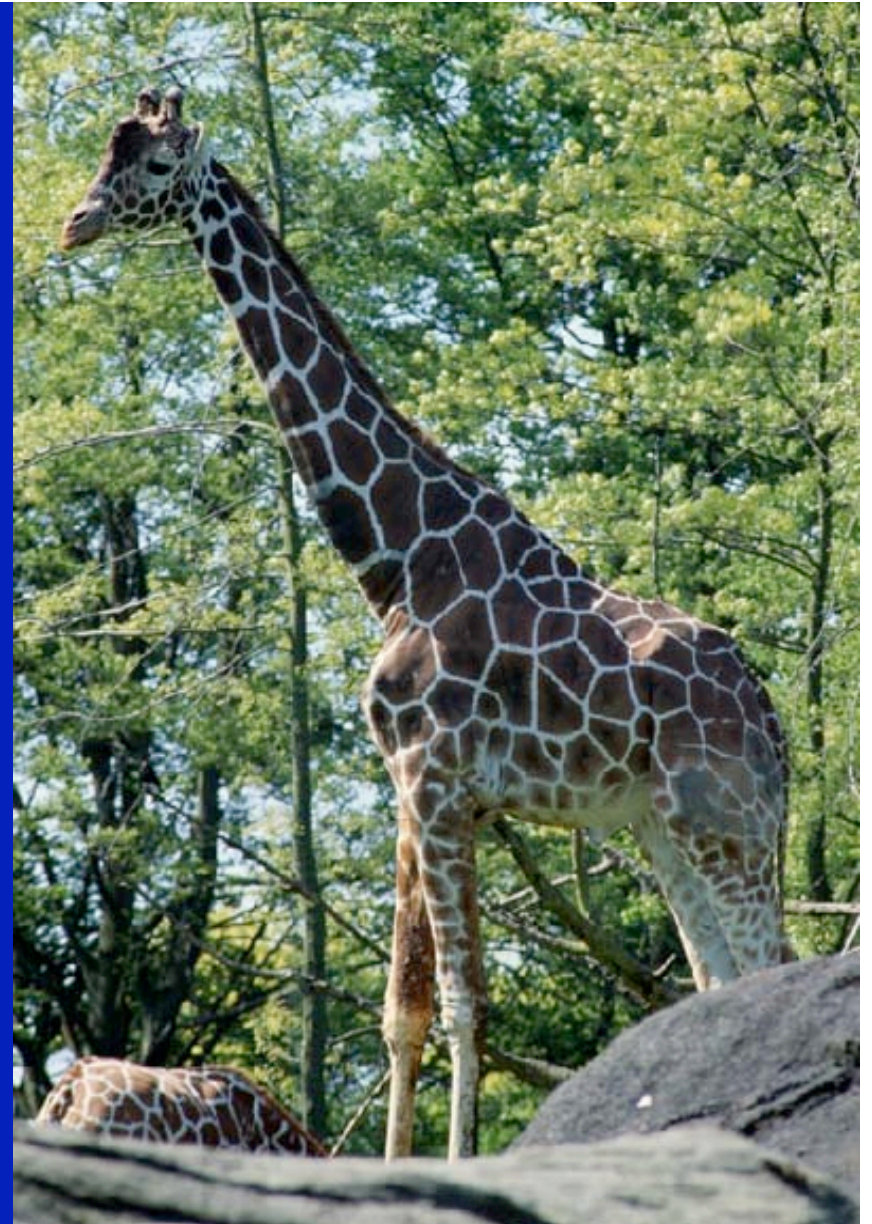


## The Living Environment

How is information transferred from one cell to another?

How does the genetic code (DNA) determine individual hereditary characteristics?

Diversity in nature



## Science Is a Human Endeavor

- Way of thinking
- Knowledge and skills
- Seeks evidence
- Offers explanations
- Evaluates evidence and explanations
- Continuous effort

## Developing Understanding and Knowledge

- Build on what students already know
- Engage students in the nature of science
- Have students learn to *do* science so that they can *learn* science

## Science Literacy

In a culture increasingly pervaded by science, mathematics, and technology, science literacy requires understandings and habits of mind...make some sense of how the designed and natural world works, to think critically and independently, to recognize and weigh alternative explanations of events and design trade-offs, and to deal sensibly with problems that involve evidence, numbers, patterns, logical arguments, and uncertainties.

*AAAS Benchmarks for Science Literacy, p.xi*

Just Say **No!**

To the scientific method !!!

## Why Science?

- Personal perspective
- National imperative

## Rising Above the Gathering Storm ...A report to Congress

86% of US voters believe that the United States must increase the number of workers with a background in science and mathematics or America's ability to compete in the global economy will be diminished.

## Rising Above the Gathering Storm, cont.

Because the United States does not have a set of national curricula, changing K-12 education is challenging, given that there are almost 15, 000 school systems in the United States.

## Rising Above the Gathering Storm, cont.

10,000 teachers, 10,000 Million Minds

- Recruit and train teachers
- Strengthen skills of in service teachers
- Foster high-quality teaching with world-class standards, curricula, and assessment of student learning

## Average Science Scores in 2005 Higher at Grade 4, Unchanged at Grade 8, and Lower at Grade 12 Since 1996

- At grade 4, the average science score was higher in 2005 than in previous assessment years
- At grade 8, the average science score in 2005 showed no significant change compared to results in 1996 and 2000
- At grade 12, the average science score was lower than in 1996, and showed no significant change from 2000

*Source: NAEP*

In 1996, US 12th graders performed below the international average in mathematics and science.

How do your district's data compare to the national and international data?

## Issues

- Parents' perceptions
- Scarcity of qualified science and mathematics teachers

## Recommendations to Strengthen Our Nation's Mathematics and Science Teaching Workforce

- **RECRUITMENT**  
Strengthen teacher recruitment policies in mathematics and science.
  - Implement a comprehensive package of mathematics and science teacher education recruitment strategies, starting in P-12 and extending through graduate school, that include incentives such as scholarships, signing bonuses, and differential pay.
  - Strengthen the content and pedagogy of teacher preparation programs to ensure a national mathematics and science teacher workforce capable of preparing P-12 students for success in higher education and the workplace.
  - Expand strategies to attract talented individuals in STEM-related professions to teaching, and ensure that they are adequately trained for the classroom.

## Recommendations to Strengthen Our Nation's Mathematics and Science Teaching Workforce, cont.

- RETENTION

Improve the retention of both new and experienced teachers, and address the causes of teacher dissatisfaction.

- Develop and implement research-based induction programs for all new mathematics and science teachers.
- Implement comprehensive policies and programs that address the leading causes of teacher job dissatisfaction, including inadequate compensation, lack of administration support, and professional isolation

**SOURCE:** *The American Imperative: Transforming the Recruitment, Retention, and Renewal of our Nation's Mathematics and Science Teaching Workforce.* BHEF, 2007.

## Alignment

- Learning goals and assessment (and national goals)
- Curriculum
- Professional education of in-service teachers

## Recommendations to Strengthen Our Nation's Mathematics and Science Teaching Workforce, cont.

- RENEWAL

Ensure that all mathematics and science teachers participate in renewal activities that support their effectiveness in the classroom.

- Provide ongoing, research-based professional development programs, focused on both content and pedagogy, for all mathematics and science teachers.
- Revamp teacher license renewal programs to incorporate measures of teacher effectiveness.
- Establish comprehensive statewide data collection systems that track student progress, teacher effectiveness, and employment trends of mathematics and science teachers.

**SOURCE:** *The American Imperative: Transforming the Recruitment, Retention, and Renewal of our Nation's Mathematics and Science Teaching Workforce.* BHEF, 2007.

## Recommendations to Strengthen Our Nation's Mathematics and Science Teaching Workforce, cont.

Our ideas for improving the nation's supply of highly qualified mathematics and science teachers are comprehensive, integrated systemically into the whole of the educational enterprise, and aligned among diverse partners who hold a stake in improving student interest and achievement in mathematics and science. They are comprehensive in the sense that they address recruitment, retention, and renewal in a holistic, rather than piecemeal, manner. They are systemically integrated to address the core components of an education system (student content standards, curricula, student assessments, and accountability) and are applied across both P-12 and higher education to ensure an approach that embraces the whole of P-16 education.

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**SOURCE:** *The American Imperative: Transforming the Recruitment, Retention, and Renewal of our Nation's Mathematics and Science Teaching Workforce.* BHEF, 2007.

## Issues, cont.

- Facilities, materials, resources
- Time for science

## Emerging Issues

- Safe and orderly environment
- Curricular connections – science, mathematics, reading, writing, and technology
- Engineering
- Learning and the brain

## Instruction

Given learning goals (standards), curriculum, and materials, how different is the implementation of the curriculum among teachers? What was intended by the developers of that curriculum and what was actually implemented by teachers in classrooms ? What were the results?

## Building Support

- Parents and community
- Teachers, district and site-based leadership
- Unions
- Institutions of higher education
- Local and regional scientific organizations
- Business and industry

## What One School Board Contributed

- 62 community volunteer scientists
- Seven sub-committees
- Visited every public school
- Recommended system-wide changes

## Collaborative Efforts

Engage stakeholders including parents, teachers, union, business and industry, community, principals, superintendent and key administrative personnel, and institutions of higher education

## What Policies Are in Place to Ensure Alignment with the Vision Students Are Achieving Learning Goals?

- Aligned standards and assessment (national standards)
- Curriculum
- Teacher quality (instruction)
- Continuous in-service education

## How Do the Policies Support the Vision to...

- Prepare teachers to teach robust science
- Develop teachers as change agents
- Change classroom practices
- Institutionalize collaboration among educators, the union, members of the community, businesses, institutions of higher education

## Strategies

- Provide incentives for continued professional education of in-service teachers
- Engage science teaching and education faculty
- Implement standards-based curriculum in classrooms

## Strategies, cont.

- Provide funding for robust summer institutes, academic year seminars and tutorials, and to form communities of practice
- Encourage participation in national networks
- Form vertical teams in schools and with feeder schools

## Support Leadership Development

- Use of data
- Develop science plans
- Analyze student work
- Examine instructional materials
- Use an observation protocol as a tool to change classroom practice

## Questions

- How might you align essential policies to affect change?
- What *benchmarks* will be established to determine progress?
- How might you take advantage of national resources to facilitate change?

## Questions, cont.

- What strategies are recommended to increase the collaboration of science, mathematics and education faculty to design courses to better prepare teachers?

**Keep your eyes on the prize**

## Photo Sources / Credits

- "No Child Left Behind" Cartoon, by John Trever, *Albuquerque Journal*.
- Pollution Photo from Friends of Sligo Creek, Maryland, [www.fosc.org](http://www.fosc.org)
- Photos for The Physical World slide from National Aeronautics and Space Administration, [www.nasa.gov](http://www.nasa.gov)
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Note: URLs provided above are subject to change. Ref'd June 2007

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