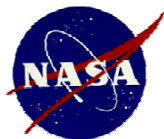


# Scientist Involvement in Education and Public Outreach



## *Making the Case*



# NASA/NSF Scientist Involvement in EPO

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Research directorates of funding agencies like NASA and NSF are increasingly encouraging (and in some cases requiring) the integration of science and education and greater scientist involvement in Education and Public Outreach (EPO).



# The Need for Improvement

## Third International Mathematics and Science Study (TIMSS)

### Overall Comparative Findings U.S. Performance Relative to the International Average

Content Area	Fourth Grade	Eighth Grade	Final Year of Secondary School	Advanced Math & Science Students
Mathematics Overall	Above	Below	Below	—
Science Overall	Above	Above	Below	—
Advanced Mathematics	—	—	—	Below
Physics	—	—	—	Below

SOURCE: National Center for Education Statistics (1996-1998). For more information visit the TIMSS website: <http://nces.ed.gov/timss>

# The Need for Improvement

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- According to NSF's *Science & Engineering Indicators -- 1996*, 53% of a sample population surveyed did not know that Earth orbits the Sun once per year.
- 21 out of 23 randomly selected students, faculty and alumni of Harvard University could not correctly explain Earth's seasons.

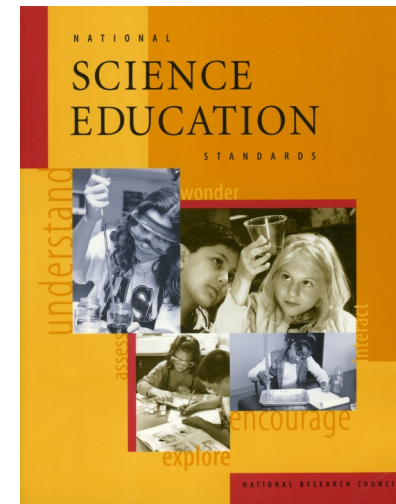
# The Need for Improvement

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- In August 1999, the Kansas State Board of Education voted 6 to 4 to remove the teaching of evolution from the state standards.
- Scientists are needed to become advocates of sound policies and standards in science education.

# National Science Education Standards

- National Science Education Standards give a consensus of educators and scientists nationwide regarding what students should know and be able to do at different K-12 grade levels in science.
- Standards also address best teaching practices, professional development of teachers, and implementing systemic reform of education.



# Importance of Partnerships

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“I now view effective science education partnerships between scientists and precollege education science teachers in a completely different light - as the only hope for lasting systemic change in precollege science education and, therefore, as an important national priority for the United States.”

-Bruce Alberts,

President of the National Academy of Sciences, 1993

# What Scientists Can Contribute

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Scientists offer much that is needed to contribute to the realm of education and public outreach:

- Respect and influence in community
- Deep knowledge of science & scientific process
- Exciting connections to real world exploration
- Access to data and facilities
- Role modeling for students



# Modern Science Education Reform

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- Students as “scientists” with teachers as facilitators of learning
  - Teacher as “a guide on the side” rather than a “sage on the stage”.
  
- “Inquiry-based” process of learning
  - “The way scientists *do* science rather than the way they were *taught* science.”

# Doing Science: Teaching Science

## Science Method

- Raise fundamental question of interest
- Research what is already known
- Plan & implement experiment
- Reflect on results and how they affect what was known before
- Communicate learning via talks & papers

## Education Analog

- Engage students, establish inquiry
- Assess prior knowledge of students
- Plan & implement a hands-on activity
- Reflect on results and how they affect prior knowledge
- Communicate learning via assessment methods

# Variety of EPO Roles for Scientists

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- Presentations in a classroom or a public setting are not the only way to contribute to education and public outreach.
- There are many other roles scientists can play in education and public outreach that are suited to a diversity of talents and interests.

# A Sampling of Roles for Scientists in Education

LEVEL OF INVOLVEMENT ==>>	ADVOCATE	RESOURCE	PARTNER
<b>K-12 STUDENTS</b>	<ul style="list-style-type: none"> <li>• Participate in PTA.</li> <li>• Talk to school board about importance of science education.</li> </ul>	<ul style="list-style-type: none"> <li>• Judge a science fair.</li> <li>• Answer student e-mail.</li> <li>• Give tour of research facility.</li> </ul>	<ul style="list-style-type: none"> <li>• Mentor a student in your laboratory.</li> <li>• Partner with students in a research project.</li> </ul>
<b>IN-SERVICE K-12 TEACHERS</b>	<ul style="list-style-type: none"> <li>• Speak out in support of appropriate professional development opportunities for teachers.</li> </ul>	<ul style="list-style-type: none"> <li>• Answer teacher e-mail about science content questions.</li> <li>• Present in teacher workshop or some aspect of science.</li> </ul>	<ul style="list-style-type: none"> <li>• Work with a teacher to implement curriculum.</li> <li>• Hire a teacher intern.</li> </ul>
<b>SCHOOLS OF EDUCATION</b> (Pre-Service Teachers, Graduate Students, Faculty Members)	<ul style="list-style-type: none"> <li>• Speak out in your department or organization in favor of closer ties with Colleges of Education.</li> <li>• Promote the teaching profession in your undergraduate classes.</li> </ul>	<ul style="list-style-type: none"> <li>• Teach a science course or workshop segment for pre-service teachers.</li> <li>• Collaborate with education faculty to improve courses on teaching science.</li> </ul>	<ul style="list-style-type: none"> <li>• Hire a graduate in education to work as evaluator or co-developer of education project.</li> <li>• Develop a science course or curriculum for teachers-to-be.</li> </ul>
<b>SYSTEMIC REFORM</b> (District, State, National)	<ul style="list-style-type: none"> <li>• Speak out at professional meetings about the importance and value of scientist involvement in systemic change.</li> </ul>	<ul style="list-style-type: none"> <li>• Review science standards for science accuracy.</li> <li>• Review the state framework for science education.</li> </ul>	<ul style="list-style-type: none"> <li>• Collaborate on writing or adapting science standards.</li> <li>• Participate on state boards for adoption of standards, instructional materials, or teacher certification.</li> </ul>
<b>EDUCATIONAL MATERIALS DEVELOPMENT</b> (NSRC, EDC, Lawrence Hall)	<ul style="list-style-type: none"> <li>• Speak out at a school board meeting for adopting exemplary educational materials.</li> </ul>	<ul style="list-style-type: none"> <li>• Agree to serve on an advisory board for a science education project.</li> <li>• Review science educational materials for science accuracy.</li> </ul>	<ul style="list-style-type: none"> <li>• Collaborate to create exemplary science education materials.</li> </ul>
<b>INFORMAL EDUCATION</b> (Science Centers, Scouts, Planetaria)	<ul style="list-style-type: none"> <li>• Participate on the board of a science center, planetarium, environmental center, or museum.</li> </ul>	<ul style="list-style-type: none"> <li>• Review science content of scripts for science exhibits, planetarium shows, or environmental programs.</li> <li>• Give talk at a science center.</li> </ul>	<ul style="list-style-type: none"> <li>• Collaborate in creation of a museum science exhibit or planetarium show.</li> <li>• Serve as science coordinator for a scout troop.</li> </ul>

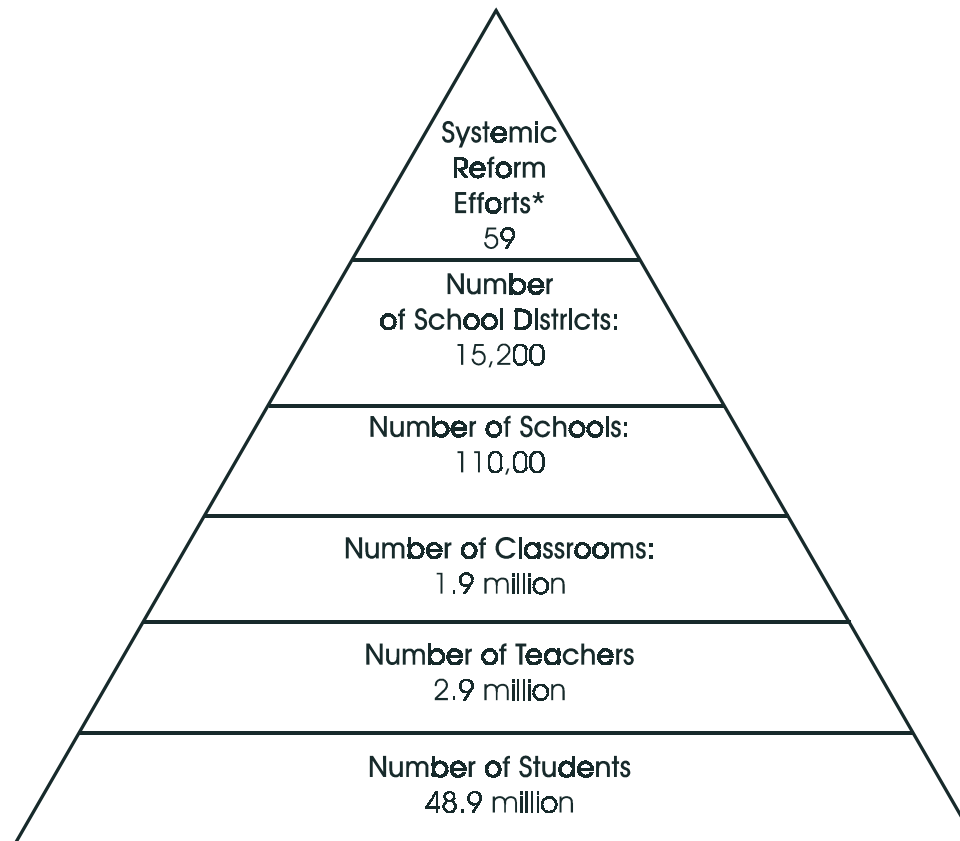
The far left column constitutes various entry points into the E/PO realm. The subsequent columns labeled, “ADVOCATE”, “RESOURCE”, and “PARTNER” represent a graduation in the time and energy spent on E/PO, with “ADVOCATE” taking the least amount of time, and “PARTNER” taking the most amount of time.

ADAPTED FROM: “Improving Science Education: The Role of Scientists,” Bybee, Rodger W., and Cherilynn A. Morrow, Fall 1998

Newsletter of the Forum on Education of the American Physical Society

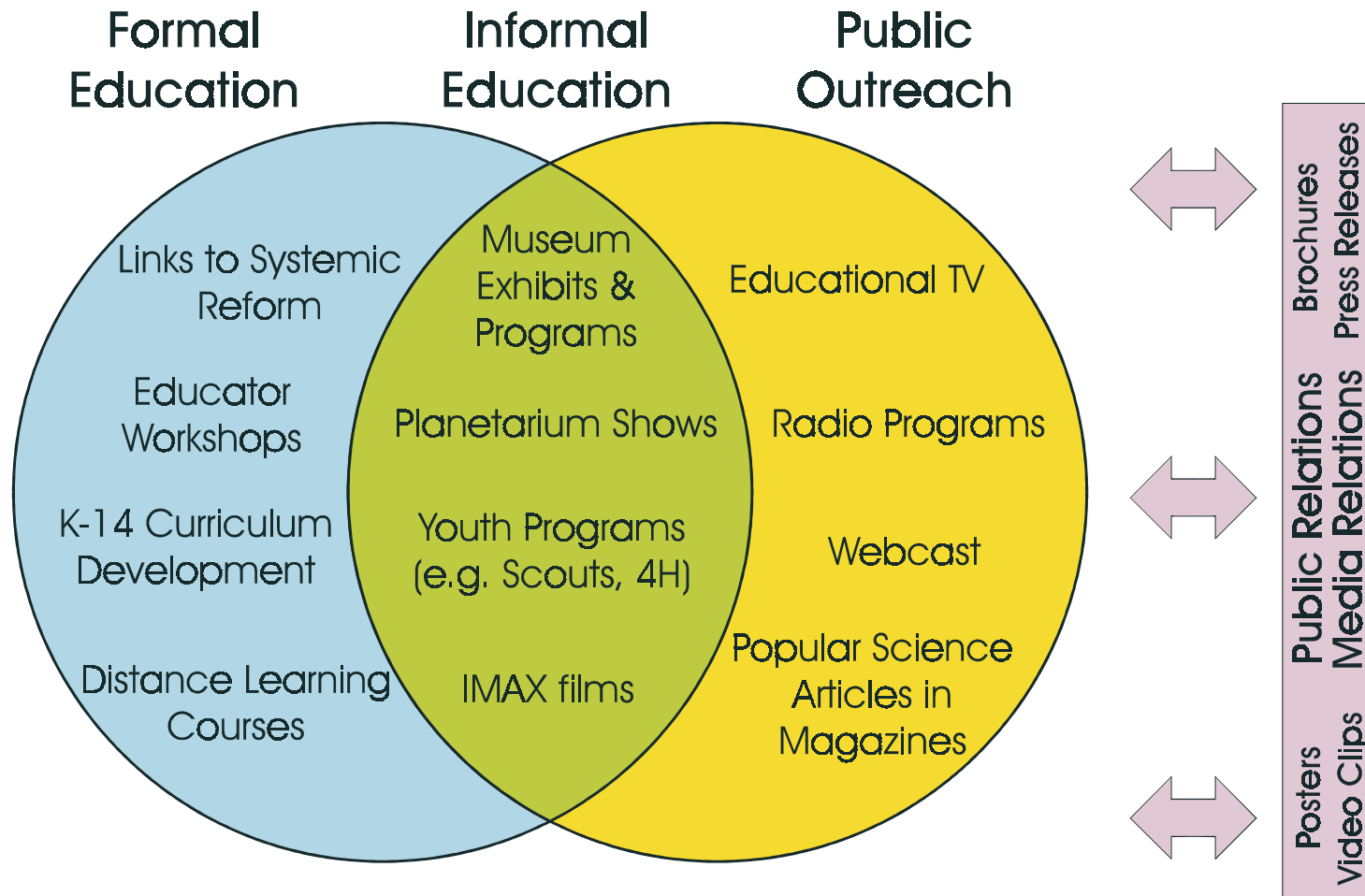
# Education Pyramid

## Statistics on the US Education System



Adapted from “Implementing the Office of Space Science Education/Public Outreach Strategy” (1996)

# Formal/Informal/ Public Outreach



The EPO products and services listed are only a sample of possibilities. Diagram developed by C. A. Morrow Space Science Institute, 1/99. Email: [camorrow@colorado.edu](mailto:camorrow@colorado.edu)

# Formal Education

Provides a sustained opportunity to deepen knowledge and understanding of fundamental ideas and concepts that are useful in contributing to and interpreting the world around us.





# Informal Education



Offers engaging learning opportunities in unique environments (e.g. museums, planetariums, nature centers) that motivate further learning and life long interest.



# Public Outreach

Reaches out to where people may conveniently tune in to hear or see in their everyday lives with information that excites, interest and arouses curiosity (e.g. TV, radio, home computer, magazines).



# Three C's for Education Partnerships

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## ➤ COLLEGIALITY

(find mutual respect with educators; acknowledge their expertise in education and the way it can complement your expertise in science)

## ➤ COMMUNICATION

(do not condescend or try to take over; be very conscious of scientific jargon)

## ➤ COLLABORATIVE SPIRIT

(collaborate rather than compete with educators)

# Ideas to Get Started in EPO

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- Attend workshop for scientists in education (e.g. SSI workshop; <http://www.space-science.org/Education/ResourcesForScientists/Workshops/1.html>)
- Study the National Science Education Standards <http://www.nap.edu/readingroom/books/nse/>
- Contact EPO support orgs. who can facilitate connections with the education community <http://www.hq.nasa.gov/office/oss/education/ecosystem.htm>
- Ask colleagues and/or EPO partners about existing EPO programs involving scientists

# Conclusions

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- There is a strong need to improve science education and science literacy in the US.
- The participation of scientists in collegial partnership with educators and outreach specialists is vital to meeting this need.
- There are a wide variety of valuable EPO roles for a scientist depending on his or her particular talents and interests.