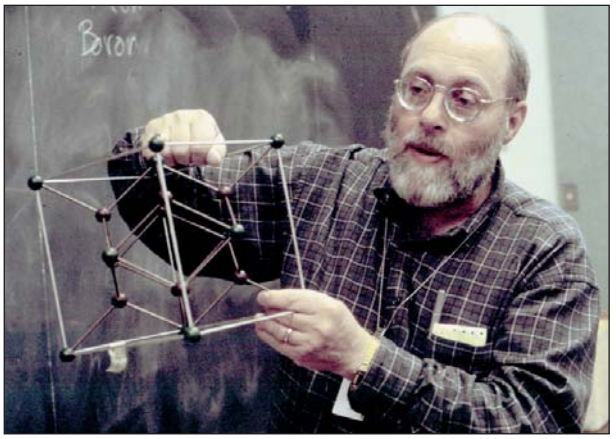
Children Sample Materials Topics in "Adventure in Science" Program at NIST

Robert D. Shull

It is 8:30 a.m. on any given Saturday between October and March and I am rushing to get to the National Institute of Standards and Technology (NIST) before 56 children arrive to spend the next 2–3 hours learning about a chosen topic in science or mathematics. During the week, I am a materials scientist at NIST but on Saturday mornings, I teach to children (ages 8–14) materials properties and their interrelationship with structure and processing. I want students to realize there is an interesting topic known as materials science when they begin to make career choices much later in life. I lucked upon materials science by accident when I was a sophomore at the Massachusetts Institute of Technology looking for an alternative to pure physics, chemistry, and mathematics, the science topics introduced to me in high school. I would like to see such a choice in the future be made by students with prior exposure to materials science during their primary education rather than by students who found the area by chance.



Robert D. Shull, president of AIS, teaches a program on "Metals."

When I first heard about the Adventure in Science (AIS) program from local newspaper articles in the early 1980s, I joined as a parent of two young children enrolled in the program. I quickly volunteered as a teacher and, since 1985, agreed to serve as one of its site managers.

Each Saturday morning, the children select one of 4–5 topics to explore. Since the selection of topics will be different from the previous and following week's offerings, in the 20–21 weeks of the program each year, the children will have the opportunity to sample at least that many different topical areas, with the hope that one topic may particularly excite them and perhaps serve as a future career choice.

Example program topics include examining crystal structures (both morphological and crystal) and how properties (e.g., thermal, magnetic, electrical, or strength) might change with that structure, making different types of polymers (e.g., viscoelastic and rubbers), studying corrosion mechanisms and batteries, and understanding light-emitting diodes, properties and techniques of solders, gas dissolution in liquids and solids, phase transformations, cement fabrication, properties of ice, flammability of materials, and superconductivity. One of the hallmarks of these sessions is that they are non-competitive, so the participants need not worry about exams or their different speed of learning.

Finding volunteers to teach the roughly 80–100 sessions each year has been one of the most challenging problems with running the program at the NIST site. The main obstacles have been in overcoming the potential volunteers' fear of how to talk to these young children and of agreeing to a huge time commitment. Showing examples of good sessions helps to solve the former concern and asking these professionals to agree to teach only one two-hour session in their area of expertise one Saturday morning minimizes the latter uncertainty. However, I have found bartering and arm-twisting to be effective inducements as well. Once volunteers have led one of these sessions, they are usually willing to do it again, perhaps the following year. In addition, parents are also required to donate a certain amount of their time to running the program.

The guiding principles in each of these teaching sessions are (1) make it enjoyable, (2) teach the basic concepts in the leader's area of expertise through hands-on activities, (3) teach the children the scientific method of first making a guess followed by the design, conduct, and analysis of experiments to test that guess, and (4) get the children accustomed to discussing their results with others. The program directs the children to write down what they did in a provided notebook and encourages them to talk to participants in the other sessions on what they did.

In addition to the NIST site, the AIS Program has meeting sites at the National Institutes of Health (NIH), at a Lockheed-Martin facility in Gaithersburg, Maryland, and at the old Communications Satellite Corporation (COMSAT) facilities in Clarksburg, Maryland. This government/industry/community partnership has been key to the success of AIS, both to the program and to the constituent groups.

During the final month of the program, all of the AIS participants from the various sites are trained to communicate science in the formal setting of a regular scientific meeting at NIST with several simultaneous sessions run by adult moderators. The AIS participants from each site choose short projects to research and present at the meeting before an audience of their parents and other guests. This is done on the last day of the program in March, called Parent's Day. At a concluding ceremony in this event, a special guest speaker talks about science to the audience and serves as a role model to the children. Among these special guests in the past 14 years have been three Nobel laureates, three astronauts, and several local television and newspaper personalities. I feel it cannot be overemphasized how important role models are to encouraging young children into the sciences. My own father, Clifford G. Shull, was such a person for me. He was one of the Nobel laureates who spoke at AIS's Parent's Day, which he did shortly after his receiving the Nobel Prize in physics in 1994.

This non-profit program, in its 34th year of operation, was conceived in 1973 by Ralph Nash, a retired materials scientist from NASA-Goddard. When he noticed that the science courses his daughter was receiving through the local school system were dull and relied heavily on memorization, he started a "hands-on" science program in his basement for 10 local neighborhood children on Saturday mornings in which the children would conduct experiments and in general explore different scientific topics.

In 1980, the program had grown too large for Nash's basement and expanded to meeting at NIST (known then as the National Bureau of Standards), at a nearby Hewlett Packard Company building, and at a facility of Bechtel Power Corporation in Gaithersburg. In 1990, the AIS program joined the National 4H program as a way to help spread Adventure in Science nationally. As a consequence of this union, sites started up in Michigan, Baltimore City, and Baltimore County; this also showed the AIS model worked well in the inner city environment. By

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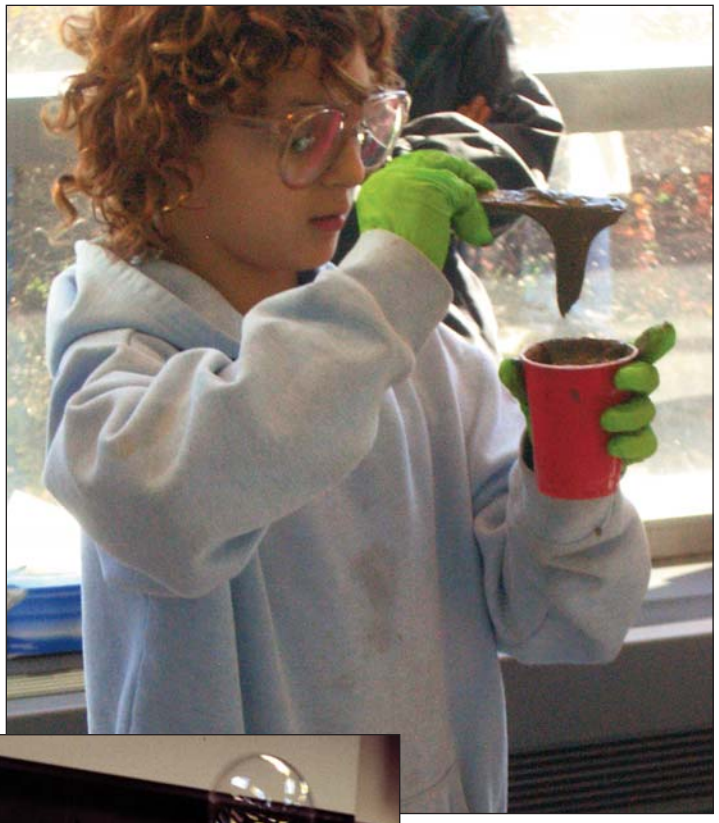

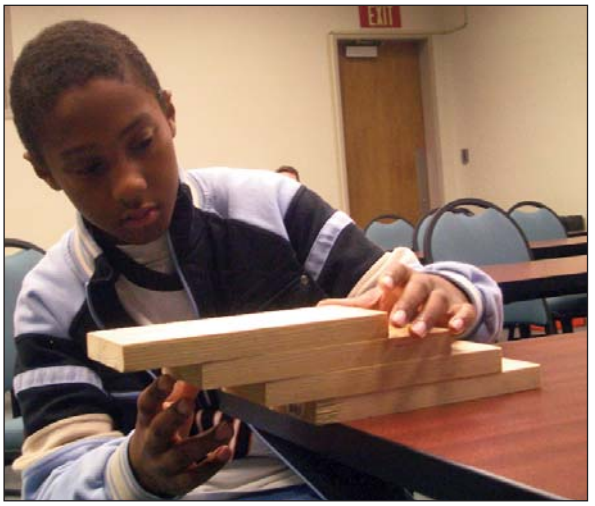

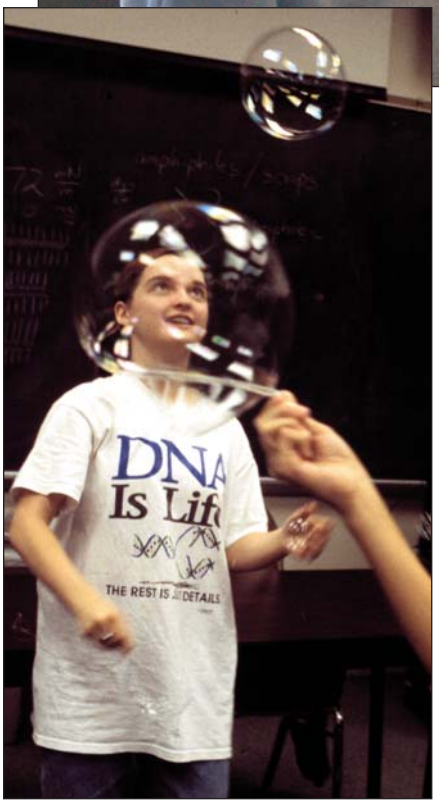

Children, ages 8–14, learn about various topics in science and mathematics, including materials science, at the Adventure in Science (AIS) Program held at various locations in the United States, including the site at the National Institute of Standards and Technology as shown: (clockwise, beginning with top-left photo) participants mix cement in a program on "Concrete," test stability ("Structures"), construct unit cells ("Crystallography"), measure Mg single crystals ("Density"), test the strength of knots ("Material Design"), and watch rising bubbles ("Soap Bubbles").

1995, the program had grown to 175–200 participants, and in 2000, I took on the additional responsibility of becoming president of AIS when Nash retired to Maine.

We are continually looking for volunteers and institutions interested in starting a site in their local area. We can provide a great deal of assistance in that effort. Contact me at shull@nist.gov.

Robert D. Shull *leads a group of scientists at the National Institute of Standards and Technology in the Metallurgy Division of the Materials Science and Engineering Laboratory on developing the science of properly measuring the magnetic properties of materials. He was a founding member of the U.S. Office of Science and Technology Policy Interagency Working Group on Nanotechnology (IWGN), the group that drafted the original National Nanotechnology Initiative in 2001. He is now president of The Minerals, Metals, and Materials Society (TMS) of AIME.*

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