Editorial

Energizing Students and Science

The recent meeting of the American Association for the Advancement of Science (AAAS), February 15–19, had as its theme "Science and Technology for Sustainable Well-Being". As a prelude to the meeting, there was a special section on energy and sustainability in the February 9, 2007 issue of *Science*, and an editorial by AAAS president John P. Holdren that listed challenges to sustainable well-being associated with energy use. Holdren's editorial concluded, "Nothing is more important to the human condition in the 21st century than rising to this set of challenges".

Who is going to rise to these challenges? Certainly scientists already involved in research, development, and administration of the many projects extant that aim to improve energy sustainability. But more importantly, I think, those young people whom we teachers will attract to science, encourage and enable to learn scientific principles and practices, and mentor to become the scientists, engineers, and technologists of the future. That is, the role of middle school, high school, and college teachers will probably be more important in the long run than the roles of the many scientists and engineers already involved. An important way in which we teachers need to rise to the many challenges of sustainable use of energy resources is to recruit students to science, develop their knowledge, skills, and understanding so that they can identify and address future problems associated with energy, and make them aware of the many ways in which their scientific careers could contribute to improving the human condition throughout the world.

How might we attract students to science and to the study of the kinds of problems summarized in the February 9 issue of *Science*? One very important way has been espoused by former ACS president Ron Breslow *(1)*, the late Richard Smalley *(2)*, and many others. It is to make students aware of the many problems that will have to be solved if we are to continue our energy-intensive economy and if developing economies are going to make use of energy at levels similar to ours. Nearly every one of those problems is going to require chemistry as part of its solution, and we should be calling upon the natural idealism of young people to interest them in the importance of dedicating their careers to fundamental science and applied science in search of solutions to these problems.

How can we develop students' knowledge and understanding of science and the scientific approach to problems? Certainly not by ignoring big, important, global problems and failing to even mention them in the classes we teach. Societal problems that can be addressed through chemistry or other sciences ought to be integrated into our descriptions and explanations of scientific principles. Many of them make excellent, concrete examples of how scientific principles can be applied to real-world situations. Even if they do not qualify as good examples of principles, they do illustrate how science works, how decisions are made regarding what research to do, and how useful and important science is—and will be in the future. And mentioning that scientists have tried to identify and anticipate problems that may affect society as a whole provides a good basis through which students can develop their own capacities for asking good questions of nature and of society.

Including in your classes discussion and examination of energy-related scientific and technical issues will benefit both your students and our society.

To contribute to the solutions of problems that are of great importance to society does not necessarily require that a student become an applied chemist or an engineer. Fundamental research has a major role to play and it is too bad that past levels of funding have not encouraged more to be done. Before we commit scarce resources to very expensive programs to develop alternative energy resources, to develop more efficient energy use, or to engineer sequestration of carbon or other major changes in the environment, we need many more answers to fundamental questions. Whitesides and Crabtree have listed nine long-term fundamental research problems that need more attention now because success or failure in solving them will be vital in making decisions about development of future energy technologies *(3)*. These are all basic research problems that could easily be discussed in both undergraduate and graduate courses. Many of them would make good subjects on which a student could develop a research proposal or capstone report.

If you have not already, I strongly encourage you to read the many articles in the February 9, 2007 issue of *Science*. There is much information and insight. You will almost certainly come away with many new ideas for topics you could incorporate in your teaching and many ways you can inspire students to productive scientific careers. Including in your classes discussion and examination of energy-related scientific and technical issues will benefit both your students and our society.

Literature Cited

1. Breslow, Ronald. *Chemistry Today and Tomorrow: The Central, Useful, and Creative Science*; American Chemical Society: Washington, DC, 1997. Breslow, Ronald; Tirrell, Matthew V. (co-chairs), Committee on Challenges for the Chemical Sciences in the 21st Century. *Beyond the Molecular Frontier: Challenges for Chemistry and Chemical Engineering*; National Academies Press: Washington, DC, 2003.
2. Smalley, Richard E. *New York Times,* September 2, 2003, p F3; *http://select.nytimes.com/gst/abstract.html?res=F30C17FC3D5C0C718CDDA00894DB404482&n=Top%2fNews%2fScience%2fTopics%2fChemistry* (accessed Mar 2007).
3. Whitesides, George M.; Crabtree, George W. *Science* **2007**, *315,* 796–798.