RECOMMENDED SCIENCE AND SOCIETY EDUCATIONAL RESOURCES

1. Karen L. Evans, Gaea Leinhardt, Michael Karabinos, and David Yaron, "Chemistry in the Field and chemistry in the Classroom: A Cognitive Disconnect?" *J. Chem. Ed.*, **83**(4), 655-661 (Apr 2006).

"A science knowledge base includes the nature of the scientific enterprise and the role of science in society as well as specific content," these authors write. "For a society to comprehend a specific domain of science requires that the public be able to use school science knowledge to interpret and use the news reports of cutting edge research to remain interested or when making personal choices or determining public policy." The degree to which high school chemistry courses enable the students taking them to make wise decisions as voters in their adult lives is the subject of this article.

The authors, which include a chemist, a chemistry teacher, an educational researcher, and an instructional designer, surveyed fifty years of Nobel Prize citations, all chemistry-related articles in *The New York Times* Science Times and *Scientific American* News Scan columns from 2002, two conventional chemistry texts, and the fourth edition of *Chemistry in the Community,* and coded what they read as "a new explanation, a new analysis, a new synthesis, or a new contribution to the toolbox." (The toolbox is a "collection of procedures and models" that "establish the technical vocabulary.") They found that only the textbooks made contributions to the toolbox, and that half the conventional texts were focused on this, with most of the rest focused on explanations. In addition to explanation, the non-text materials also focused on analysis and synthesis, and, of the texts, only *ChemCom* did this. In this they see "a bottom-up instructional approach in which instructors try to build a solid base of factoidal knowledge . . . presenting students with a vision of chemistry consisting of abstract concepts and tools such as chemical and mathematical symbols, formulas, and equations" leading to a "separation of learning from its intellectual and practical use," which "results in inert bits of unconnected knowledge that are rarely usable let alone memorable for students."

(*Editor's Note*: The fifth edition of *Chemistry in the Community* is reviewed in this issue.)

2. Sidney D. Drell, "The challenge of nuclear weapons," *Phys. Today*, **60**(6), 54-59 (Jun 2007).

Now that nuclear weapons are no longer essential to insure mutual deterrence during the cold war but instead pose a greater hazard as they threaten to proliferate to more places on Earth, this long-term advisor to the US government on technical issues of national security seeks to rekindle the spirit of the 2006 Reagan-Gorbachev meeting in Reykjavik, which nearly ended all nuclear weapons, and offers a program designed to meet the needs of nations seeking to develop nuclear technology for energy as well as the concerns of nations who have foregone the development of nuclear weaponry in order to keep nuclear proliferation under control.

(Editor's Note: This article is based on the author's talk, "What Are Nuclear Weapons For?" at the March 2007 meeting of the American Physical Society. Coverage of the author's talk to the

American Association of Physics Teachers about nuclear weapons concerns was reported in our Fall 2004 issue, with a follow-up in the Fall 2005 Clearinghouse Update.)

3. James Hansen, Makiko Sato, Pushker Kharecha, Gary Russell, David W. Lea, and Mark Siddall, "Climate change and trace gases," *Phil. Trans. R. Soc. A*, **365**, 1925-1954 (2007).

On the basis of their interpretation of synchroneity of climate forcing and ice sheet response, and taking into account nonlinearization in the ice sheet response, these authors see grave danger to the West Antarctic and Greenland ice sheets and, with it, the end of an extended period of stable climate which has lasted the past 12,000 years. These consequences are far more dire than those predicted by the IPCC (Intergovernmental Panel on Climate Change) based on linear ice sheet response. According to these authors, the only way to avoid these dire consequences is to limit atmospheric carbon dioxide to 450-475 ppm, which would allow only one more Celsius degree increase in average global temperature than at present. This would allow the world's remaining supplies of gas and oil to be burned but would require immediate phasing out of coal, unless its carbon dioxide emissions are captured and sequestered. The emission of all other greenhouse gases into the atmosphere would also have to be stopped.

4. Albert V. Crewe, "SCIENCE And the War on . . .," *Phys. Today*, **20**(10), 25-30 (Oct 1967), reprinted in *Phys. Today*, **60**(7), 45-50 (Jul 2007).

This archival description of what the scientific community could develop 40 years ago to wage "war" on pollution and crime is less of interest for any particular scientific or technological developments than for what it says about the relationship between science and society. If scientists pursue problems of interest to them but without regard to societal need, risks result for both science and society. "There is a great deal that the scientific community can do to accept the problems that face our own society and apply to them the same kind of scientific reasoning that we apply to problems which we choose ourselves," Crew writes. "After all, the man in the street is more likely to accept our claims for supporting the luxury of basic science if we can also demonstrate that science is eminently practical and essentially relevant." Crewe also laments that "Our existing governmental structure cannot be expected to seek our advice and help because they are much more accustomed to solving problems by new legislation or new appropriations."

5. Philip W. Mote and Georg Kaser, "The Shrinking Glaciers of Kilimanjaro: Can Global Warming Be Blamed?," *Am. Sci.*, **95**, 318-325 (Jul-Aug 2007).

The answer, briefly, to the question raised in the title of this article is "no." What is causing the Kilimanjaro glacier to shrink is continued sublimation (which reduces the amount of ice) and reduced snowfall (which would act to replace the ice removed).

6. Jim Dawson, "Interim sites for spent nuclear fuel are of limited value," *Phys. Today*, **60** (4), 30 (Apr 2007).

A report by the American Physical Society, Consolidated Interim Storage of Commercial Spent Nuclear Fuel, concludes that, if the planned permanent waste repository at Yucca

Mountain, NV, isn't "substantially" delayed beyond 2017, there is no benefit to moving spent nuclear fuel from its present temporary storage to an interim storage site. This is because "there is sufficient space at all operating nuclear reactors to store all spent nuclear fuel in pools and in existing or additional dry casks . . . for the duration of the plant licenses." However, if the spent fuel could be moved from nine reactors which have shut down, those reactors and their sites could be decommissioned. Such a transfer of spent nuclear fuel "would establish a process for taking Federal title to commercial spent fuel and decouple private sector nuclear power plant operators from the long-term spent-fuel management problem" and remove "a potential obstacle to siting new nuclear power plants." This latter point is especially significant to the Nuclear Energy Institute.

Dawson's report also refers to the proposal, cited at "The Role of Nuclear Energy" workshop at Washington and Lee University 20-24 June 2007 (lead story in this issue), to lift the 70,000 metric ton cap on waste disposal at Yucca Mountain.

7. Gregory P. Laughlin, "Extrasolar Planetary Systems," *Am. Sci.*, **94**, 420-429 (Sep-Oct 2006).

This article investigates mechanisms whereby extrasolar planets are formed and reports systematics of those which have already been observed. Laughlin characterizes many already observed extrasolar planets as "Hot Jupiters" or "Eccentric Giants," and he reports that at least one such extrasolar planet "accompanies a bit less than 10 percent of the stars in the solar neighborhood." In addressing the conjecture of "What about the other 90 percent?" Laughlin considers the "metallicity" of stars (their percentage of heavy elements) and notes that a star like our Sun, with somewhat less than 2% heavy metals by mass, has "a roughly 5 percent chance of harboring a readily detectable Hot Jupiter or Eccentric Giant." He then adds that "When the stellar metallicity increases to twice the solar value, however, the rate of planet detection jumps by more than a factor of five."

On the other hand, "Surveys of stellar wobble have located a number of Neptune-mass planets orbiting the 150-odd red dwarfs that are near enough . . . to be studied in this way," in agreement with calculations Laughlin has done. Laughlin also writes that "we don't expect to revise the fundamental conclusion of the last decade -- that our galaxy alone contains many billions of planets."

8. Susan Solomon, John S. Daniel and Daniel L. Druckenbrod, "Revolutionary Minds," *Am. Sci.*, **95**, 430-437 (Sep-Oct 2007).

You may have received a gold star from your elementary teacher for a series of temperature measurements done every day at the same time at your home, but if you were the third and fourth president of the United States, your data merit an article in the flagship publication of Sigma Xi. The data discussed here were measured at sunrise and 4 p.m. (supposedly the coolest and warmest parts of the day). Although the Philosophical Transactions of the Royal Society of London recommended mounting thermometers in unheated rooms of a house, Madison's family moved his thermometer out to the porch while the founding father attended the Constitutional Convention, and this difference forms the basis of this article, with emphasis on the difference between Madison's and Jefferson's data in February 1790.

9. Richard A. Kerr, "Even Oil Optimists Expect Energy Demand to Outstrip Supply," *Science*, **317**, 437 (27 Jul 2007).

The National Petroleum Council predicts a 50%-60% increase in demand for oil by 2030, the same as the rate of increase in production the past 25 years. But extracting oil will be more difficult in the next 25 years, and the Association for the Study of Peak Oil and Gas predicts that actual production, peaking in 2015, will begin to fall short of demand in 2010.

10. Jeffrey Mervis, "A New Twist on Training Teachers," *Science*, **316**, 1270-1277 (1 Jun 2007).

Three promising programs for training high school physics teachers are profiled -- at Brigham Young University (producing 5% of all U.S. high school physics teachers), UTeach at the University of Texas (ExxonMobil Foundation has created a National Mathematics and Science Initiative to replicate it), and the Learning Assistant Program at the University of Colorado at Boulder. Characteristics of all these programs are pointed up as keys to their success: 1) they are implemented by science as well as education departments; 2) their courses are taught by master classroom teachers as well as university faculty; 3) their courses are taught the way their students are expected to teach; and 4) teaching is encouraged and treated as a respected profession.

11. David Schneider, "Who's Resuscitating the Electric Car?" *Am. Sci*., **95**, 403-404 (Sep-Oct 2007).

Schneider fingers the battery as the villainous answer that was left off the hook in Who Killed the Electric Car? The reason is that the traditional lead-acid batteries that energized early electric vehicles such as GM's EV1 allowed a car to travel only 65 miles. Subsequent improvements due to nickel-metal-hydride (NiMH) batteries increased this only to 100 miles. New hope is seen from the lithium-ion batteries used to energize laptop computers -- if safe versions can be produced (laptop batteries have been known to burst into flames). As Schneider writes, "such an event is problematic enough when it happens to a 30-watt-hour laptop battery; with a 30-kilowatt-hour vehicle battery, it could be catastrophic." The most promising modification of the lithium-ion battery replaces lithiated carbon (the cause for the flames) by lithium titanate. An added feature is the ability to re-energize the battery in 10 minutes. Meanwhile, Tesla Motors will shortly market a roadster using 6831 lithium-ion batteries to provide more than 200 miles of driving.

12. *The Science Teacher*, **74**(6), (Sep 2007).

The theme of this issue is "weather and climate." Articles range from investigating environmental effects to activities based on the web to the infusion of climate determinants into a physics course.

13. Pervez Amirali Hoodbhoy, "Science and the Islamic world -- The quest for rapprochement," *Phys. Today*, **60**(8), 49-55 (Aug 2007).

The chair of the physics department at Quaid-i-Azam University in Islamabad, Pakistan, expresses his concern that, following "Islam's Golden Age in the 9th-13th centuries" that "created algebra, elucidated principles of optics, established the body's circulation of blood, named stars, . . . science in the Islamic world essentially collapsed." "That arrested scientific development is one important element," Hoodbhoy continues, "that contributes to the present marginalization of Muslims and a growing sense of injustice and victimhood." Hoodbhoy's greatest concern is that "a bloody clash of civilizations, should it actually transpire, will surely rank along with the other two most dangerous challenges to life on our planet -- climate change and nuclear proliferation."

When Hoodbhoy compares the 57 counties of the Organization of the Islamic Conference (OIC) with the world, he finds that the world average of scientists, engineers, and technicians per 1000 persons is 40.7, and that 2.4% of gross national product is spent on research and development. For the OIC these figures are 8.5 and 0.3%.

Hoodbhoy sees this disparity as a reflection of the pressure of religion, not unlike that which has spawned creationism in the U.S. "Science, in the view of fundamentalists, is principally seen as valuable for establishing yet more proofs of God," he writes. "The scientific method is alien to traditional, unreformed religious thought," he continues, noting that "if the scientific method is trashed . . . scientific research becomes, at best, a kind of cataloging or 'butterfly-collecting' activity."

But it was not always this way in Islamic nations. "In the mid-1950s all Muslim leaders were secular, and secularism in Islam was growing." Hoodbhoy then catalogs Western political decisions that enhanced the status of Islamic fundamentalism. "The struggle to usher in science will have to go side-by-side with a much wider campaign to elbow out rigid orthodoxy and bring in modern thought, arts, philosophy, democracy, and pluralism," he counsels.

Hoodbhoy's article also inspired Jay Tolson to write about it in the 10 September 2007 issue of *US News & World Report*.