RECOMMENDED SCIENCE AND SOCIETY EDUCATIONAL RESOURCES

1. David Bodansky, "Reprocessing spent nuclear fuel," *Physics Today*, **59**(12), 80-81 (Dec 2006).

The original concept of the fuel cycle for nuclear reactors envisioned extracting plutonium and uranium from spent light water reactor fuel for future use in breeder reactors, but the threat of nuclear proliferation caused President Carter to cease such reprocessing of spent nuclear fuel. If anything, the threat of nuclear proliferation is even more dangerous today, but the renewed interest in nuclear energy because it does not contribute to global warming has prompted a renewed interest in spent nuclear fuel reprocessing. Instead of the PUREX (Plutonium and Uranium Recover by EXtraction) process once envisioned, the processes under current consideration are the UREX+ process (PUREX without the plutonium) and the pyrochemical process. Both processes separate spent light water reactor fuel into three streams -- uranium, plutonium and other actinides (that make the plutonium unfit for s, though it can be used as fuel in a fast neutron reactor), and the shorter-lived fission products. The difference is the chemistry used to reprocess the fuel: UREX+ dissolves the spent fuel in nitric acid, and the pyrochemical process uses a bath of chloride salts at a temperature high enough to melt the fuel, followed by electrorefining.

2. Aimee L. Stern and Elizabeth McCrocklin, *What Works Best in Science & Mathematics Education Reform*, <http://www.pcgpr.com/graphics/NSFmathscience.pdf>.

The authors of this report on the National Science Foundation's Urban Systemic Program (formerly Initiatives), which reached more than a third of all U.S. public school students in 36 American cities between 1994 and 2003, visited more than 100 classrooms in 11 elementary, 13 middle, and 17 high schools in focusing on the achievements of eight selected urban districts: Brownsville, TX; Jacksonville, FL; Columbus, OH; San Diego, CA; Miami, FL; Houston, TX, Chattanooga, TN; and Los Angeles, CA.

3. Wasim Maziak, "Science in the Arab World: Vision of Glories Beyond," *Science*, **308**, 1416-1418 (3 Jun 05).

The thesis of this assessment is that Arab states have become rich with oil money, but "wealth . . . is powerless against the culture of those who create and own the technology." Arab states have been invaded by Western technology, and they have been hurt by assuming a stance of being receivers of but not contributors to technology. Instead, they have turned away from technology and toward Islam, further embittering themselves against the West. A further impediment to the pursuit of science in Arab states is the lack of openness, required of science, in their governments.

"The same information revolution that has been perceived by so many Arabs as threatening also presents an unprecedented opportunity for every nation in the world to close the science and technology gap. Every society now has the means to build its own science and technology capacities and in ways that do not necessarily follow the path of the West's scientific revolution. Such a prospect should make it easier for Eastern cultures to build their science base, and indeed, many nations in Asia are doing just that without much concern about the loss of their cultural identity or moral values."

"The global arena is open to everybody, and the more a nation is advanced technologically and open to new ideas, the more it is likely to contribute to, and influence, the emerging global culture. The dilemma for Arabs today comes down to choosing between self-exile from the global community for the sake of preserving cultural identity, or contributing one's own identity to a global culture with no specific or chosen color, religion, or ideology."

4. Wallace Broecker, "CO2 Arithmetic," *Science*, **315**, 1371 (9 Mar 07).

Burning 4 Gt of carbon increases the carbon dioxide concentration in the atmosphere by 1 ppm. Presently the world burns twice this amount in one year. Broecker advocates dealing with carbon burning in terms of the maximum concentration of atmospheric carbon dioxide we are willing to tolerate. This in turn determines the size of the "carbon pie," which is the amount of carbon we may still burn without sequestering the carbon dioxide produced. A maximum atmospheric carbon dioxide concentration of 450 ppm gives a 280 Gt carbon pie; doubling the preindustrial atmospheric carbon dioxide concentration to 560 ppm gives a 720 Gt pie. The difficult part of this approach to the carbon dioxide problem is how to divide the pie up among the nations of the world.

5. Michael Eikerling, Alexei A. Kornyshev, and Anthony R. Kucernak, "Water in polymer electrolyte fuel cells: Friend or foe?" *Phys. Today*, **59**(10), 38-44 (Oct 06).

The role of water in a fuel cell is complicated by the fact that water is both a component chemical and a chemical by-product. These authors suggest that "water in fuel cells acts not as a fuel but as a 'lubricant,'" then add, "If the lubricant is too hot, it evaporates and is lost, proton conduction then worsens, and local heating effects degrade the cell. If it is too cold, the lubricant freezes solid, also resulting in local heating and possibly irreversible cell deformation. Too much water drowns the cell and makes it function inefficiently; too little dehydrates it."

6. Silvan S. Schweber, "Defending against nuclear weapons: A 1950s proposal," *Phys. Today*, **6**0(4), 36-41 (Apr 07).

The proposal described in this article was that of Robert R. Wilson to defend against oncoming nuclear weapons with particle beams generated by portable particle accelerators using strong focusing. Although the accelerators Wilson envisioned were never used for their originally intended purpose, they later found a beneficial application in cancer therapy, because it was found that protons, unlike x rays, would deposit most of their energy in a region whose

depth was determined by the proton energy. Indeed, the article cites that "more than 45,000 people have undergone proton cancer therapy."