TEACHERS CLEARINGHOUSE FOR SCIENCE AND SOCIETY EDUCATION NEWSLETTER

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Clearinghouse Contributor Honored
Bartlett Receives Award

by John L. Roeder

Last 13 October I received a most heartwarming letter from Al Bartlett. "Dear John," it read. "This letter just came in and I thought I would share it with you promptly. Apparently my short article in your Newsletter won a writing prize for articles on population. Thanks so much for publishing the article."

The letter Al had received was from Jennie Wetter, Program Manager of the Population Institute, "an international, educational, non-profit organization that seeks to voluntarily reduce excessive population growth, through universal access to family planning information, education and services." This is what Wetter wrote:

> It is with great pleasure that I inform you of your selection as one of the winners of the 29th Annual Global Media Awards for Excellence in Population Reporting in the category of Best Magazine Article for your article entitled "Why Have Scientists Succumbed to Political Correctness?" appearing in the *Teachers Clearinghouse for Science and Society Education Newsletter*. We look forward to your presence in Los Angeles, CA, to accept the award and your participation in population related events from 17

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Bartlett recalls LA experience

by Albert A. Bartlett

At the time of the meeting, I was in the middle of a series of chemotherapy treatments that left me quite weak, so I had to have my daughter Jane accompany me to help get me through the airports, *etc.*

We arrived at Los Angeles on Monday, 17 November, where we met several of the other participants for the Population Institute's Awards meeting and traveled by van to the Luxe Hotel on Sunset Boulevard in Bel Air. That evening there was a welcome dinner and reception for the award winners. Here we had the opportunity to meet William Ryerson, President of the Population Institute, and several of the staff and directors of the Institute.

On Tuesday we were guests of the Population Institute at a day-long symposium, "Changing Climate… Changing People, Connecting to the Biggest Story of Our Time," which was held at the nearby Skirball Cultural Center. This was billed as

> . . . a Climate Change Summit in Hollywood for the American entertainment industry, to promote the use of entertainment-education strategies to address the

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Why Have Scientists Succumbed to Political Correctness?

by Albert A. Bartlett

Throughout the world, scientists are prominently involved in seeking solutions to the major scientific problems such as global climate change and the growing inadequacy of energy supplies. The scientists present their writings in publications ranging from newspapers to refereed scientific journals, but with a few rare exceptions, on one point they all replace scientific objectivity with "political correctness." In their writings the scientists identify growing populations as being the cause of the problems. But their recommendations for solving the problems caused by population growth almost never include the recommendation that we advocate stopping population growth. Political Correctness dictates that we

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Grunow: Hiroshima from the Japanese point of view

In his book, *Hiroshima: The World's Bomb* (reviewed in our Fall 2008 issue), Andrew Rotter raises the following questions:

- "Was the bomb necessary to end the war?"
- "Were both bombs needed?"
- "In their absence, or with a decision not to use them, would it have taken a bloody American invasion of Japan itself to achieve surrender?"
- "Would it have been enough for the Untied States to have modified its demand that Japan surrender unconditionally, perhaps by signaling that the imperial system, the *kokutai*, could be retained?"

While Rotter deals with these questions in terms of actions at the highest levels of government, Tristian Grunow deals with them at the level of Japanese scientists and military officers in his paper, "A Reexamination of the 'Shock of Hiroshima': The Japanese Bomb Porjects and the Surrender Decision," which received the Frank B. Gibney Essay Award and was published in *The Journal of American-East Asian Relations*, **12**(3-4) (Fall-Winter 2003). Grunow also cites a more extensive literature by Japanese authors.

According to Grunow, Japan had three separate programs investigating the possibility of producing atomic weapons – one started by the Army, two by the Navy (one as early as 1934) – all of which concluded that developing such weapons for use in World War II was not feasible, neither for Japan nor any other combatant in the war, though they apparently knew no more than rumors about what was happening in other countries, even about Germany. Thus dropping the atomic bomb on Hiroshima caused the Japanese to doubt that it was an atomic weapon and to consider President Truman's announcement to be American propaganda. Although the delegation sent to investigate the destruction at Hiroshima eventually concluded that the bomb was atomic, their report was not submitted until 10 August, the day *after* Nagasaki was bombed. Even then there continued to be doubt that the Hiroshima bomb was atomic, and a conference debating this question was held as late as 15 August, the date of Japan's official surrender.

Although the Japanese Cabinet was persuaded by its military ministers on 7 August to delay any response, pending the report on the Hiroshima bomb, the receipt of this report came after the civilian leaders of the government had prevailed upon Emperor Hirohito to agree to the surrender terms of the Potsdam Declaration with the provision of maintaining Japan's imperial system of government.

Even after the Soviet invasion of Manchuria and the bombing of Nagasaki, the Japanese military were reluctant to surrender, because they felt they could get better terms at the negotiating table from defending

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IN THIS ISSUE

The TEACHERS CLEARINGHOUSE FOR SCIENCE AND SOCIETY EDUCATION, INC., was founded at The New Lincoln School on 11 March 1982 by Irma S. Jarcho, John L. Roeder, and the late Nancy S. Van Vranken. Its purpose is to channel information on science and society education to interested readers. To this end it publishes this *Newsletter* three times a year. Thanks to funds from tax-deductible contributions, the Clearinghouse is happy to be able to offer its services for a one-time nominal charge. In order to continue offering its services for a nominal charge, it also solicits underwriting of its publications by interested corporate sponsors. All correspondence should be addressed to the editor-in-chief at 194 Washington Road, Princeton, NJ 08540-6447 or via e-mail at <JLRoeder@aol.com>. The Clearinghouse is sponsored by the Association of Teachers in Independent Schools, Inc., and is affiliated with the Triangle Coalition for Science and Technology Education.

Horak Charts Ways to Reduce Carbon Dioxide Emissions

Compared to other countries in the world, the U.S. is relatively energy independent. This is because 80 percent of our energy comes from North America, while most Saudi oil goes to Europe. Our sense of energy dependence comes from our shortfall in transportation, which is 97% dependent on oil, as opposed to only 70% in Europe.

This is how William Horak, Chair of the Energy Science and Technology Department of Brookhaven National Laboratory, opened his presentation to the Physics Club of New York at New York University on "Energy and the Environment: Pathways to a Low Carbon Infrastructure" on 13 March. And our awareness of our shortfall in transportation sparked our interest in everything he had to say. Horak structured his presentation in the context of what he called the Energy Trifecta: 1) the American Recovery and Reinvestment Act of 2009 (aka "Stimulus Bill"), 2) the Energy Policy Act of 2009, and 3) the Climate Change and Recovery Act of 2009. The "Grand Challenge," he said, was to increase energy supply while decreasing carbon intensity.

Horak cited three approaches to reduced carbon intensity: 1) Socolow and Pacala's "wedges" from their article in *Science* (**305**, 968-972 (13 Aug 04)), most recently referenced in the Spring 2008 issue of this *Newsletter* in our coverage of a talk by Socolow himself); 2) a report from EPRI (Electric Power Research Institute) in 2007; and 3) McKinsey's *Reducing US Greenhouse Gas Emissions: How Much at What Cost?*(2007). He categorized Socolow and Pacala's 15 "wedges" as follows: end-user efficiency and conservation (3); power generation (2); carbon capture and sequestration (CCS) (3); alternative energy (5); and agriculture and forestry (2). He also displayed a bar graph from the McKinsey report showing cost on the vertical axis plotted against the number of gigatons of carbon that would be eliminated per year, starting with negative bars representing savings from conservation measures and then positive bars representing costs for alternative energy sources. Horak observed that, because the savings from the negative bars pretty much equaled the costs from the positive bars, the issue of dealing with climate change is not economic but rather choosing how to do it. He added, though, that the amount of savings was conditioned on the degree to which the measures which lead to savings could penetrate the market.

There are many energy-environment assessment tools, Horak said, ranging from simple spreadsheet models to sophisticated human factors (semi-delphic) models. Brookhaven uses MARKAL (for MARKet ALlocation), with a reference energy system calibrated to the National Energy Modeling System (NEMS), with a wells-to-wheel approach, detailed technology models, and market penetration based on least cost (though he cautioned that people sometimes make economic decisions for reasons other than least cost). MARKAL does energy policy analyses to answer "what if" questions. It gives answers for reaching specified goals but does not provide a roadmap to the future. One of the applications of MARKAL concerned carbon prices for a variety of technology sets, with "business as usual" technology set as a base. Horak showed a graph of cost per ton of carbon dioxide removed versus the amount of carbon dioxide to be eliminated. The graph started at the origin and increased in a concave upward shape, rising to $100/ton carbon dioxide at the targeted amount of carbon dioxide to achieve a stabilized average global temperature. He then displayed the effect of adding in seven different carbon dioxide reducing measures (including IGCC (integrated gas combined cycle) with CCS, nuclear, geothermal, solar, and wind). Each lowers the curve and moves the point at which the cost of carbon dioxide removal becomes positive over to the amount of carbon dioxide it can remove. Horak observed that carbon dioxide emissions credits were recently auctioned for $3/ton carbon dioxide.

Other studies with MARKAL have investigated the potential impact of hydrogen fuel production, the effect of the Global Nuclear Energy Partnership program (with the nuclear power base decreasing in 2030 as old plants are decommissioned and not replaced), and whether it would be better to trade with Brazil for ethanol rather than produce it with locally-grown corn (probably not, given that Brazil is likely to increase its use to all it can make).

Regarding the "Energy Trifecta," Horak outlined the financial provisions of the "Stimulus Bill": $38.7 billion to the US Department of Energy (DOE), including $11.3 billion for grants to states and municipalities for energy efficiency projects; $2 billion for advanced batteries, $4.5 billion for a "smart [electric power] grid"; $3.4 billion for CCS; $6 billion for loan guarantees, and $4.5 billion for research and development (with $0.4 billion for ARPA-E (to develop novel innovations related to energy as DARPA does for the Department of Defense), $0.7 billion for biofuels, and $0.4 billion for geothermal). Horak noted that since McKinsey is a consultant for DOE, the Stimulus Bill priorities match the mid-range abatement curve in his report.

The second part of the Trifecta is the Energy Policy Act of 2009. Horak expected it to contain proposals from Representatives Waxman and Markey, with an energy

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Schauer considers applications of polysaccharides

Noting that responsible scientists need to look at the waste stream as a source of useful materials, Caroline L. Schauer of the Department of Materials Science and Engineering of Drexel University presented "Polysaccharides: From Waste Products to Smart Materials" at the "Science on Saturday" lecture at the Princeton Plasma Physics Laboratory on 24 January 2009. In addition to the well-known polysaccharides, cellulose and starch, Schauer also listed among the "common" polysaccharides chitin (from seafood shells), alginate (from seaweed), hyaluronic acid (involved in healing wounds), and chondroitin sulfate (lost in injuries to joints). Clearly, chitin is a waste product from the seafood industry. Schauer noted that cellulose is a waste product from the citrus industry (what do you do with all the orange rind after you make orange juice?). Among other things, Schauer cited, waste polysaccharides can be used for construction materials, paper products, water absorption (diaper manufacture), and ion exchange/metal chelation (useful for industrial wastewater treatment).

Schauer focused her talk on chitin, and its "cousin," chitosan. Chitin, of which arthropods produce more than a billion tons a year, is a polymer of "x"- and "y"-units (the "x" contains an amide group, NH_2, while the "y" has an acetyl group substituting for an H in its amide group). Chitin is also found in butterfly wings and beetle shells, she noted.

Chitin is bacteriostatic, immunologic, and hemostatic, and has anticoagulant properties. Its medicinal uses include artificial skin, corneal bandages, contact lenses, surgical suture thread, and implants. It is also found in cosmetics, because of its tolerance by skin and ability to hydrate skin.

Because chitin is so insoluble, its "cousin" chitosan (with a different ratio of "x"- and "y"-units) lends itself to other applications – it is soluble in dilute acid (but the solution it forms is very viscuous). Chitosan is useful in treating drinking water by removing organic chemicals and heavy metals. It is also useful for stent coatings and dressings to heal wounds.

Toxic metal ions bind to chitosan, but the +6 state of chromium reacts differently. Schauer has studied this by looking for color change in chitosan thin films. People's breath also causes color change – *e.g.,* acetone in the breath of diabetics. Smoker's breath also causes a distinct color. In view of this, Schauer has in mind to use the effect of breath on the color of chitosan thin films as a noninvasive medical test. These thin films have subsequently been modified to make them able to discriminate and indicate the presence of specific metal ions.

Chitosan has also been electrospun into fiber and fibrous mesh – onto both skin and metal, to serve as filters. Here, too, modifications are made to make the filter sensitive to specific compounds, and, in the case of toxic compounds, to destroy them.

AAAS Symposia address a sustainable Earth

Sustainability was a key theme of many symposia at the joint winter meeting of the American Association of Physics Teachers and the American Association for the Advancement of Science in Chicago. At one, "Toward the Science and Ethics of A Culture of Sustainability," the closing speaker, Mary Evelyn Tucker of Yale University, described Earth Charter, which sees Earth as providing the conditions for life and humans as geological, environmental, and biological beings, not at the top of a Medieval hierarchy but rather recentering humans as a part of life with respect for life. There must also be social and economic justice and no dominance by the first world over the second and third, Tucker said.

She noted that eco-economists like the Calvert Group have drawn on the Earth Charter, as have those arguing for a sustainable lifestyle and sufficiency within a finite planet. The Earth Charter, she added, is also invoked to promote the Millennium Development Goals. For more information about the Earth Charter, visit <www.earthcharter.org>.

Likewise, Susan Kieffer of the University of Illinois, speaking on "Celebrating the Earth: Its Past, Our Present, A Future?" regarded Planet Earth as Island Earth. We need to create the equivalent of a CDC (Centers for Disease Control) for Earth, and our actions cannot be grand delusions, she said. We owe it to our children and grandchildren not to fail as a society, but if we do, it is possible that at some future date a new society may arise upon the rubble of our finite resources.

Also pertinent to a sustainable Earth was the talk by Jean-Claude Gascard of Universtie Pierre et Marie Curie, Paris, on "The Arctic: An Outpost for Climate Changes" in a symposium on "The Disappearing Arctic Sea Ice." Associated with disappearing Arctic ice (which is predicted by climate models to completely disappear in the next 50 years), noted Gascard, is melting of the Greenland ice sheet. This will not only raise sea level but also slow down the thermal conveyor belt warming the North Atlantic. Unlike the Antarctic, the Arctic is not covered by international treaty, and we are not in a position to stop and wait.

AAAS Symposia address food *vs.* fuel

Two symposia at the joint winter meeting of the American Association of Physics Teachers and the American Association for the Advancement of Science in Chicago pointed up the relationship between production of food and sustainable energy. Held on 15 February 2009 at the Hyatt Regency Hotel, one symposium, organized by Susan Cozzens of Georgia Institute of Technology, was titled "Biofuels Ablaze"; the other, "Food for Thought: Feeding Ourselves, Feeding the Climate Crisis," was organized by Astrid J. Scholz of Ecotrust (Portland, OR) and Nathan Pelletier, Dalhousie University, Halifax, Canada.

The first speaker at the "Biofuels Ablaze" symposium, Mark Rosegrant of the International Food Policy Research Institute, Washington, DC, began by observing that while biomass accounts for 90% of the energy for many developing countries, food is still more expensive (food costs 80 cents per day, while energy costs only 9.3 cents). There is a direct correlation between hunger and biomass use, Rosegrant added. Production of more biomass could provide more energy to improve living standards, he went on, but he maintained that these biomass crops should not take away from agricultural output for food. Already, he said, increasing malnutrition is being seen in these countries. Jatropha, sweet sorghum, and pongamia, he noted, are suitable biomass crops now being developed.

The second "Biofuels Ablaze" speaker, Tom Wilbanks of Oak Ridge National Laboratory, observed that breakthroughs in science and technology have driven societal change better than we can cope with it. Thus, he said, we need to develop mechanisms, based on past experience, on how to deal with emerging social concerns. Some past changes he cited that have elicted social concerns are nuclear energy, radioactive waste, and DNA manipulation. Science and technology focuses on the possibilities made possible by change, Wilbanks noted, while societal concerns are based on risk. He added that it has been helpful to involve the public in discussion about perceived risks. Current emergent technologies with risks and concerns include nanotechnology, biotechnology, and information technology.

Technology acceptance is fundamentally a social process, Wilbanks continued. He was particularly concerned about bioengineering for alternative energy technologies – *e.g.*, engineering organisms so that they can survive only in a biomass refinery, to produce more hydrocarbons, and to facilitate production of cellulosic ethanol. The risks, as in all bioengineered species, are the consequences of their escape and "contaminating" natural species by interbreeding with them.

Cozzens and Diran Soumonni then looked at "World News Coverage of Public Perceptions" of biofuel production. Biofuels, they said, are an example of a global learning process directed to solving a world-level problem. They found a correlation between articles about biofuels development and oil process, with the former lagging the latter by about a year. Cozzens and Soumonni surveyed the Lexis-Nexis Major World Contributions for 2003-2008 but noted that this database covers only English language publications. They reported finding a strong spurt between 2006 and 2007, with a leveling or slight dropoff in 2008.

In 2003-2005 oil prices ranged from $25 to $61 per barrel, they recalled. Palm oil in Asia and other biodiesel feedstocks were dominant. Europe had already set its target of providing 10% of its liquid fuel from biomass. During this time the role of the sugar industry emerged in Latin America. And in the U.S. ethanol was seen as a replacement oxygenator for MTBE, and feedstock prices were seen to be rising even then.

Then in 2006-2008 oil prices spiked at $171 per barrel. Consequent African biofuel investment caused food prices to inflate, and ethanol production threatened wheat production in Australia. Ongoing developments in Asia and the U.S. continued, and Latin America and Caribbean countries increased their sugar allocation to ethanol.

In their assessment of the world news coverage of these events, they reported finding articles from the Associated Press to be balanced between food and fuel, that Africa News had many more articles on food, while *The New York Times* and *The Washington Post* emphasized energy and *The Washington Times* emphasized food, to the point of discrediting biomass. Europe responded most quickly to the food *vs.* food controversy and abandoned its 10% standard. Cozzens and Soumonni concluded that global learning does occur, but that global governance is harder.

If there ever were any doubt about whether food crops should be used for fuel, David Pimentel of Cornell University put it to rest at the "Food for Thought" symposium. Echoing Arjun Makhijani's argument that photovoltaic cells are a much more efficient absorber of solar energy than plants (his *Carbon-Free and Nuclear-Free: a Roadmap for U.S. Energy Policy* was reviewed in our Winter 2008 issue), Pimentel began his talk by contrasting the 0.1% of incident solar energy captured by green plants with 20% which can be captured by photovoltaic cells. Moreover, even if we devoted all the biomass har-

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food *vs.* fuel

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vested in the U.S. to biofuels, we could not provide the equivalent of our present fossil fuel needs. From 900 million tons from crops, 527 million tons from grass, and 600 million tons from forests we could produce 30 quadrillion Btu (quads, or Q), but our present fossil fuel needs are 100 Q. A gallon of ethanol (containing 19,400 kilocalories) requires 22 pounds of corn, 1700 gallons of water, and 28,500 kilocalories of energy (almost as much as the 30,000 kilocalories in a gallon of gasoline). To feed an SUV once thus requires 660 pounds of corn, enough to feed two people for a year. Evaluations of ethanol viability, Pimentel said, ignore the overhead and negative environmental consequences of producing it.

Currently, he said, the U.S. produces 9 billion gallons of ethanol from 33% of the corn grown; it provides 1.3% of our total oil consumption. Add to that all the ethanol produced in Brazil, he went on, and you still provide only 2% of U.S. oil consumption. Pimentel added that ethanol production is also subsidized sixty times as much as that of gasoline.

He was not enthusiastic about producing biofuels from other sources, either. Cellulosic alcohol, which some have viewed more favorably than that produced from corn, requires 100 pounds of biomass per gallon. Pimentel also discredited the viability of producing biofuel from algae.

Helene York of the Bon Appetit Food Management Company Foundation next spoke about the "Bon Appetit Management Company's Low-Carbon Diet program." She said that 49% of the meals American's eat are prepared in commercial kitchens, that this percentage has not changed in recent years, though the types of foods people buy have changed.

York said that Bon Appetit chefs determine their own menus and must make their foods from scratch, with emphasis on using locally-grown (within a radius of 150 miles) foods. Their Low-Carbon Diet Program was instituted in 2007, the first national program to act to minimize climate change from the food industry. It looks at life-cycle effects of its food, not just the transportation miles. There are four components to this program: 1) reduction of beef and cheese 25% in two years (10% in the first year); 2) elimination of air-freighted food products, beginning with seafood (they have found with their own taste tests that frozen seafood tastes as good as fresh); 3) reduction of food waste (which requires educating front-line servers to provide portions matching the food consumption of eaters); 4) achievement of efficiencies in conjunction with other energy uses. Some of the obstacles York cited were 1) farm fisheries who "green wash" by calling themselves "green" because they have photovoltaic cells and 2) disposable packaging (which can require more energy to manufacture than the food it contains).

The last speaker at the "Food for Thought" symposium, Christopher Weber from Carnegie-Mellon University, supported the first goal of Bon Appetit Low-Carbon Diet Program by saying that red meat and dairy are the largest greenhouse gas generators in the food industry (which ranks behind only private transportation and electric utilities in its generation of greenhouse gases). Eating less red meat and dairy food would reduce greenhouse gas emissions more than buying locally-grown food, Weber said, because 80% of the greenhouse gas emissions generated from agriculture are from food production.

Journal of Renewable and Sustainable Energy makes on-line debut

The new on-line *Journal of Renewable and Sustainable Energy* heralded by the American Institute of Physics (AIP) is here. All you have to do to get it is visit <http://jrse.aip.org> — at least that's all you have to do right now (a subscription charge will apply beginning next year). There you will find Vol. 1, Issue 1, January 2009, waiting for you. A welcoming editorial will remind you that renewables still comprise less than 1 percent of the worldwide energy supply and that the goal of achieving energy independence and security while combating the "deleterious effects of global warming and climate change" is "one of the most important, if not the most important, of the 21st century." Because "we cannot accomplish these goals with business as usual," the *JRSE* was created. The on-line format also allows for links to energy-related media articles and to AIP's *Scitation* publishing platform.

The first issue contains seven articles, three devoted to solar photovoltaics, two to wind, and one article each to fuel cells and energy conservation. Topics currently being covered are bioenergy, geothermal energy, marine and hydroelectric energy, nuclear energy, solar energy, wind energy, energy conversion, energy-efficient buildings, energy storage, power distribution, renewable energy resource assessment, and transportation. Not presently included are energy policy, biofuels, biorefining, clean fossil fuels, and hybrid renewable-fossil systems. Manuscripts should be submitted to <http://jrse.peerx-press.org>.

Natural History Museum mounts Climate Change Exhibit

For the first time since 1992 the American Museum of Natural History in New York City has mounted an exhibit on Climate Change, with a focus on the results of global warming. It opened to the public on 18 October, and five days later area teachers were invited for a special presentation and tour.

The presentation was made by Ed Mathez, Curator of the Museum's Department of Earth and Planetary Science, who addressed "The Issue of Climate Change and Lessons to Draw From It." Characterizing climate as "the average weather over years, typically a decade," Mathez noted that different climates result from differential heating by the Sun and the response of the atmosphere, hydrosphere, and lithosphere to it. Mathez called the ocean, holding a thousand times the heat and fifty times the carbon dioxide as the atmosphere, the cauldron of climate.

Carbon dioxide is only one of several greenhouse gases leading to global warming, Mathez said, but it is the most important. The Keeling curve that he displayed showed the steady rise in carbon dioxide concentration in the atmosphere with seasonal fluctuation since 1958. Data from earlier years comes from ice cores drilled in Greenland and Antarctica, which go back to 800,000 years ago. During that time atmospheric concentration of carbon dioxide hovered between 170 and 300 ppm (parts per million), but now it is up to 380 ppm, with no limit in sight.

The past gives us insight into the working of present climate, Mathez went on. Global temperature has been increasing since the 1970s, most intensely in polar regions (though other locations have experienced a slight cooling). No explanation other than greenhouse gases for the observed temperature increase in the troposphere coupled with a temperature decrease in the stratosphere has been found – this type of distribution of temperature change could not come from increased solar radiance, for example. Warming of all the oceans has also proceeded as expected from greenhouse gases.

One of the consequences of climate change is rising sea level. According to Mathez, sea level was 90 meters lower 14,000 years ago, and the English Channel was a dry land bridge. (The comparable part of the exhibit states that sea level was 120 meters lower 21,000 years ago.) Current sea level rise is due to thermal expansion of the sea water as it warms, accounting for about 20 cm in the past century. But Mathez mentioned that melting of Greenland or Antarctic ice shelves will cause much more, because these shelves have been confining glaciers which could then increase their outflow into the ocean. A six meter sea level rise would severely affect the American East Coast, and a model of Lower Manhattan in the exhibit shows the areas that would be inundated by 3-mter or 5-meter sea level increases. Although observations related to the global warming hypothesis are not direct, Mathez noted, the ultimate test of that hypothesis will lie in those observations.

The exhibit itself, which will run through 15 August 2009, is divided into eight sections:

1. Introduction – shows how coal burning has sparked an increase in the atmospheric concentration of carbon dioxide, depicted in a neon light graph, over the past 400 years.

2. Climate Change Today – features a video on the origin of fossil fuels, carbon dioxide emissions and temperature changes from burning them, plus ways to reverse present trends.

3. Making a Difference – shows ways to conserve energy in different aspects of our lives – at home, traveling, working outdoors, materials consumption.

4. Changing Atmosphere – contains a rotating glass globe showing atmospheric circulation and storms, with more intense storms and heat waves expected. Ways to cope include floating gardens in Bangladesh, underground tunnels in Japan, and flood-tolerant rice in Asia.

5. Changing Ice – includes the model of Lower Manhattan showing the results of increasing sea level by three and five meters, also notes that melting the Greenland and Antarctic ice sheets would increase sea level by *64 meters*.

6. Changing Ocean – portrays the ocean as the dumping ground as well as the cauldron of climate, since 30 % of human-generated carbon dioxide over the past two centuries ahs landed there (and added to the oceans' acidity).

7. Changing Land – presents the threat of more floods, droughts, and wildfires, and shows that pied flycatchers now arrive in Northern Europe after the young caterpillars they used to feed their young have already hatched and gone.

8. A New Energy Future – points to the need for an alternative to coal to generate electricity (hydro

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Grunow on Hiroshima

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their homeland against invasion. They also persisted in futile efforts to develop their own atomic bomb.

Others sought to blame Japan's defeat on the atomic scientists: Grunow quotes Yamamoto Yoichi of the 8th Army Research Division, who mistakenly construed the Potsdam Declaration to be an announcement of the development of the bomb:

> If the Japanese scientists' thinking that production of atomic bombs was not presently possible had not led them to deny as a rumor the American announcement [the Potsdam Declaration] that the United States had completed the bomb, Hiroshima and Nagasaki would not have been bombed. The regrettable thing is, we then have no excuses for the victims of Hiroshima and Nagasaki. If the scientists knew the dreadfulness of the atomic bomb, simply because of the completion of the atomic bomb, would there not have been an effort to take a step toward ending the war?

But if Yamamoto's claim is viewed as too extreme, perhaps Grunow's own conclusion might find greater acceptance:

> If, in the wake of Hiroshima, the military had immediately perceived that the bomb was atomic, they could have sooner utilized the "face-saving" possibility of the atomic bomb, and acquiesced to Foreign Minister Togo's entreaty for peace on 7 August. In this case, the hundreds of thousands of casualties and lives lost in the disaster of Nagasaki and the Russian invasion of Manchuria would have been preventable.

Grunow is identified as a doctoral candidate in history at the University of Oregon. The editors of *The Journal of American-East Asian Relations* award the Frank B. Gibney Prize each year to an essay in the field of American-East Asian relations written by a graduate or undergraduate student and submitted by his or her instructor. The prize honors the work and life goals of Frank Gibney (1924-2006), especially for the support he offered to the *Journal* when it was struggling for recognition. Gibney worked in both East Asia and the United States for more than fifty years to educate the peoples of the Pacific Basin about each other. He began his study of Japan as a military intelligence officer during World War II and the Japanese occupation and then became a correspondent and editor at *TIME*, *LIFE*, and *Newsweek*. He joined *Encyclopaedia Britannica* in 1966 and developed its Asian presence. He wrote or edited fourteen books and at the time of his death was President of the Pacific Basin Institute, which he cofounded in 1979, and Professor of Politics at Pomona College.

Horak

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efficiency portfolio standard and a renewable energy portfolio standard. Horak suggested that combining these two into a combined standard would yield improved results.

For the third member of the Trifecta, the Climate Change and Recovery Act of 2009, Horak recommended a carbon dioxide emissions tax rather than the cap-and-trade which has successfully reduced sulfur dioxide emissions from power plants. Except in the electricity sector, carbon dioxide emissions cannot be localized (as sulfur dioxide can), and the difficulty of tracking carbon dioxide emissions from their source means that it is more equitable for users to pay according to the total amount of carbon dioxide generated in producing the products they use.

(*Editor's Note*: See Reference #7, this issue, for another argument for a carbon tax rather than a cap-and-trade system.)

Climate Change

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> contributes 15 % but is maxed out, but nuclear could produce 25 %, wind 20 %, geothermal 5 %, and solar 100 %; in addition, carbon capture and storage could reduce carbon dioxide emissions by 90 %).

Collaborating with the Museum to organize the climate Chagne exhibit are the Abu Dhabi Authority for culture & Heritage, United Arab Emirates; The Cleveland Museum of Natural History; The Field Museum, Chicago; Instituto Sangari, São Paolo, Brazil; Juna de Castilla y León, Spain; Korea Green Foundation, Seoul; Natural History Museum of Denmark, Copenhagen; Papalote Muso del Niño, Mexico City, Mexico; and Saint Louis Science Center. More information about the exhibit is available from the Museum's website, <www.amnh.org/education/.climatechange>.

That the Museum is revisiting the topic of an exhibit 16 years ago is a sign that the message that topic has to convey needs to be better heard by a wider audience. That message is encapsulated on a very small plaque at the beginning of the exhibit:

> Can we avoid disastrous climate change by altering the way we live? There is still time. But it will take a worldwide effort lasting generations. And it must start now.

Science's decadal energy review

The last year of each of the past two decades has seen a special section on energy in an issue of *Science*. The special section of this decade came two years "early," in the 9 February 2007 issue, and it bore the title "Energy and Sustainability."

What is interesting to compare in the successive special sections on energy is their distribution of topics. The report on the 30 July 1999 issue of *Science* in our Fall 1999 issue noted that, in contrast with the earlier 21 April 1989 issue, the 1999 issue said nothing about nuclear energy and placed all its emphasis on a renewable energy future. Although renewable energy continued to dominate in the 2007 issue, three of the twelve "news stories" concerned nuclear energy – on establishing a bank of nuclear reactor fuel under the International Atomic Energy Agency, developing a thorium-based breeder reactor, and developing the EMPRESS reactor simulation so that reactors can be "tested" with computer models in the same way as new plane designs.

By far and away the dominant energy topic in the 9 February 2007 issue of *Science* was biomass fuel, particularly cellulosic fuel, given the brouhaha about the competition of agricultural land for food caused by planting corn as a feedstock for ethanol. Five of the twelve "news stories" fall into this category, as do three of the seven "perspectives." Two of the news stories address the issue of producing larger biofuel molecules from biomass, with the goal of increased energy yield, and two of the perspectives discuss the difficulties generating ethanol from cellulosic biomass. The third perspective, by José Goldemberg, Secretary of Energy of the Brazilian state of São Paulo, describes the now successful Brazilian program of generating ethanol from sugar cane, competitive without subsidy since 2004, at a cost of $.81/gal, compared with $1.03/gal for ethanol from corn and $2.25/gal for cellulosic ethanol. If the Brazilian program could be multiplied tenfold, Goldemberg writes, 10% of the world's presently-used liquid transportation fuel could be provided.

But the overarching theme of the "Energy and Sustainability" section of the 9 February 2007 issue of *Science* is the urgent need for massive amounts of alternative energy to raise living standards around the world and the need to be willing to pay for the needed research and development *now*. Other aspects of energy considered are fuel cells, wind, and photovoltaic solar. There is also a perspective on carbon capture and the strong concern about climate change from then Director of Lawrence Berkeley Laboratory Steven Chu, who is now the Secretary of Energy in President Obama's cabinet.

Discover pictures energy future

The June 2009 issue of *Discover* contains a special section on the future of energy. After "The Big Heat," in which editor-in-chief Corey S. Powell interviews Robin Bell, Ken Caldera, Bill Easterling, and Stephen Schnieder about Earth's climatic future and what is likely to be done about it, three articles treat the transmission, storage, and generation of energy, respectively.

Writing about the transmission of energy in "Rising Power," Peter Fairley likens our present electrical grid to our road network before Interstate highways. A "smart grid," he writes, would be overlaid on the existing grid and use technological advances in high-voltage transmission to transmit wind power generated in remote locations to where it is needed. But because this power can be intermittent, it must be backed up by a conventional power plant or energy storage capacity. Another possibility which Fairley describes is for consumers to monitor the grid for power supply and reduce their consumption when the supply is low or for the system to draw power from plugged-in hybrids in such an event. Such an equalization of power supply and demand, which could achieve efficiencies by reducing peak demand, could eventually be managed by computer.

According to Maggie Koerth-Baker's "Sunshine in a Bottle," ways to store solar and wind energy to make it more continuously available include compressed air storage (which requires airtight underground space), molten salt heat exchange (liquid nitrates can retain their thermal energy in insulated tanks for weeks, she writes), new battery technologies (sodium sulfur, zinc bromide, and vanadium redox flow), and a new way to create hydrogen fuel. The first two of these technologies have already been demonstrated commercially on a limited scale.

In a sidebar on "Assault on the Battery," Andrew Grant writes that there are "14 improved designs that should make lithium-ion batteries smaller, safer, and more efficient," and GM, Ford, Mercedes, and Nissan are developing vehicles to run on them. Presently using nickel-metal hydride cells in its Prius, Toyota has also shown interest in metal-air batteries. Though their range would be longer than that of lithium-ion batteries, they are not rechargeable, Grant states.

In "Back to the Atom," Elizabeth Svoboda writes about the future generation of power from nuclear fission with maximized efficiency and minimized radioactive waste products. This is to come from two new nuclear reactor designs: the graphite-moderated, helium-cooled very-high-temperature reactor (VHTR) and the sodium-cooled fast rector (SFR). The VHTR can heat its coolant

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Kurlansky shares concerns about fish

"I'm very worried about fish. I've been following fish since the 1960s, earning money for college working on fishing boats. It was then that I heard about overfishing, and it keeps getting worse. Most of the fish we eat are in trouble."

Thus began Mark Kurlansky's presentation about his latest book, *The Last Fish*, to the Calhoun Upper School on 23 October 2008. Fish in the middle of the ocean have darker and oilier meat, he said. Fish in the bottom of the ocean have white meat, and this is where the trouble is.

Fishermen are blamed for overfishing, Kurlansky acknowledged, but he added that it's not that simple. Although everyone agrees that the oceans have been overfished and that fishing needs to be regulated, there is no consensus on how to do this. U.S. regulations, dating to 1972, have largely failed, he said.

Should a fisherman's catch be limited by weight? Kurlansky cited an example of a fisherman in Gloucester, MA (where the book is focused), who was limited to 500 pounds per day but brought in 1500 pounds with the intent that it would count for three days of fishing. He was told that he could keep only his allowance for that day and had to throw the excess 1000 pounds away.

Should the time at sea be limited? This would cause fishermen to overfish the areas nearest to shore in order to minimize travel time.

Another possibility would be to limit the methods of fishing. Increasing the mesh size of nets would allow more fish to escape. This is how lobsters have survived: cameras in lobster pots have found lobsters escaping after they eat the bait in the pot.

One method of fishing that leads to overfishing is dragging nets. They depleted fish stocks in the North Sea in 10 years, Kurlansky noted. Attempts to ban this approach in New England failed, and now New England has become overfished. Fish caught with hook and line are of the best quality and command a higher price, Kurlansky said – catching fish in nets bruises them and reduces their quality. In general, the cheapest ways of catching fish are the most destructive, he added.

But Kurlansky had one fish success story to report: the striped bass, once near extinction, came back to the point

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DeMenna analyzes barbecue from different regions

Dr. Jerry DeMenna of Fun-Science Academics spoke to the Physics and Chemistry Teachers Clubs of New York on "Chemically Correct Cooking" at their 9 January 2009 meeting at New York University. This was a broadening of his original title, "Spectrometric Examination of Barbecue Sauce," because, as he said, he wanted to include some "other things." Cooking, after all, he went on, is chemistry with organic reagents, including such processes as pH adjustments, neutralizations, esterifications, and dehydrations. Proteins, carbohydrates, and fats are the raw materials. There are only four tastes (sweet, sour, bitter, and salt), he said, but there are billions of flavors and aromas.

Analytical tools to evaluate cooking include spectroscopy, chromatography, thermometry, and electrochemistry. The infrared spectrum identifies fat, protein, carbohydrates, and water in food. While spectroscopy looks at whole samples, chromatography is based on separation of a sample – gas chromatography found 88 peaks in olive oil in about 240 minutes and is used to measure cholesterol in foods for Nutrition Facts labels on food. (But many Nutrition Facts are still measured by outmoded methods, DeMenna added, some of these at the behest of food lobbies.) Electrochemistry identifies ions, also acidity and ionic strength.

But, in spite of DeMenna's broadened title, the "main course" of his talk was still barbecue. He described barbecue from three regions of the country known for its distinctive barbecue. Barbecue from the Carolinas is based on pork and is made with an acidic marinade. Texas-style barbecue is based on beef, using sauce that contains sugar. Barbecue from Tennessee is based on all types of meat and uses dry rub.

The sweetness of Texas-style barbecue sauce, DeMenna said, was developed for improperly aged beef, to mask the sour "gamey" taste. (Beef is aged at 42^{o}F. A higher temperature would accelerate the aging process but also increase the likelihood of spoilage.) Sugar also reacts with proteins and provides an alkaline environment to produce glycerine, which contributes to "juiciness".

Acids in sauce for Carolina-style barbecue neutralize amines formed by the hydrolysis which decomposes proteins, DeMenna continued. They also sequester cholesterols and mono- and diglycerides to form safer triglycerides and esters. The same effect is achieved by applying lemon juice to fish. These reactions require suf-

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Third Physics Education Symposium focuses on "Physics First"

The topic of the Third Annual Symposium on Physics Education, on 15 February 2009, at the winter meeting of the American Association of Physics Teachers in Chicago was "Early High School Physics: Building a Foundation for Understanding the Sciences." In more straightforward language, this is Physics First, and it featured a panel assembled by the leading exponent of teaching physics to ninth graders, Leon Lederman.

Opening the panel was Paul Hickman, himself a pioneer in teaching physics to ninth graders, first at Cold Spring Harbor High School in New York and later in Belmont, Massachusetts. Hickman reported that students at close to 1200 schools now study Physics First (*i.e.*, physics in the ninth grade) and that this has increased the number of high school physics students at all levels nationally to 3.5 million (37% of the total student body), equally divided by gender except at the Advanced Placement level. He reported that there is still a shortage of teachers with sufficient background and greater turnover among physics teachers than among teachers in other subjects. Moreover, some physics teachers "don't do ninth graders." Hickman noted that his Physics First program at Cold Spring Harbor died after he moved to Belmont, but that his Physics First program there has continued to live.

The most recent thrusts to increase the momentum of the Physics First movement have been statewide efforts – in Rhode Island and Missouri. Ron Kahn described Rhode Island Governor Donald L. Carcieri's efforts, which began with a blue ribbon panel on mathematics and science education. (Carcieri is a former math teacher, Kahn, noted, married to a former science teacher.) The report of the Rhode Island blue ribbon panel reminded Kahn of Leon Lederman's original A.R.I.S.E. report. The resulting Physics First effort for Rhode Island's 14,000 ninth graders began with funding from the National Governor's Association, eventually rising to $250,000 for the first year. The first year (2005-2006) focused on planning and deciding what program to use for Physics First, also what to follow it up with. They decided on a model like BSCS's "Sweeping Change Model." The second year (2006-2007) started with 2485 ninth graders in six pilot schools, including two from inner cities. The schools had to commit all their ninth graders to the program, and their teachers to professional development. Retired physics teachers were brought in for support, but the actual teachers were largely crossovers – 44.4% from general science, 22.2% from physics, 33.4% from general science (with biology or chemistry) plus special ed. Close to 50% had more than 10 years teaching experience, and more than half had master's degrees. The current school year has the first Physics First cohort taking biology as juniors, after chemistry as sophomores – with some juniors taking AP biology. The first data will come when this cohort takes the New England Common Test Assessment for 11th graders. Meanwhile 30 chemistry teachers are working on an appropriate chemistry course to follow Physics First, and 23 biology teachers are doing the same for a biology course built on what is previously learned in physics and chemistry.

Speaking about Missouri's A-TIME for Physics First was Gabriel de la Paz, who teaches Physics First at Clayton High School in Clayton, MO. He reported that the partners in this program are the Columbia (MO) Public Schools and 12 original partner districts, the University of Missouri, and Missouri State University. The science teachers in these schools, la Paz said, have a diversity of degrees, and a host of incentives was provided to induce them into the program. The curriculum writing team of university professors and high school teachers developed a curriculum of 12 units based on the Modeling approach to physics. The Physics First teachers were taught by teams of three lead professors, three peer teachers, and graduate Teaching Assistants. The Physics First teachers showed improvement in post-tests versus pre-tests, and their students showed even more improvement (post/pre about 4), la Paz reported. The next steps are extending the Physics First program to more schools and designing a tenth grade chemistry course to follow Physics First.

Another member of the panel had nothing to do with teaching Physics First but pointed up several reasons to teach it. Marsha Rosner, Director of the Ben May Institute for Cancer Research at the University of Chicago, pointed out that biology is taught descriptively but must be understood conceptually. Physics First provides a conceptual framework that makes it easier to learn biology, she said. Mindful of the failure of biology to cure cancer, Rosner has proposed looking at the problem from a physics point of view. The time for Physics First, she said, has come.

Leon Lederman closed the panel with his own insightful words. He recalled conversations about his former senator who is now President and spoke favorably about President Obama's commitment to science. He also noted the importance of enlisting the support of the business community in science education, for their future depends on a scientific and technologically literate work force.

Two retirees recall their work for the Manhattan Project

Two retirees from the Manhattan Project recalled their experiences working for the Project at the joint winter meeting of the American Association of Physics Teachers and the American Association for the Advancement of Science in Chicago on 15 February 2009: Ellen Weaver, who worked at Oak Ridge, and Dorothy Gans, who worked at the University of Chicago.

Ellen Weaver married a physicist named Harry in 1944. Because he had experience separating isotopes with gaseous diffusion barriers from previous work in Philadelphia, he was "kidnapped" to Oak Ridge, and Ellen returned home to Cleveland to finish her college degree, but was allowed to join Harry at Oak Ridge during the holidays. Initially, she recalled, it wasn't sure which isotope separation method would work best. Thousands of gaseous diffusion barriers were built in the course of months, and this gave gaseous diffusion a head start. She finished the last two courses for her degree at the University of Tennessee in Knoxville, then went to work at Oak Ridge as a chemist. Her first job was to manipulate numbers with a Frieden calculator without knowing what the numbers meant; but after two weeks of this, she pleaded for something else to do and was assigned to develop a means to protect against phosphorus-32. She reported assembling her own Geiger tube in the course of doing this.

Weaver also recalled a visit by I. I. Rabi and taking courses from the University of Tennessee on base at a cost of $1 per semester-hour. She said that she found fellow women workers unwilling to join her in trying to get the same pay scale as the men. Eventually, though, her grievance was addressed, and she worked on the analysis of fission products. She reported great excitement at Oak Ridge when the first test was done at Alamogordo, but she found it tragic that a second bomb had to be dropped to end the war, although she was relieved to know that it was over.

Weaver also recalled that, in addition to his work at Oak Ridge on isotopic separation with gaseous uranium hexafluoride, her husband later designed a nuclear power plant for submarines. She said that two colleagues moved in with them so they could work on the submarine project in their Oak Ridge home. The plans for the submarine nuclear power plant were marked "TOP SECRET" and filed, and the next year Admiral Chester Nimitz authorized building the *Nautilus* as the first nuclear submarine under Admiral Hyman Rickover, who, she said, never acknowledged the contribution of Harry. She said she would like to see a nuclear submarine named after him.

Dorothy Gans reported getting a job at $36/week at the Armory in Chicago, near the University, after she earned her A. A. in chemistry. When told what they were doing, she said she first didn't want to be a part of it, but when told that "we had to get there first," she relented. When atomic energy became known, everyone wanted her to explain it, but she said that she couldn't. From her earnings she was able to pay the $45/year required for the remaining two years needed to earn her bachelor's degree, which was in the biological sciences.

In the Q&A following, Weaver reported that she *was* aware that the Alamogordo test used plutonium fission and that she was aware of the existence of Los Alamos and Hanford. When asked about the security system imposed by Gen. Leslie R. Groves, military commander of the Manhattan Project, she remarked that he was "not beloved."

After earning money to see husband Harry through a doctorate in physics, Ellen Weaver earned a doctorate in genetics. Dorothy Gans, married to a surgeon, decided to become a homemaker.

DeMenna analyzes barbecue

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ficient time to produce their desired effect, he added, noting that four to eight hours are optimum for food flavor "development."

When DeMenna applied chemical analytical methods to determine the composition of the acid barbecue sauce, sugar barbecue sauce, and dry rub, he found that the Texas sauce rated highest in taste but that the Carolina sauce was healthier because of its lower cholesterol and fat content.

The "other things" that DeMenna shared with us were french fries. Here the contrast was between McDonald's and Jimmy's from the Jersey Shore. No significant differences were found in infrared and ultraviolet spectra, but the McDonald fries gave a doublet fluorescence peak versus a singlet peak from Jimmy's. DeMenna observed that the only doublet he knew of came from α-benzo-pyrene, which is found in cigarette smoke. The major difference that he found was in the sodium chloride content, higher in the Jersey Shore french fries, which he attributed to salt in the air near the ocean, which reacted with the frying oil to form a small amount of organic sodium salts, which are, in effect, soap. Chemistry Club president Lew Malchick picked up on this to wonder why there was a similar difference between fries at Nathan's at Coney Island and those sold "inland."

NJAAPT focuses on applications of physics

Responding to the preferences of its membership, the New Jersey Section of the American Association of Physics Teachers (NJAAPT), meeting at Princeton University on 20-21 March 2009, devoted its annual spring meeting to applications of physics to other fields. Speakers covered such diverse areas of application as law enforcement, embryology, music, and medicine.

Leading off as the Friday night after-dinner speaker was William H. Pauli of the Collision Analysis Reconstruction Team in the Somerset County (NJ) Prosecutor's Office – a team formed as the result of two acquittals of people charged with vehicular homicide, presumably because less had been done to support the prosecution than the defense. A former police officer with a background in traffic safety, Pauli has sought to do outreach to students to prevent them from causing collisions themselves. He sought to do the same kind of outreach to NJAAPT – in a presentation called "Physics is Your Passenger."

Physical evidence, Pauli said, is the most important ingredient in reconstructing a collision. The intent is to determine the speeds of cars before they collided and how the collision occurred, matters that could be material to a subsequent court case. Evidence includes distribution of the severity of damage to vehicles and marks left on the road. The analyses Pauli showed focused on forces exerted between colliding vehicles at their point of maximum contact, and Pauli noted that forces striking far from the center of mass will cause a car to rotate about its center of mass, possibly including rotation about a horizontal axis to produce gouges in the road. But, in contrast to crime scenes that can be kept isolated for inspection as long as needed, Pauli noted that he needed to do his analysis quickly, because roads must be kept open.

Many of the examples of serious collisions shown by Pauli, most of them resulting in death, were caused by people under the influence of alcohol or drugs. In general, Pauli said, human factors are the major cause of accidents. But there are important physical factors too, principal among them the coefficient of friction between vehicle tires and the roadway. This coefficient, the ratio of the friction force to the vehicle's weight, is 0.8 for dry new pavement, but this reduces to 0.6 or 0.7 in time, is only 0.5 for wet gravel and 0.4 for a snow-covered road. Only 0.2 is needed for normal driving, but 0.5 is needed for casual braking and 0.7 for maximum braking. Moreover, sudden braking requires disproportionate stopping force applied by the front wheels. In this case the tire surface is found to buckle up in the middle.

The physics for calculating the speed of a vehicle prior to collision is very straightforward if the coefficient of friction and the distance traveled by the vehicle after collision are known. The vehicle is slowed by negative work done by the friction force, and this negative work equals the decrease in the vehicle's kinetic energy. Since the negative work is determined by multiplying the friction force by the distance through which it acts, one obtains

$$mg\mu d = \tfrac{1}{2}\, mv^2, \text{ where}$$

m = mass of car
g = acceleration due to gravity (32 ft/s^2 in the units used by Pauli)
μ = coefficient of friction
d = distance traveled by car (in ft)
v = speed of car (in ft/s).

This leads to

$$v = \sqrt{64\mu d}$$

for the speed in ft/s or

$$v = \sqrt{30\mu d}$$

for the speed in mi/hr, since 1 mi/hr = 1.466 ft/s.

Pauli stated that he measures the coefficient of friction on-site *three* ways and determines the distance traveled after collision by skid marks on the road. But, although this formula for measuring speed derives from energy transformation analysis, Pauli added that momentum analysis is far more useful a tool to analyze collisions.

Pauli also noted that the typical response time of drivers in accident situations, including the time to move their feet over to the brake pedal, is 1.6 seconds, more than the 0.7 seconds used in driver education manuals to calculate the distance traveled before braking when approaching a traffic light. He called the 1.6 seconds a *passive* response time and added that it is longer than 0.7 seconds for approaching a traffic light, because in the latter case the driver *expects* to have to take action. And even this 0.7 seconds is longer, Pauli said, than the 0.1 seconds needed to react after being hit in the head or blasted with a horn.

As an indication of the increased safety of automobiles, Pauli noted that vehicles must be subjected to barrier tests before they can be sold. Cars today, he said, are designed to bend, to lengthen the time of a collision impulse (and thereby reduce the force). Most of them also have black box recorders, to protect manufacturers in the case of product liability lawsuits. At the same time, Pauli expressed concern that drivers are lulled into the security of relaxing in their living rooms while driving. *Crashing at 40 miles per hour* (which is what some vehicles did in the accident scenes he showed us) *is equivalent to falling*

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from a five-story building, he observed. Pauli also pointed out that driver education cannot provide young drivers the experience that is ultimately the basis for safe driving. "Experience," he said, "cannot be taught."

Eighteen of New Jersey's 21 counties now have units similar to the one in which Pauli works. The New Jersey Division of Highway Traffic Safety trains the personnel, using staged collisions with donated cars in a poor state of repair.

Bialek Discusses Embryological Problems

Although Bill Bialek spoke to NJAAPT about "Physics Problems in Early Embryonic Development," he holds an appointment in Princeton's Physics Department as part of an interdisciplinary program. Bialek chose as his subject the fruit fly, which starts life as a single-celled egg half a millimeter long, which becomes a maggot, sectioned like human vertebrae. Since this development happens within a shell, it happens at constant volume and mass and does so in the course of three hours. He observed that the type of cell in the maggot is determined by which protein is made from reading its DNA. This, in turn, is determined by "transcription factor" molecules which block certain genes in the DNA. The segmentation of maggots results from the alternating concentration of transcription factors in the egg.

Studies of all possible variations of segmentation of maggots shows that they are identified with only 100 of the fruit fly's 25,000 genes. Bialek said that the mother laying the eggs determines their segmentation by placing messenger-RNA for a particular protein at the head of the egg. This evolves into a decaying concentration from the head to the tail of the egg, which interacts with other proteins in the egg to produce the ultimate alternating concentration of transcription factors.

Bialek also observed that concentrations of proteins in cells are typically nanomolar and pointed out that a 1 nM solution would contain only 0.6 molecules per cubic micron (micrometer), typical size of a cell. For this reason, as little as 10% in the difference of a protein concentration would have a significant effect on the fate of a cell.

Aaronson Makes Us Aware of How We Hear

Using his background in psychoacoustics and a modification of his presentation on "Sounds, Hearing, and Music" to the American String Music Association, Neil Aaronson of Richard Stockton College of New Jersey, involved us in listening to a series of sounds to understand how they are perceived by the human ear. The vibrations of strings, with two fixed ends, are known for having harmonics with frequencies a whole number times the lowest, or fundamental, frequency, which corresponds to a wavelength twice the length of the string. Aaronson enabled us to hear that the apparent pitch of the sound of a vibrating string was that of the fundamental frequency, regardless of the distribution of harmonics. Moreover, the apparent pitch remained the same even when the fundamental frequency was deleted, because the synthesis of the harmonics had the same frequency as that of the missing fundamental.

By presenting only selected frequencies to us, Aaronson also enabled us to learn how information is transmitted in speech. Vowels, he pointed out, are characterized by formants, which are harmonics far above the fundamental frequency. When he transmitted a message of human speech with the formant frequencies deleted, we could barely understand what was being said. But when he transmitted the message with the fundamental frequency deleted, we could understand the message, although with poorer quality sound. Because this requires less energy, Aaronson said, telephones use this procedure, and this is why the voices of mothers and their daughters can be confused on the telephone.

Aaronson took us on a "tour" of the human ear, noting that we can hear sounds produced when the amplitude of the vibration of the eardrum is as low as a tenth of a nanometer. Our hearing system, he pointed out, uses analog signals until they reach the organ of Corti, which converts them to digital input to our brain. Aaronson demonstrated cross-linking between our visual and auditory systems by playing what was ostensibly an audiovisual of a person saying "da." But when he replayed it and asked us to close our eyes, we heard "ba" – our lip reading of the visual signal overrode what our ears had been hearing (the separately-recorded soundtrack had been synchronized with the visual "da").

Lastly, Aaronson showed, by playing a repetition of a phrase, that although different parts of our brain handle speech and music, there is a musical quality of speech. The more we heard the repeated phrase, the more it sounded as if it were being sung – and Aaronson even showed the notes he had written to represent the music.

Dougherty Speaks About Physics in Medicine

Larry Dougherty, from the University of Pennsylvania, speaking about "Physics Research and Clinical Medicine," observed that 76% of all physicists in medicine were involved with therapeutic radiology and another

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15% with diagnostic imaging. He focused his presentation on these two aspects of physics in medicine.

Dougherty cited six types of diagnostic imaging – X-rays, nuclear radiation, CT (computerized tomography), ultrasound, MRI (magnetic resonance imaging), and optical (diffuse optical tomography). MRI, he said, images local body chemistry and shows up the contrast between healthy and diseased tissue, primarily by imaging protons from their magnetic properties as a spinning charge. A strong magnetic field aligns them, but even with a field as strong as 1.5 tesla, the ratio of "spin up" to "spin down" is only a thousandth of a percent greater than 1. Applying a resonant oscillating magnetic field causes the aligned protons to flip, and MRI looks for an echo that indicates the presence of disease. The first commercial MRI scanner was developed by General Electric in 1982, Dougherty said, and in 1985 Medicare started paying for MRI scans. MRI can produce images at various depths, he added, noting that it can detect breast cancers more reliably than mammograms, which give 20% false negatives. On the other hand, MRI is much more expensive and has been accused of detecting too much. Dougherty noted an emerging school of thought that the body can heal many cancers, that lung and breast cancers below a certain size should be left alone except for further monitoring. "Overtreatment," Dougherty observed, can escalate the already exploding cost of medicine even more.

Dougherty spoke about two other techniques of diagnostic imaging – PET (positron emission tomography) scans and optical tomography. PET uses positrons from radioactive beta decay, by the gamma rays emitted from positron-electron annihilation, to produce images, but it requires a nearby cyclotron to make the required short-lived radioactive isotopes. Optical tomography uses near-infrared radiation, which is scattered multiply as it passes through tissues. It does no damage and *can* detect cancer, Dougherty said.

Once cancer is detected, Dougherty went on, there are three radiation options: 1) X-rays, which penetrate too much to concentrate energy onto a target; 2) electrons, which don't penetrate much and are therefore useful for treating only surface cancers; and 3) protons, the most versatile option. Proton dosage is maximized at a "Bragg peak," whose depth is determined by the proton energy.

Treatment consists of determining the total dose needed and the number of installments needed to deliver it. Multiple beams will insure delivery of maximum dose to the target while afflicting neighboring areas with lower doses. Although proton treatment was pioneered by Bragg and Wilson, little was done on a widespread basis until Loma Linda made it available in 1990. In addition to Loma Linda, there are now four other proton treatment centers in the U.S. It is very expensive, and Dougherty felt it might be most efficacious in children, who are more radiosensitive than adults.

Bilash Presents Physics Demonstrations

The classic end to NJAAPT meetings at Princeton University is the presentation of physics demonstrations, usually by the Princeton University staff, drawing from their huge emporium of lecture demonstrations. But this time the demonstrations were scheduled for presentation by the team of Borislaw Bilash II of Pascack Valley High School and Dave Maiullo of Rutgers University – this team has recently published a book, *A Demo a Day – A Year of Physics Demonstrations*, available through Flinn Scientific. However, because Flinn had called Maiullo to present demonstrations to the National Science Teachers Association's Annual Conference in New Orleans, his participation at the NJAAPT meeting was limited to a call to Bilash on his cell phone.

This couldn't have been timed better. Bilash had just made a splashy entrance with a fire extinguisher backpack that had ripped the slats out of the side of the stage left entrance, when the phone rang to have Maiullo ask him how things were going. After we shouted our greetings to Maiullo, Bilash picked up where things had left off before the phone call and posed a very legitimate question: is a teacher entering his classroom with a fire extinguisher backpack teaching or showing off? Would a balloon or fan cart be more effective to teach Newton's Laws of Motion? Demonstrations should be followed by questions to engage students in inquiry, he said. The fan cart allows more variations to lead to a lot more discussion than a backpack fire extinguisher, and Bilash demonstrated several of these. Learning through demonstrations without subsequent engagement, Bilash went on, shows only a 30% retention rate. On the other hand, practice by doing gives 75% retention, and teaching others 90%. In teaching students how to learn, we should build upon what they *already have learned*, Bilash said. If you want only to entertain, you should join a circus.

Bilash demonstrated some interesting kinematics with dart guns, which he observed have become hard to find and have been totally banned in Australia. Two darts, one weighted, will hit the ground simultaneously when dropped at the same height from rest. But when fired downward, the lighter dart had a greater initial velocity and it the floor before the weighted one.

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Bilash also demonstrated a tug-of-war between two evenly-matched constant velocity buggies. He showed that adding mass to one increases its friction with the ground and allows it to win. So does allowing a cart to move onto sandpaper (another way to increase friction between it and the ground).

Among the other things Bilash demonstrated: eggs dropped from the same height onto a plain and cushioned bucket to show the effect of lengthening the time for the impulse to stop them; beats from the sounds generated by rubbing two aluminum rods differing in length by a centimeter when held at their center; electric field lines emanating from a charged object, represented by tinsel taped to the charged object.

Hein Presents AAPT Vision

Warren Hein, Executive Officer of the national American Association of Physics Teachers, was also on hand to tell members of the New Jersey Section what the national organization offers. An incentive to get more section members to join the national organization, which will be available the next three years on a trial basis, is a reduced-price Associate Membership. Costing only $36, it offers first-time members hard copy of *Physics Today* and the *AAPT Annual Report* plus 42 articles on-line from the two AAPT journals, the *American Journal of Physics* and *The Physics Teacher*. There is also a financial incentive of $9 to each section for each new AAPT member they produce. AAPT's goal for 2009 is to increase its membership by 2000 in this way, Hein said, and he is counting on the sections to help achieve it.

SEPUP expands *Science and Sustainability* into *Science in Global Issues*

According to the Fall 2008 issue of *SEPUP News*, SEPUP (Science Education for Public Understanding Program) has obtained funding from the National Science Foundation to expand its *Science and Sustainability* program, published in 2000, into a two-year program called *Science in Global Issues* (*SGI*). Designing the new program backward from "course objectives correlated to the National Science Education Standards and a number of state standards," SEPUP came up with the following nine units comprising *SGI*: After an introductory unit addressing the question "What is sustainability?" comes an ecology unit addressing sustainable fisheries, a unit on the chemistry of matter focusing on the use of Earth's resources, a unit on waves dealing with earthquakes and electromagnetic radiation, and a unit of cell biology concerning global infectious diseases. This completes the first year of the course. The second year consists of a genetics unit with a focus on genetically modified organisms, a unit on evolution that deals with biodiversity con-

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Discover pictures energy future

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up to 1000°C and thus produce electrical energy with greater efficiency. The SFR can fission nuclei of U-238 directly by fast neutrons, thus avoiding the more toxic (but fissionable) Pu-239. And since it fissions U-238 directly, the SFR can be fueled by the spent fuel rods from presently operating nuclear reactors (once their residual radioactivity decreases to a safe level) or uranium depleted in U-235 after the enrichment process. This would ultimately reduce radioactive waste from nuclear fission to the products of fissioned uranium and reduce the waste's sequestration time from thousands to hundreds of years. But economics plus lingering public skepticism linking nuclear power with nuclear weapons are expected to make this nuclear future a long time in coming, in spite of its promise as a carbon free energy source that could generate the energy for the American power grid's base load.

Kurlansky shares concerns about fish

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that people claim that there are too many of them (they eat lobsters). The major cause for this success was cleaning up rivers (and the Hudson River was one of the first).

In spite of fish shortages, fish are still available on the market – but at a higher price. Kurlansky did not see "fish farms" as solving the problem of preserving natural marine ecosystems, though. For one thing, farmed fish are fed products of wild fish. More seriously, farmed fish cannot survive in the wild, and if they escape and mate with wild fish, their offspring will be similarly disadvantaged. Finally, farmed fish don't taste as good as wild fish. The most endangered fish species are Atlantic cod, once 60 % of the European diet, and Atlantic salmon (only 500 are believed to be left – and Pacific salmon are showing signs of depletion as well).

Kurlansky would like to see environmentalists work more cooperatively with fishermen. He is also concerned that the fishing industry not experience that same fate that has befallen agriculture in the form of "agribusiness.

News from Triangle Coalition

Elementary Science Unhurt by Focus on Math, Reading

(Source: NSTA Reports)

The emphasis placed on math and language arts by high-stakes testing does not lead to lower scores in science, at least at the elementary level, according to a paper released by the Center for Civic Innovation at the Manhattan Institute. Marcus Winters, a senior fellow at the Manhattan Institute and lead author of *Building on the Basics: The Impact of High-Stakes Testing on Student Proficiency in Low-Stakes Subjects*, said he was surprised by what he and his fellow researchers found. His group examined how the threat of sanctions – based on high-stakes testing in reading and math under Florida's A+ Accountability Program – affected student proficiency in science. Florida's A+ program is often cited as a template for the federal No Child Left Behind legislation. Winters and his fellow researchers examined data on Florida fifth graders in the 2002-03 school year. Because the state did not test students on science in the fourth grade, the researchers used prior math and reading scores as a proxy for prior sciences scores. They compared the proxy scores to the results of the 2002-03 Florida Comprehensive Assessment Test in science (the first year science was tested), finding students in schools previously sanctioned for receiving a failing grade in math and reading had "substantial improvements in science proficiency." This finding contradicts qualitative research and anecdotal evidence that suggests high-stakes testing has reduced student knowledge in general. The researchers attributed their results to a correlation effect – improvements in math and reading have increased proficiency in science. Whether the effect would continue in higher grades or have any bearing on other untested subjects has not been studied. The report summary is available at <http://www.manhattan-institute.org/pdf/cr_54.pdf>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 16 October 2008 and reprinted with permission.)

Diploma to Nowhere

High school seniors have returned to school this fall confident that their course loads are challenging enough to prepare them for the rigor of college study. They might be wrong. Strong American Schools recently released *Diploma to Nowhere*, a study which highlights the fact that many college freshmen need to take remedial classes to relearn skills they should have been taught before graduation. The study also reveals that remediation affects students of all income and ethnicities and the psychological impact that remediation has on these students. According to the report, remediation in public institutions costs roughly $2.5 billion every year to provide students with the content and skills that high schools failed to provide them. New York City Schools Chancellor Joel I. Klein observed that "the extent to which students are graduating high school unprepared for the challenges of college is clearer now than ever. The report highlights the need for strong standards and assessments to ensure that students leave school ready to meet post-graduate challenges. We simply can't afford, either economically or as a society, to fail to provide students with the education they need."

The report shows that well over a million incoming college students must take remedial courses to acquire basic academic skills in math and reading in order to take and comprehend entry-level college courses. And, no one is more surprised by the failings of American high schools than the students those schools have recently graduated. Even some students who took advanced classes and achieved good grades required remediation. Strong American Schools, a project of Rockefeller Philanthropy Advisors, is a nonpartisan campaign supported by The Eli and Edythe Broad Foundation and the Bill & Melinda Gates Foundation. The full report is available at <http://www.edin08.com/diplomatonowhere.aspx>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 23 October 2008 and reprinted with permission. An Education Working Paper, "Public High School Graduation and College Readiness Rates in the United States," prepared by the same Manhattan Institute that produced the "High Stakes Testing" report (item #1 above) and also funded by the Bill and Melinda Gates Foundation, states that "to be 'college ready' students must pass three crucial hurdles: they must graduate from high school, they must have taken certain courses in high school that colleges require for the acquisition of necessary skills, and they must demonstrate basic literacy skills." This study found that the high school

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SEPUP

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servation, a unit on electricity and energy devoted to supplying electrical energy, and a unit on chemical reactions that relates to alternative and fossil fuels. National field testing, which began in the fall of 2007, will continue through the spring of 2009. SEPUP can be contacted at <sepup@berkeley.edu>, and its website is <www.sepuplhs.org>.

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graduation rate for the class of 2001 was 70% (ranging from 51% for African-Americans to 79% for Asian-Americans). But only 36% had taken courses to qualify them as "college ready," and the requirement of basic literacy skills further reduced this percentage to 32%. This paper is available online at <http://www.manhattan-institute.org/html/ewp_03.htm>.)

It All Adds Up: Early Achievement in Math May Identify Future Scientists and Engineers

New research published in the October issue of *Psychological Science*, a journal of the Association for Psychological Science, suggests that there may be a way to identify budding scientists and engineers and thus be able to guide them, from a young age, to careers that will enable them to make the most of their abilities. Vanderbilt University psychologists Gregory Park, David Lubinski, and Camilla P. Benbow wanted to see if early mathematical reasoning ability would be predictive of future accomplishments in scientific and technical fields. The researchers identified 1500 young adolescents who had scored in the top 1% on the math portion of the SAT. Twenty-five years later, the researchers looked to see how many of those youths had gone on to publish articles in peer-reviewed journals, receive advanced degrees, and earn patents. The researchers grouped the participants according to the degrees they had earned, then examined within each group the relationship between SAT math scores and scientific creativity (as determined by journal publications and patents earned). The researchers found that there were more peer-reviewed journal authors and patent holders in the doctorate group compared to the bachelor's and master's degree groups. However, more interesting was the finding that within each advanced degree group, adolescents who had scored highest on the SAT math test were most likely to have authored a peer-reviewed scientific publication or to have earned a patent as adults. Also, when the researchers looked only at participants who earned graduate degrees from schools ranked in the top 15 for science, technology, engineering, and mathematics graduate programs, the participants who scored highest on the SAT math test still achieved more scientific accomplishments as adults.

The authors note that "educational credentials are clearly important, as are educational opportunities at outstanding universities, but that they cannot fully substitute for ability. Our results suggest that, among other things, individual differences in cognitive ability (even when measured in early adolescence) are important to take into account when identifying and modeling exceptional scientific and technical human capital." The authors conclude that these findings are relevant because they "come at a time when national initiatives and industries are searching for new methods to identify and harness creative potential, particularly in science and technology." More information is available online at <http://www.vanderbilt.edu/Peabody/SMPY/>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 6 November 2008 and reprinted with permission.)

Leading Public Universities Commit to Boosting Quality and Quantity of Science and Math Teachers

Take a look at the state of science and mathematics education in U.S. public schools, and you'll find an equation that simply doesn't compute. With too few highly qualified teachers and too many underachieving students, efforts to create a pipeline of well-prepared workers for the competitive 21st Century global economy are not measuring up. To address this challenge, 79 colleges and universities in 32 states have thus far committed to the "Science and Mathematics Teacher Imperative (SMTI)," an ambitious effort by member institutions of the National Association of State Universities and Land-Grant Colleges (NASULGC). SMTI has a goal of

- Substantially increasing the number and diversity of high quality mathematics and science teachers in middle and high schools;
- Identifying immediate and longer term needs for science and mathematics teachers in states where NASULGC member institutions are located; and
- Building partnerships among universities, school systems, state governments and other entities to address statewide needs for teachers on a sustained basis.

NASULGC-member institutions educate the largest cohort of undergraduate science, technology, engineering and mathematics (STEM) students, on research-intensive campuses with influential colleges of education. By committing to this effort, NASULGC-member institutions are responding to the call for 10,000 new science and mathematics teachers in the National Academies report, *Rising Above the Gathering Storm*. The teacher imperative is supported thus far with grants from the Carnegie Corporation of New York, the National Science Foundation (NSF), and in-kind contributions of faculty from several universities. More details are at <www.teacher-imperative.org>.

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(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 20 November 2008 and reprinted with permission.)

CCSSO and Pearson Foundation Release Recommendations for Math and Science Success

On 20 November 2008, the Council of Chief State School Officers (CCSSO) and the Pearson Foundation released the first in a series of joint annual reports designed to inform success among educators worldwide. The "Report and Recommendations for Education Policy Leaders" identified key conclusions of the first CCSSO/ Pearson International Conference on Science and Mathematics Education, held 28 April through 1 May 2008 in Singapore. This conference, created and presented by CCSSO and the Pearson Foundation, convened delegates from 13 countries and six continents to explore firsthand the educational and cultural drivers that consistently help Singapore students to score at the top of international surveys such as the Programme for International Student Assessment (PISA).

The report cites specifically Singapore's country-wide investment in teachers; the development of their administrative leadership; and the educational system's adoption of innovative core curriculum designed to foster students' creativity and independent thinking. Small working teams from countries including Brazil, Canada, England, Italy, Japan, Korea, New Zealand, South Africa, Taiwan, the United Kingdom, and the United States also shared key educational, assessment, and professional development practices that ensure student success in mathematics and science education in their respective countries. Report and Recommendations for Education Policy Leaders is the first in a series of annual reports from CCSSO and The Pearson Foundation that will present shared conclusions of CCSSO members from around the world. Triangle Coalition member, Pearson Education, is the global leader in educational publishing, providing scientifically research-based print and digital programs to help students learn at their own pace, in their own way. More information is available at <www.pearsoned.com>.

Using Technology to Personalize Education

Over the past 18 months, former Education Secretary Spellings convened a series of three roundtable discussions with representatives from across the education and technology landscape, from teachers to CEOs, and a fourth roundtable with students. The conversations were frank and informative and provided a view into the potential, and the challenges of harnessing technology to help transform education. A paper was recently released which was based on feedback from the roundtables. It identifies five areas where federal, state, and local governments can collaborate to build on the success of NCLB and accelerate the transformation of our education system.

According to the report, we need to retool our education system to respond to changes in the world. Part of the challenge has been that technology has been applied to the outside of the education process, rather than as a critical tool in revamping the process itself. Personalizing instructional delivery through the strategic use of technology is a key part of that transformation. However, educational technology should not be implemented in a vacuum -- it must be tied to the principles of learning and high-quality teaching, all of which must align with challenging content and skill standards. The federal government is a critical but not solitary player in this transformation. Working together with states and localities and inspiring the private and philanthropic sectors we can effect systematic change across the education system from the administrative back office through to the classroom. Through NCLB our nation has been asked to raise our expectations for students. Technology tools can help students meet those expectations and be prepared for the rapidly changing, competitive world they will enter. The new global, information economy means new demands and expectations, and we must meet the challenge. The full report is available online at <http://www.ed.gov/about/offices/list/os/technology/reports/harnessing.innovation.pdf>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 11 December 2008 and reprinted with permission.)

Trends in International Mathematics and Science Study Released

On 9 December 2008 the National Center for Education Statistics at the U. S. Department of Education released the 2007 results for the *Trends in International Mathematics and Science Study* (TIMSS). The Study, which compares mathematics and science test scores among thirty-six nations in the fourth grade and forty-eight nations in the eighth grade, shows promising results for American students in mathematics but unremarkable scores in science.

For mathematics, the United States not only scored above the average in test scores in both fourth and eighth

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grades but also showed improvement from 1995 when the TIMSS was first conducted. The scale average was 500 for both the fourth and eighth grade tests with the U. S. scoring 529 and 508 respectively. From 1995 to 2007 the fourth grade scores improved from 518 to 529 and from 492 to 508 in the eighth grade. As for the U. S. rankings compared to other countries, the U. S. placed 11th in the fourth grade and 9th in the eighth grade. It must be noted again that there were twelve more nations participating in the Study in the eighth grade than the fourth grade.

Despite the improvement in mathematics, the science results were not as promising. Again, with the average score being 500 on the science tests the U. S. scored 539 in the fourth grade and 520 in the eighth grade. Despite being above the average, the fourth grade score actually declined from 542 in 1995. The eighth grade score was 513 in 1995. The U. S. also ranked 8th in the fourth grade and 10th in the eighth grade compared to other countries.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Legislative News* for 10 December 2008 and reprinted with permission.)

Asian Students are Top Performers in Math and Science According to TIMSS 2007

Students from Asian countries were top performers in math and science at both the fourth and eighth grade levels, according to the most recent reports of the Trends in International Mathematics and Science Study (TIMSS). In mathematics, at the fourth grade level, Hong Kong SAR and Singapore were the top performing countries, followed by Chinese Taipei and Japan. Kazakhstan, the Russian Federation, England, Latvia, and the Netherlands also performed very well. In mathematics achievement at the eighth grade, Chinese Taipei, Korea, and Singapore were followed by Hong Kong SAR and Japan. There was a substantial gap in average mathematics achievement between the five Asian countries and the next group of four similarly performing countries, including Hungary, England, the Russian Federation, and the United States.

In science, students from Singapore and Chinese Taipei were top performers at both grade levels. In science achievement at the fourth grade, Singapore was the top performing country, followed by Chinese Taipei and Hong Kong SAR. Japan, the Russian Federation, Latvia, England, the United States, Hungary, Italy, and Kazakhstan also performed very well. At the eighth grade in science, Singapore and Chinese Taipei again had the highest average achievement, followed by Japan and Korea. England, Hungary, the Czech Republic, Slovenia, Hong Kong SAR, and the Russian Federation also performed well.

TIMSS is one of the world's most influential global assessments of student achievement in math and science. With more than 60 participants and 425,000 students assessed, TIMSS 2007 also is the largest study of student math and science achievement in the world. Each country sampled approximately 4,000 students in 150 schools. The TIMSS 2007 report also provides data at the fourth and eighth grades for those countries that also participated in TIMSS 1995, 1999, and 2003. As with previous TIMSS reports, TIMSS 2007 data provide international benchmarks that can be used to help define world-class performance in mathematics and science at the middle or lower-secondary school level. Beyond comparisons in mathematics and science test scores, the reports provide information on educational policies and practices around the world, as well as on gender performance, home environment, curriculum and instructional approaches, and teacher preparation in math and science. *Highlights From TIMSS 2007* is available online at <http://nces.ed.gov/pubs2009/2009001.pdf>. Also available at <http://nces.ed.gov/timss/pdf/Comparing_TIMSS-NAEP_PISA.pdf> is "Comparing TIMSS with NAEP and PISA in Mathematics and Science," which helps interpret the 2007 results from the Trends in International Mathematics and Science Study (TIMSS) by comparing its design, features, framework, and items with those of the U.S. National Assessment of Educational Progress and another international assessment in which the United States participates, the Program for International Student Assessment (PISA).

AGI Publishes Transition Document for Next U.S. Administration

Triangle Coalition member, the American Geological Institute (AGI), has released *Critical Needs for the Twenty First Century: The Role of the Geosciences*. This concise document suggests policy directions for the next President, his administration, federal agencies, and the United States Congress. The document identifies seven national issues and the role geosciences can play in addressing them: energy and climate, water, waste disposal, natural hazards, infrastructure, raw materials, and workforce and education needs. AGI unveiled the document as part of the first annual Geosciences Congressional Visits Day, where over sixty geoscientists visited their members of Congress encouraging steady investment in geoscience research and education.

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The American Geological Institute is a nonprofit federation of 45 geoscientific and professional associations that represents more than 120,000 geologists, geophysicists, and other earth scientists. Founded in 1948, AGI provides information services to geoscientists, serves as a voice of shared interests in the profession, plays a major role in strengthening geoscience education, and strives to increase public awareness of the vital role the geosciences play in society's use of resources, resiliency to natural hazards, and interaction with the environment. More details are at <www.agiweb.org> (the URL for the report is <www.agiweb.org/gap/teotrans08.pdf>).

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 18 December 2008 and reprinted with permission. See separate story on the AGI report in this issue.)

Texas Science Academy Responds to Gathering Storm

The Academy of Medicine, Engineering, and Science of Texas today released a report recommending ways to improve math and science education in the state of Texas. *The Next Frontier* was developed in response to the National Academies' 2005 report *Rising Above the Gathering Storm*, which called for reforms to U.S. science and math education and a greater investment in basic research, steps that are needed to keep the nation economically competitive. *Rising Above the Gathering Storm* argued that without a major push to strengthen the foundations of America's competitiveness, the U.S. will soon lose its position in the global economy. The ultimate goal is to create new, high-quality jobs for U.S. citizens by developing new industries that stem from the ideas of exceptional scientists and engineers. Norman Augustine, retired chair and CEO of Lockheed Martin and chair of the committee that produced the Gathering Storm report,

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AGI Cites Critical 21st Century Needs

Representing more than 120,000 geoscientists in 44 member societies, the American Geological Institute (AGI) has set forth in a 20-page booklet, *Critical Needs for the Twenty First Century: The Role of the Geosciences*, a statement of the AGI's greatest concerns about the "natural resources we rely on . . . derived from the Earth system": energy resources; water resources; soil resources; mineral, metal and building material resources; ecological resources, such as forests, wetlands, coastal systems and the oceans. They devote a page to framing each of the following seven "critical needs," which is followed by a page of recommendations regarding each:

1. Energy and Climate Change: How do we secure stable energy supplies in an increasingly carbon-constrained world?

2. Water: Will there be enough fresh water and where will it come from?

3. Waste Treatment and Disposal: How will we reduce and handle waste and provide a healthy environment for all?

4. Natural Hazards: How will we mitigate risk and provide a safer environment?

5. Infrastructuure Modernization: How will we develop and integrate new technology and modernize aging infrastructure?

6. Raw Materials: How will we ensure reliable supplies when they are needed and where will they come from?

7. Geoscience Workforce and Education: Who will do the work to understand Earth processes and meet demands for resources and resiliency? Who will educate the public and train the workforce?

In framing its concerns, the geoscience community is clearly also staking out its own role in meeting them. Its recommendations regarding the need for energy resources call for recognizing that "fossil fuels are the bridge to a more diverse and sustainable energy portfolio and as the transition to other energy sources occurs federal support for fossil fuel production and investment in fossil fuel research and development (R&D) must grow substantially to ensure full utilization of these vital resources."

And in expressing its final "critical need," AGI laments that "less than 7 percent . . . of 13 million high school students took a high-school Earth science course in 2000" and displays a graph showing that the awarding of bachelor's degrees in geosciences in the 1990s was only half that in the 1980s (though the number of doctorates each year has held steady). They recommend that geoscience become a "core course in middle school and high school" and that an Advanced Placement course in Earth Science be developed.

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stated that "since the National Academies study was conducted, many other nations have increased their spending on education and research, thus making the U.S.' ability to compete for jobs in the 21st century knowledge economy even more tenuous. The Texas science academy's report provides a valuable roadmap to help the state and the nation reverse these trends."

The Texas report recommends ways to attract, train, and retain strong math and science teachers. It also urges the state to take action to interest more K-12 students in math and science fields, to support advanced-placement classes, and to help align K-12 math and science curricula with the needs of higher education and industry. *The Next Frontier* report's findings and recommendations center around four key areas of STEM education:

- Teachers: Recruiting, rewarding, and retaining high-quality teachers;
- Curriculum: Developing curriculum that piques and holds student interest;
- Accountability: Modifying the accountability system to reward improvement, and better preparing students for college and careers; and
- Guidance: Establishing a statewide advisory council to oversee and coordinate Texas' STEM education efforts.

The Next Frontier is available online at <http://tamest.org/edu_full_report.pdf>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 8 January 2009 and reprinted with permission. See separate story on the Texas Academy report in this issue.)

Accelerating the Agenda: Actions to Improve America's High Schools

Building on the national imperative first set forth at the 2005 National Education Summit on High Schools, the National Governors Association Center for Best Practices (NGA Center), National Conference of State Legislatures (NCSL), Council of Chief State School Officers (CCSSO), and National Association of State Boards of Education (NASBE) released this joint report measuring the progress states have made improving America's high schools and citing the challenges that remain in ensuring high school students are prepared for college and career success in the global economy. The report represents the four organizations' shared vision for the changes needed in today's high schools and offers fresh ideas and new practices that show state leaders how to:

- Restore value to the high school diploma by elevating academic standards and high school graduation requirements to a college- and career-ready level;
- Redesign high schools through alternative delivery mechanisms;
- Ensure excellent teachers and principals by connecting teacher preparation, hiring, and evaluation to student outcomes and other factors;

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TAMEST responds to *RAGS*

In October 2007 The Academy of Medicine, Engineering and Science of Texas (TAMEST) published *The Next Frontier: World-Class Math and Science Education for Texas* in response to the *Rising Above the Gathering Storm* (*RAGS*) report issued two years earlier at the request of the U.S. Congress. Comprised of Texas Nobel Laureates and members of the National Academies, TAMEST recognized that "the future of Texas is tied to its non-Anglo population [expected to be two thirds of the total by 2040], which is not being educated at the level required to support a high-tech economy." Of special concern is a lack of college readiness among African-Americans and Hispanics, and a Hispanic dropout rate that is nearly 50%.

Recalling that *RAGS* had emphasized the importance of good STEM (science, technology, engineering, and mathematics) teachers, TAMEST noted two programs that are positive in this regard: the Advanced Placement Strategies program, which is credited with increasing "the number of minority students taking and passing AP tests . . . by more than 400 percent," and UTeach, which began in 1997 as a pre-service teacher training program for math and science majors at the University of Texas at Austin and is now replicated at the University of Houston, the University of Texas at Dallas, and the University of North Texas, in addition to many other sites outside Texas.

But getting good STEM teachers into the classroom is only the first step. The next step is to keep them there. The five-year turnover of STEM middle and high school teachers in the Austin Independent School District was found to be nearly 100 percent, and more frequently cited as a reason than low salaries was a discouraging teaching

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- Improve accountability by aligning postsecondary expectations to high school expectations; and
- Enhance education governance by bridging K-12 and postsecondary expectation gaps through P-16 councils.

Additionally, the report highlights emerging trends, such as greater appreciation for international benchmarking and an increased focus on science, technology, engineering, and mathematics education that have the capacity to improve student success in the global economy. The report is available online at <http://www.nga.org/FIles/pdf/0901IMPROVE HIGHSCHOOLS.PDF>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 29 January 2009 and reprinted with permission.)

NSB Recommends Stem Actions to New Administration

The National Science Board (NSB) has recommended a set of actions for the new Administration to implement starting in early 2009 to advance STEM (science, technology, engineering, and mathematics) education for all American students, to nurture innovation, and to ensure the long-term economic prosperity of the Nation. According to the NSB document, the urgency of this task is underscored by the need to ensure that the United States continues to excel in science and technology in the 21st century. It must develop the ideas that could transform and strengthen the economy, ensure a skilled workforce for American industry, and guarantee that all American students are provided the educational resources and tools needed to participate fully in the science and technology based economy of the 21st century. The solutions offered in the report are derived from studies by the Board over the past decade. According to the report, the essential components of an effective STEM education system include:

- A motivated public, students, and their parents;
- Clear educational goals and assessments;
- High quality teachers;
- World-class resources and assistance for teachers;
- An early start in science; and
- Communication, coordination, and collaboration.

The National Science Board was established by Congress in 1950, and has two important roles. It provides oversight for, and establishes the policies of, the National Science Foundation, within the framework of applicable national policies set forth by the President and the Congress. It also serves as an independent body of advisors to both the President and Congress on broad national policy issues related to science and engineering research and education. The full recommendations are available online at <http://www.nsf.gov/nsb/publications/2009/01_10_stem_rec_obama.pdf>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 5 February 2009 and reprinted with permission. See separate story on the NSB recommendations in this issue.)

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TAMEST

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environment. It is a credit to the support UTeach gives its teachers than "approximately 80 percent of UTeach graduates are still teaching five or more years after graduation compared to 50 percent nationally." Moreover, "principal turnover is even higher than teacher turnover, particularly in economically challenged schools, and for many of the same reasons."

TAMEST also addressed that fact that "many students don't actually *want* to study science and math even if they want to stay in school" and noted that "presenting STEM fields as an exciting career choice is essential in engaging students." The Executive Summary concluded that "In public education, more focus must be placed on teacher and principal support and improvement of the teaching environment. In the world at-large, a more positive image of STEM careers and the people who pursue them must be conveyed."

In its report, TAMEST stated four broad findings, followed by an associated recommendation with a series of action steps to be followed:

1. Texas must provide STEM teachers with enough training, support and pay – so they will come and stay.

2. Texas must do more to interest students in STEM fields and help interested students pursue STEM careers.

3. Texas must help ensure students' continued success in STEM – from college to careers.

4. Texas must make improving STEM education an even higher priority.

The Next Frontier is available online at <http://tamest.org/edu_full_report.pdf>.

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Professional Learning in the Learning Profession

Every year, nine in 10 of the nation's three million teachers participate in professional development designed to improve their content knowledge, transform their teaching, and help them respond to student needs. These activities, which can include workshops, study groups, mentoring, classroom observations, and numerous other formal and informal learning experiences, have mixed results in how they impact student achievement. Research shows that professional learning can have a powerful effect on teacher skills and knowledge and on student learning. To be effective, however, it must be sustained, focused on important content, and embedded in the work of collaborative professional learning teams that support ongoing improvements in teachers' practice and student achievement. A comprehensive new report released recently by researchers from Stanford University and the National Staff Development Council (NSDC) finds that while the United States is making progress in providing support and mentoring for new teachers and focusing on bolstering content knowledge, the type of support and on the-job training most teachers receive is episodic, often fragmented, and disconnected from real problems of practice.

"Professional Learning in the Learning Profession: A Status Report on Teacher Development in the U.S. and Abroad" also notes that U.S. teachers participate in workshops and short-term professional development events at similar levels as teachers in other nations. But the United States is far behind in providing public school teachers with opportunities to participate in extended learning opportunities and productive collaborative communities. Those opportunities allow teachers to work together on instructional planning, learn from one another through mentoring or peer coaching, conduct research on the outcomes of classroom practices, and collectively guide curriculum, assessment, and professional learning decisions. The following are some examples from the report of approaches to professional learning:

- In South Korea — much like Japan and Singapore — only about 35 percent of teachers' working time is spent teaching pupils. Teachers work in a shared office space during out-of-class time, since the students stay in a fixed classroom while

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National Science Board sends recommendations to President Obama

by John L. Roeder

As reported in our Fall 2007 issue, on 9 August 2007 the National Science Board published a draft form of *A National Plan of Action for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System* after receiving the report of its Commission on 21st Century Education in Science, Technology, Engineering, and Mathematics (STEM) on inhibitions to reform of STEM education the previous 15 March.

The editorial in our Fall 2008 issue quoted then-NSTA Executive Director Gerry Wheeler's statement on the lack of attraction of students into STEM careers that "parents don't get it."

These two elements came together in a letter sent by National Science Board Chair Steven C. Beering to Dr. Tom Kalil on the Transition Team for then President-Elect Barack Obama. The subject of the letter was "Actions to Improve Science, Technology, Engineering, and Mathematics (STEM) Education for all American Students," and the attached three pages of recommendations to the Obama Administration listed six "Essential Components of an Effective STEM Education System":

(1) A motivated public, students, and their parents.
(2) Clear educational goals and assessments.
(3) High quality teachers.
(4) World-class resources and assistance for teachers.
(5) An early start in science.
(6) Communication, coordination, and collaboration.

In short, the Board was wasting no time in informing the new President about what it felt was needed to improve STEM education and to offer its services toward achieving that goal. Most of what they advocated has appeared repeatedly in myriad reports on reforming American science education, but the one new word I picked up on was that cited by Wheeler: parents. The Science Board called upon parents to be involved along with the public and students, and in item (5) the President is called upon to "exercise his leadership often and intensely to motivate parents and other members of the community. . . ."

The full text is available online at http://www.nsf.gov/nsb/publications/2009/01_10_stem_rec_obama.pdf.

(*Editor's Note*: See separate story on the position statement on "Parent Involvement in Science Learning" adopted in April 2009 by the Board of Directors of the National Science Teachers Association (NSTA).)

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the teachers rotate to teach them different subjects. The shared office space facilitates sharing of instructional resources and ideas among teachers, which is especially helpful for new teachers.

- In Finland, teachers meet one afternoon each week to jointly plan and develop curriculum, and schools in the same municipality are encouraged to work together to share materials.
- More than 85 percent of schools in Belgium, Denmark, Finland, Hungary, Ireland, Norway, Sweden, and Switzerland provide time for professional development in teachers' work day or week.
- In Singapore, the government pays for 100 hours of professional development each year for all teachers in addition to the 20 hours a week they have to work with other teachers and visit each others' classrooms to study teaching.
- England has instituted a national training program in best-practice literacy methods, using videotapes of teaching, training materials, and coaches who are available to work in schools. This effort coincided with a subsequent rise in the percentage of students meeting the target literacy standards from 63 percent to 75 percent in just three years.

"Professional Learning in the Learning Profession" is available as a 36 pp. report online at <http://www.nsdc.org/stateproflearning.cfm>.

Teaching by Choice: Addressing the National Teaching Shortage

With support from the National Science Foundation (NSF), the American Association of Community Colleges (AACC), in partnership with the National Association of Community College Teacher Education Programs (NACCTEP) and the American Mathematical Association of Two-Year Colleges (AMATYC), have developed "Teaching by Choice (TBC): Addressing the National Teacher Shortage." TBC is a three-part initiative focusing on the increasing demand for K-12 teachers and community college faculty in science, technology, engineering, and mathematics (STEM). As part of the initiative, a new report was recently released that includes recommendations for community college practice in post-

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UCS recommendations for scientific integrity

Billing itself as "the leading science-based nonprofit working for a healthy environment and a safe world," the Union of Concerned Scientists (UCS) has published *Federal Science and the Public Good: Securing the Integrity of Science in Policy Making* in order to insure that the travesties visited upon science by the last presidential administration are not propagated by the present one. It lists five procedures necessary for "restoring scientific integrity to federal policy making" – "protecting government scientists" (so they can do their job without political interference and without reprisal for "blowing the whistle" against political interference), "making the government more transparent" (so that the results of federal science research can be freely accessed), "reforming the regulatory process" (so that government agencies will not be micromanaged by the White House), "ensuring robust scientific input to federal decision making" (so that scientists and the work that they do are fully respected), and "strengthening monitoring and enforcement" (so that continually-monitored data will be accurately reported). Scientific Integrity Checklists are provided for Congress, the President, and Agency and Department Heads. One item on the Congressional checklist is reinstatement of the Office of Technology Assessment, defunded in 1995.

A separate chapter delineates patterns of abuse practiced by the George W. Bush Administration, broken down into nine categories: 1) "falsifying data and fabricating results," 2) "selectively editing documents and creating false uncertainty," 3) "tampering with scientific procedures," 4) "intimidating and coercing scientists," 5) "censoring and suppressing scientists," 6) "hiding, suppressing, and delaying release of scientific findings," 7) "disregarding legally mandated science," 8) "allowing conflicts of interest," and 9) "corrupting scientific advisory panels." And a final chapter lists ways that the Bush Administration systematically "changed the rules" – by 1) "centralizing decision making and the unitary executive," 2) "homogenizing agency decision making," 3) "reducing transparency," 4) "adding unnecessary bureaucracy," 5) "retaliating against whistle-blowers," 6) "foxes guarding the henhouse," 7) "removing science from decision making," and 8) "weakening enforcement and monitoring." The UCS is more concerned about the rules changes, because they have the potential "to enshrine politicized science indefinitely. These changes represent an infection that has sunk into the marrow of government, which must be cured before science can again provide impartial information to policy makers and the public." One such insidious change cited (on p. 43) was removing the phrase "to understand and protect the home planet" from NASA's official mission statement in February 2006.

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baccalaureate teacher education and professional development programs for current and future K–12 teachers in science, mathematics, engineering, and technology. "Teaching by Choice: Community Colleges Expand K–12 STEM Pathways and Practices" is the third and final report in the Teaching by Choice series which focused on the recruitment, retention, and professional development of K–12 and community college faculty in STEM fields.

Community colleges are playing a pivotal role in meeting the need for highly qualified teachers to fill the K–12 classrooms. Teacher education programs at community colleges have traditionally prepared students for transfer to four-year colleges and universities to earn bachelor's degrees in education. Now an increasing number of community colleges also offer post-baccalaureate teacher education programs for "career switchers" as well as professional development programs in science, mathematics, and technology for teachers already in the K–12 workforce. This report grew out of a February 2008 national conference, "Teaching by Choice: Beyond 2 + 2," which was convened to enhance, expand, and sustain the science, math, and technological knowledge and practices of current and future K–12 teachers. Based on deliberations and recommendations from the conference participants, the report offers practical suggestions for developing and strengthening these post-baccalaureate and professional development programs. "Teaching by Choice" is available as a 19 pp. report online at <http://www.aacc.nche.edu/Resources/aaccprograms/Documents/K12STEMpaths.pdf>.

Report Finds That States Squander Opportunities with New Teachers

A new report released by the not-for-profit National Council on Teacher Quality (NCTQ) finds that the laws and regulations of a majority of states discourage promising new teachers from sticking with the profession, while doing little to identify and move out ineffective teachers. The report finds that states: 1) do not require sufficient support and evaluation of new teachers, a problem since most districts rarely opt to exceed state requirements; 2) do not require or even allow a teacher's effectiveness to be considered when granting tenure, although states control how and when tenure is awarded; 3) cling to anachronistic compensation schemes rather than advancing differentiated pay systems; 4) are lagging in the development of the systems necessary for identifying effective teachers; 5) place a disproportionate emphasis on providing pension benefits to retiring teachers at the expense of providing benefits that would appeal to younger teachers; and 6) allow far too many ineffective teachers to remain in the classroom and gain tenure, including teachers who repeatedly fail to meet the state's own licensing standards.

NCTQ President Kate Walsh said, "The third through fifth years of teaching represent an opportunity lost for teacher quality. That's certainly when teachers begin to add real value, and it's also when they tend to make decisions about staying or leaving. States can help districts do much more to ensure that the right teachers stay and the right teachers leave." The 2008 State Teacher Policy Yearbook finds that state regulations are in need of significant reforms in order to improve teacher quality and offers states specific guidelines for rectifying substandard policies. Each state's Yearbook, as well as a national summary, is immediately available for free download at <www.nctq.org/stpy>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 12 February 2009 and reprinted with permission.)

U.S. Must Ensure 55 Percent of Americans Earn Postsecondary Degree by 2025

According to the College Board, the United States must take immediate action to reverse its fall from the top ranks of countries with a college-educated workforce. The national commission recommends a specific 10-part action agenda to reverse the current trend and promises annual evaluations to track success. Completed by the College Board's Commission on Access, Admissions and Success in Higher Education, "Coming to Our Senses: Education and the American Future," notes the alarming decline of U.S. educational attainment among 25- to 34-year-olds and details how the country can regain its competitive edge. The report documents that after having led the world in high school completion rates throughout the 20th century, the United States ranked 21st out of 27 advanced economies. College completion rates have followed a similar pattern: once second in the world for younger workers (ages 25 to 34), the United States now ranks 11th. Additionally, dropout rates for high school students (grades nine through 12) have tripled in the last 30 years. The report provides recommendations to strengthen our education system across the P-20 pipeline, increase the number of students earning postsecondary degrees or certificates and regain our global competitive edge for the 21st century.

The 28-member commission is a nationally representative group of college presidents, university chancellors, admissions and enrollment deans, school counselors and administrators, and other education experts who examined demographic, socioeconomic, public policy, and

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education trends that affect college access and success. They recommend actions to address specific areas of weakness while building a renewed education system that will increase current college completion rates and drive the United States toward reclaiming its position as a global leader. The report is available online at <http://professionals.collegeboard.com/profdownload/coming-to-our-senses-college-board-2008.pdf>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 26 February 2009 and reprinted with permission. See separate story on "Coming to Our Senses: Education and the American Future" in this issue.)

Taking on Education, President Obama Announces Education Pillars of Reform

On 10 March, President Barack Obama offered remarks on education at a Hispanic Chamber of Commerce gathering in Washington, D.C. The President explained why, on education in particular, we cannot afford to wait, noting that even within a few years America will see a different reality: "By 2016, four out of every ten new jobs will require at least some advanced education or training." The President pledged to end pointless partisan finger-pointing, and to ensure that new investments also came with new reforms. He pointed to deep commitments both in the recovery act and his budget proposal, while also telling the audience that "It is time to start rewarding good teachers and stop making excuses for bad ones." He proposed four pillars of reform:

1) "Investing in early childhood initiatives" like Head Start;
2) "Encouraging better standards and assessments" by focusing on testing itineraries that better fit our kids and the world they live in;
3) "Recruiting, preparing, and rewarding outstanding teachers" by giving incentives for a new generation of teachers and for new levels of excellence from all of our teachers.
4) "Promoting innovation and excellence in America's schools" by supporting charter schools, reforming the school calendar and the structure of the school day.

And for students themselves, the President had a message: "No matter how innovative our schools or how effective our teachers, America cannot succeed unless our students take responsibility for their own education. That means showing up for school on time, paying attention in class, seeking out extra tutoring if it's needed, and staying out of trouble. And to any student who's watching, I say this: don't even think about dropping out of school. As I said a couple of weeks ago, dropping out is quitting on yourself, it's quitting on your country, and it is not an option – not anymore. Not when our high school dropout rate has tripled in the past thirty years. Not when high school dropouts earn about half as much as college graduates. And not when Latino students are dropping out faster than just about anyone else. It is time for all of us, no matter what our backgrounds, to come together and solve this epidemic." More details on the pillars and the educational plan are available at <http://www.whitehouse.gov/the_press_office/Fact-Sheet-Expanding-the-Promise-of-Education-in-America/>.

McREL and Partners Unveil "Nanoleap Into New Science" Module

Triangle Coalition member, Mid-continent Research for Education and Learning (McREL), and the Stanford Nanofabrication Facility (SNF) have released the first of two instructional modules from the "NanoLeap into New Science" project funded by the National Science Foundation (NSF). The new modules integrate real-world nanoscale science and engineering research into high school chemistry and physical science courses. Each standards-based module includes teacher guides, assessments, student activities, and experiments. Using topics normally taught in high school science, students engage in nanoscale science and technology concepts within a real-world context. The first module released, "Investigating Static Forces in Nature: The Mystery of the Gecko," is designed for physical science classrooms and includes videos, animation, and interactive technologies.

Instructional materials for the module were developed by McREL in collaboration with master science teachers and nanoscale science and technology researchers. Throughout the four-year development project, materials were vetted and evaluated thoroughly in high school classrooms. The module is available at <http://www.mcrel.org/nanoleap/ps/.> McREL is a Denver-based, nationally recognized, private, nonprofit organization that is dedicated to improving education for all students through applied research, product development, and service.

NEA Partners to Develop Standards for Measuring 21st Century Skills

The National Education Association (NEA) has announced its partnership with the Council of Chief State School Officers; the National Governors Association; Achieve, Inc.; the Alliance for Excellent Education; the Hunt Institute; the National Association of State Boards

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of Education; and the Business Roundtable, in a new state-led initiative to improve the access of every student to a complete, high-quality education that provides the skills and knowledge needed to thrive in the 21st century. The Common Core State Standards Initiative is working to produce a common core of voluntary state standards across grades. The K-12 standards would cover English/ language arts, math, and eventually science. The initiative plans to be an inclusive and transparent process that will include input from education, civil rights, and business leaders among others.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 12 March 2009 and reprinted with permission.)

Secretary Duncan Testifies Before House Budget Committee

On 12 March, Secretary of Education Arne Duncan testified before the House Budget Committee on the Fiscal Year 2010 Budget Request for the U.S. Department of Education. In his opening statement, the Secretary summarized the budget and indicated that more details will be available in the next few weeks. President Obama is asking for $46.7 billion in discretionary funding for the Department in fiscal year 2010, or roughly a $500 million increase over the 2009 level. Duncan said that the President "believes strongly that one key for both individual and national success in the global economy is a college education. This is why he has set a national goal of ensuring that America is number one in the percentage of citizens holding college degrees. Today roughly 40 percent of 25-34 year-old Americans hold college degrees, and we want to raise that to 60 percent." With regard to the education workforce, the Secretary said that the budget request will include proposals to bring greater accountability to teacher and principal preparation programs, to improve systems and strategies for recruiting, evaluating, and supporting teachers, and to provide incentives that will both reward effective teachers and encourage them to teach where they are most needed.

The Secretary also outlined an interest to create a stronger and more reliable Pell Grant program by moving the program to the mandatory side of the Federal budget. And, because rising costs mean Pell Grants cover less than half as much tuition as they did 30 years ago, the proposed budget would raise the maximum Pell Grant to $5,550 a year, indexing it above inflation. The request would also significantly expand the Perkins Loan program to give students with extra borrowing needs a better alternative to high-cost private loan programs. The proposal would expand the number of schools offering Perkins Loans from 1,800 to up to 4,400, and potentially more than quintuple the number of students receiving Perkins Loans, from 500,000 to 2.7 million, and better distribute student aid among schools. The loans would carry a 5 percent interest rate, with interest accruing during school, and would be handled by private sector organizations instead of colleges shouldering the responsibility for loan collection.

Bayer Awards $200,000 to NSTA to Nurture Early-Career Science Teachers

Bayer Corporation's Bayer USA Foundation has awarded the National Science Teachers Association (NSTA) a $200,000 grant to create the Bayer-NSTA Fellows program and to expand the NSTA New Science Teacher Academy. This latest Bayer USA Foundation grant supports Bayer Corporation's ongoing commitment to improve science education and science literacy through the company-wide "Making Science Make Sense" program. Each year for three years, the grant supports 10 early-career middle and high school science teachers with an array of professional development resources and tools. Bayer-NSTA Fellows receive a comprehensive NSTA membership package, online mentoring with trained instructors who teach in the same discipline and the opportunity to participate in a variety of Web-based professional development activities, including Web seminars. The NSTA New Science Teacher Academy is a year-long professional development program to help reduce the high-attrition rate among science teachers who are new to the profession. Research shows that nearly 50 percent of early-career teachers leave their jobs in the first five years. Intended for science educators entering their second or third year of teaching, the Academy aims to reverse this trend by promoting quality science teaching, enhancing teacher confidence and classroom excellence and improving teacher-content knowledge. With its emphasis on encouraging and supporting middle and secondary school science educators in their first few years of teaching, the NSTA New Science Teacher Academy aligns with two of President Barack Obama's key education policy initiatives to make math and science education a national priority and retain teachers.

This spring, Bayer and NSTA will issue a call for entries to the 2009-2010 NSTA New Science Teacher Academy. Science teachers located throughout the country who will be entering their second or third year of teaching and whose schedule is a minimum of 51 percent middle or high school science, can apply to the become an NSTA Fellow. For more information about the NSTA New Science Teacher Academy, to learn how to apply to

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become a fellow and 2009-2010 deadline information visit <www.nsta.org/academy>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 19 March 2009 and reprinted with permission.)

U.S. Secretary of Education Speaks at NSTA National Conference on Science Education

U.S. Secretary of Education Arne Duncan recently addressed more than 2,000 science educators at the National Science Teachers Association's (NSTA) National Conference on Science Education in New Orleans, LA. Duncan discussed the future of science education and the various provisions of the education reform strategy that he and President Obama will be pursuing this year. "Science education is central to our broader effort to restore American leadership in education worldwide," Duncan said. America won the space race but, in many ways, American education lost the science race. "We need more people in engineering. We need them for the healthcare and the green energy industries. We need them in technology. And we need them in the classroom. Too many middle school students are being taught by a generalist. We've known about this for years, but we haven't done enough to address it. Among other comments, Duncan said that we need to respond to the market by paying more to teachers in high-need subjects like science and math. He also said that he wants to provide incentives for schools to attract and support great talent in the STEM subjects.

Regarding Obama's focus, Duncan said that "he (Obama) understands that a nation not only needs its poets and scholars to give us words and wisdom, but also its inventors and engineers to design new cell phones, rebuild the levees of New Orleans, and find new sources of energy and new treatments for disease. Moreover, he is a president who will not allow scientific research to be held hostage to a political agenda. Whether it's global warming, evolution or stem cell research, science will be honored, respected, and supported by this administration." With regard to funding support, Duncan promised that "many of the teaching jobs we will save with stimulus dollars will be in science labs all across America." He said that some of that money will help modernize science labs, though admitted that those decisions will be made at the local and district level. He indicated there is also a "pot of $650 million for education technology grants." His full comments are available online at <http://www.ed.gov/news/speeches/2009/03/03202009.html>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 26 March 2009 and reprinted with permission.)

Technology as Catalyst for Critical School Reform

The State Educational Technology Directors Association (SETDA) has released its annual National Trends Report, announcing new data on technology's power to increase student achievement and engagement, and equip our nation's children and teachers with the knowledge and technological proficiency necessary to position America as a leader within the increasingly digital, competitive, and global economy. The 2009 Trends Report, "Focus on Technology Integration in America's Schools," identifies programs that effectively integrate technology in efforts to create robust subject matter content, innovative curricula, ongoing professional development, and diagnostic assessments to facilitate individualized instruction. The Report highlights the Enhancing Education Through Technology (EETT) program, a component of the No Child Left Behind, Title II, Part D (NCLB IID) Act, and focuses on how states are using these funds to increase student achievement. A sampling of findings in select high-need districts and states include:

- 31% increase in innovative use of technology by teachers in core subject areas
- 17% - 33% increase in reading achievement
- 18% - 36% increase in math achievement
- 14% increase in graduation rate (66% to 80%)

The findings demonstrate the power of instructional technology to substantially increase student engagement and graduation rates, preparing our students for college and the workforce. The report also says that the implications of integrating technology into all aspects of education extend to real improvements in state economies. By increasing high school graduation rates, technology can greatly increase states' return on investment. The report is available at <http://www.setda.org/web/guest/2009nationaltrendsreport>. Founded in 2001, the State Educational Technology Directors Association (SETDA) is the principal association representing the state directors for education technology. SETDA works in partnership with the U.S. Department of Education, education associations, and the corporate community in an effort to promote national leadership in education technology; provide professional development in educational leadership for members; and build partnerships and provide leadership to advance learning opportunities.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 23 April 2009 and

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reprinted with permission. The 2008 SEDTA "STEM" Report is described in this column of our Fall 2008 issue.)

President Obama Focuses on STEM Ed During NAS Speech

On Monday, 27 April, President Obama gave his first speech on science and technology since taking office three months ago at the annual meeting of the National Academy of Sciences (NAS) in Washington, D.C. During the speech, which was broadcast online, the President said that "there are those who say we cannot afford to invest in science. That support for research is somehow a luxury at a moment defined by necessities." He disagreed, stating "Science is more essential for our prosperity, our security, our health, our environment, and our quality of life than it has ever been." He noted that "our schools continue to trail. Our students are outperformed in math and science by their peers in Singapore, Japan, England, the Netherlands, Hong Kong, and Korea, among others. Another assessment shows American fifteen year olds ranked 25th in math and 21st in science when compared to nations around the world." He also pointed out that "A half century ago, this nation made a commitment to lead the world in scientific and technological innovation; to invest in education, in research, in engineering; to set a goal of reaching space and engaging every citizen in that historic mission. That was the high water mark of America's investment in research and development. Since then our investments have steadily declined as a share of our national income -- our GDP. As a result, other countries are now beginning to pull ahead in the pursuit of this generation's great discoveries."

With a specific focus on STEM education, Obama announced a renewed commitment to education in mathematics and science, and announced the "Race to the Top" program. He said that "the progress and prosperity of future generations will depend on what we do now to educate the next generation." Through the program, states making strong commitments and progress in math and science education will be eligible to compete later this fall for additional funds under the Secretary of Education's $5 billion "Race to the Top" program. The President challenged states to "dramatically improve achievement in math and science by raising standards, modernizing science labs, upgrading curriculum, and forging partnerships to improve the use of science and technology in our classrooms." Obama also challenged states to "enhance teacher preparation and training and to attract new and qualified math and science teachers to better engage students and reinvigorate these subjects in our schools." He pointed out that there are "chemists who could teach chemistry; physicists who could teach physics; statisticians who could teach mathematics. But we need to create a way to bring the expertise and the enthusiasm of these folks into the classroom." The President also encouraged STEM professionals to spend time in the classroom, to encourage their universities to participate in programs to allow students to get a degree in scientific fields and a teaching certificate at the same time, and to think about new and creative ways to engage young people in science and engineering, citing science festivals, robotics competitions, and science fairs as examples. A transcript of the President's speech is available at <http://science.nsta.org/nstaexpress/ObamaSpeechOnR&DAndScienceAndMathEducation.pdf>. More details on planned activities are available at <http://www.whitehouse.gov/the_press_office/Fact-Sheet-A-Historic-Commitment-To-Research-And-Education/>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 30 April 2009 and reprinted with permission.)

Economic Impact of the Achievement Gap in America's Schools

A new report by the McKinsey & Company, a global management consulting firm, examines the dimensions and economic impact of the education achievement gap. While much controversy exists on the causes of the gap and on what the nation should do to address it, the full range of the achievement gap's character and consequences has been poorly understood. The report, "The Economic Impact of the Achievement Gap in America's Schools," examines the dimensions of four distinct gaps in education: (1) between the United States and other nations, (2) between black and Latino students and white students, (3) between students of different income levels, and (4) between similar students schooled in different systems or regions. The report finds that the underutilization of human potential as reflected in the achievement gap is extremely costly. Existing gaps impose the economic equivalent of a permanent national recession – one substantially larger than the deep recession the country is currently experiencing. For individuals, avoidable shortfalls in academic achievement impose heavy and often tragic consequences via lower earnings, poor health, and higher rates of incarceration.

According to the report, what happens in schools and school systems matters profoundly. There has long been debate as to whether students' fates are shaped more by socioeconomic factors outside of school or by what hap-

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pens inside school. McKinsey's reading of the evidence suggests that while factors outside of school are certainly very important sources of unequal outcomes, superior educational policies and practices at every level – federal, state, district, school, and classroom – matter profoundly for student achievement, and thus for students' economic prospects and life chances. American education is filled with instances in which students with similar backgrounds and traits achieve very different results. McKinsey believes this can be dramatically affected by what happens (or doesn't happen) in our schools, and that research to refine more precisely what drives this system achievement gap among similar students should be a priority. The report is available on-line at <http://www.mckinsey.com/clientservice/socialsector/achievement_gap_report.pdf>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 7 May 2009 and reprinted with permission. See separate article in this issue.)

NSTA Position Statement: Parent Involvement in Science Learning

The National Science Teachers Association's (NSTA) Board of Directors has voted to adopt a recently revised position statement bringing attention to the important role that parents and other caregivers play in their children's science learning at home, in school, and throughout the community. The statement, "Parent Involvement in Science Learning," encourages parents to be actively involved in their children's science learning because it is crucial to their children's interest in and ability to learn science. It says that "the more actively engaged parents and other caregivers are in their children's schooling, the more beneficial schools can be for building their child's appreciation and knowledge of and confidence and skills in science and technology."

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McKinsey charts achievement gaps

The CEEB report, "Coming to Our Senses," in noting the decline in America's ranking in the pursuit of higher education, observes that "a major part of the challenge lies in erasing disparities in educational attainment so that low-income students and underrepresented minorities can take their place at the table. Just 26 percent of African Americans, 18 percent of Latino and Hispanic Americans, and 24 percent of Native Americans and Pacific Islanders have at least an associate degree." With the number of Hispanic high school graduates expected to grow by 54% between 2000 and 2020 (compared with 3% increase for African Americans, 7% for Native Americans, a slight amount for Asian Americans, and a decline of 11% for whites), it is noted that "eliminating the degree gap between underrepresented minorities and white Americans would produce more than half the degrees needed to meet the 55 percent goal."

McKinsey & Company, in their report, "The Economic Impact of the Achievement Gap in America's Schools," focuses not only on the "degree gap" between racial and economic groups in the United States but more broadly on gaps in all types of academic achievement – and the consequent economic impacts.

Most of this report is devoted to describing and analyzing the achievement gaps themselves. Four specific gaps are investigated: 1) the gap between 2006 PISA (Program for International Student Assessment) scores of 15-year-olds in math and science, 2) 2007 NAEP (National Assessment of Educational Progress) test scores for reading and math for White, Latino, and Black students in grades 4, 8 and 12; 3) 2005 NAEP test scores for reading and math for not low income and low income students; and 4) 2007 NAEP grade 4 math test scores for students in different states. In each case there are gaps, and the "racial achievement gap worsens the longer children are in school." The second section of the report determines the cost of each gap by the increase in 2008 US GDP that would have resulted from closing the gap between 1983 (the publication year of *A Nation at Risk*) and 1998. The cost of the international achievement gap is placed between $1.3 and $2.3 trillion (which is noted to be "larger than the deep recession the United States is currently experiencing"); the cost of the racial achievement gap is placed between $310 and $525 billion; the cost of the income achievement gap is placed between $400 and $670 billion; and the cost of the "systems" achievement gap is placed between $425 and $700 billion. Taking the same note as "Coming to Our Senses" of the demographic shift to a greater proportion of Blacks and Latinos in the population and workforce, this report notes that the consequences of the achievement gaps will only become greater unless these gaps are narrowed.

The report is available on-line at <http://www.mckinsey.com/clientservice/socialsector/achievement_gap_report.pdf>.

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The statement also points out that parents and other caregivers play an important role in ensuring that their children have the necessary knowledge and skills in science and technology to become scientifically literate and informed citizens. It says that it "is imperative that we develop a strong science- and technology-skilled workforce. Parents can encourage children to consider and pursue a science- or technology-related career and to obtain the necessary knowledge and skills that will allow them access to and success in such a career." The position statement, which includes many ideas for parental involvement in science, is available at <http://www.nsta.org/about/positions/parents.aspx?lid=exp>.

(*Editor's Note*: The above was excerpted from the *Triangle Coalition Electronic Bulletin* for 14 May 2009 and reprinted with permission. See separate article on the NSTA position statement in this issue.)

NSTA adopts statement on Parent Involvement

In April 2009 the National Science Teachers Association (NSTA) Board of Directors adopted a position statement on "Parent Involvement in Science Learning," in which it expressed the belief that

> the involvement of parents and other caregivers in their children's learning is crucial to their children's interest in and ability to learn science. Research shows that when parents play an active role, their children achieve greater success as learners, regardless of socioeconomic status, ethnic/racial background, or the parents' own level of education. Furthermore, the more intensely parents are involved, the more confident and engaged their children are as learners and the more beneficial the effects on their achievement.

Noting that "Children are naturally curious about the world around them," the statement lists six ways "parents and other caregivers can nurture this curiosity in children of all ages by creating a positive and safe environment at home for exploration and discovery." Noting that "The more actively engaged parents and other caregivers are in their children's schooling, the more beneficial schools can be for building their child's appreciation and knowledge of and confidence and skills in science and technology," the statement lists seven ways for parents to be actively engaged. Finally, because "It is also imperative that we develop a strong science-and-technology-skilled workforce," seven ways are listed whereby "Parents can encourage children to consider and pursue a science-or-technology-related career and to obtain the necessary knowledge and skills that will allow them access to and success in such a career."

Infusion Tips

The late Dick Brinckerhoff suggested the following criteria for ways to infuse societal topics into our science courses: items should be a) challenging, b) relevant, c) brief, and d) require a value judgment. Consider the following:

1. According to a report in *Science* (**314**, 401-403 (20 Oct 06)), chemistry Nobelist Paul Crutzen, who co-developed the chemistry of ozone layer destruction, is giving second thoughts to a mitigation of climate change he formerly rejected: "spewing megatons of sulfurous debris into the stratosphere to shade the planet and rein in global warming." This "geoengineering" would need to replicate the eruptions of Mt. Pinatubo by sending "millions of tons of sulfur tens of kilometers into the air every year." A model developed at the National Center for Atmospheric Research (T. M. L. Wigley, "A Combined Mitigation/ Geoengineering Approach to Climate Stabilization," *Science*, 452-454 (20 Oct 06)) indicates that a *biennial* "Pinatubo eruption" would suffice. Says Meinrat Andrea: "Your papering over the problem so people can keep inflicting damage on the climate system without having to give up fossil fuels." What do *you* say?

2. National Public Radio's "Morning Edition" reported on 11 December 2008 that claims of celebrities that vaccinations against disease can cause autism are now being countered by another celebrity concerned that not vaccinating children will mean a resurgence of disease. The same report, in fact, cited a resurgence of measles, contracted by many children whose parents decided not to have them vaccinated. Celebrities are not medical experts, yet whatever they have to say – about anything – is often accepted as valid by indiscriminate listeners. The freedom of speech guaranteed by the U. S. Constitution doesn't apply if it causes a "clear and present danger." Is such a consideration applicable to celebrity pronouncements about vaccinations?

(*Editor's Note*: While Reference #14, this issue, does not deal with the role of celebrities in the controversy about vaccines and autism, it does present extensive background about the issues involved.)

3. According to Michael Scott Moore, "Tilting at Turbines," *Miller-McCune*, **2**(3), 30-39 (May/Jun 09), a dam and a "barrage" of underwater propellers to generate electric power from the tides, installed at the mouth of

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College Board aims for greater college success

At a time of concern about America's scientific and technological leadership in the world and the performance of American students in science, technology, engineering, and mathematics courses, the College Board has focused on a declining American high school graduation rate and failure of American students to keep up with the world's increase in the percentage of students earning post-secondary degrees. Its 44-page report, "Coming to Our Senses: Education and the American Future," displays a graph of enrollment by educational level plotted against educational level. After grade 9 there is a clear dropoff, which becomes even steeper past grade 12. "High school graduation rates have fallen from about 77 percent in 1971-72 to 67 percent today," it says. "The United States, which led the world in high school completion rates throughout the 20th century, ranked just 21st out of 27 advanced economies in 2005." The report is thus led to conclude that "As an aging and highly educated workforce retires, for the first time in the history of our country we face the prospect that the educational level of one generation of Americans will not exceed, will not equal, perhaps will not even approach, the level of its parents."

In contrast to this *status quo*, the College Board report notes that not even high school graduation is enough:

> *Merely to reclaim our position in the front rank of international educational leadership, many experts believe we must establish and reach a goal of ensuring that by the year 2025 fully 55 percent of young Americans are completing their schooling with a community college degree or higher.*

The leading nation in postsecondary attainment – in all age groups – is the Russian Federation, no doubt a consequence of the emphasis on training highly-skilled workers in science and technology in the former Soviet Union. The postsecondary attainment of their 25-to 34-year-olds is 57%, even higher than the 45% of their 55-to 64-year-olds. The percentages of postsecondary attainment of Americans in these age groups is 39% and 37%, respectively. While this still represents an increase in younger workers over older workers, it is only a slight increase; and, while the postsecondary attainment of older Americans is second only to the Russians, the postsecondary attainment of younger students in Canada, Japan, Korea, Norway, Ireland, Belgium, Denmark, Spain, and France has moved ahead of younger Americans to move the younger Americans back to 11th place.

"Asian Americans already meet this goal [of 55% postsecondary attainment] and middle-class white Americans are within striking distance," the report notes. "A major part of the challenge lies in erasing disparities in educational attainment so that low-income students and underrepresented minorities can take their place at the table. Just 26 percent of African Americans, 18 percent of Latino and Hispanic Americans, and 24 percent of Native Americans and Pacific Islanders have at least an associate degree." With the number of Hispanic high school graduates expected to grow by 54% between 2000 and 2020 (compared with 3% increase for African Americans, 7% for Native Americans, a slight amount for Asian Americans, and a decline of 11% for whites), it is noted that "eliminating the degree gap between underrepresented minorities and white Americans would produce more than half the degrees needed to meet the 55 percent goal." "The 55 percent degree attainment goal would be reached if, for example, between now and 2025 the United States increased its postsecondary education productivity by just one percentage point annually."

After presenting the present situation and what needs to be done in the first chapter, the second chapter of "Coming to Our Senses: Education and the American Future" sets forth "Seven Great Education Challenges":

- many poor and minority children arriving at kindergarten educationally well behind their peers;
- high attrition rates at crucial stages of the educational pipeline;
- shortcomings in K-12 student preparation and college readiness and lack of alignment between high school and college;
- disparities in the quality of K-12 teaching;
- significant challenges on our college campuses, including complex admissions and financial aid processes, affordability challenges and disappointing completion rates;
- outdated college credit and transfer practices that inhibit student mobility; and
- inadequate investment in adult education.

The relevant statistic supporting the first challenge is that "a child from a family on public assistance has an average working vocabulary of about 500 words at 3 years of age. Meanwhile a child in a blue-collar family has an average vocabulary of 750 words (50 percent greater), while the child in a professional family has an average vocabulary of 1,100 words (120 percent greater)."

The dropoff in the "K-16 pipeline" has already been described in terms of a graph in the first paragraph of this article. The report also observes that "high school drop-

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greater college success

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outs can be predicted with 70 percent accuracy based on low reading scores in the third grade" and adds the following about college completion: "The United States slipped between 1995 and 2005 from second to 14th in university completion ranks. Just 36 percent of first-time, full-time U.S. undergraduates at four-year colleges, who enroll intending to earn a bachelor's degree, attain their goal within four years. . . only 58 percent achieve it within six years."

In considering "Shortcomings in Preparation and Readiness," the report discusses "University-School-Community Partnerships to Encourage Minority Enrollment," particularly those of California State University and The Ohio State University. In terms of alignment between high school and college, the report emphasizes that "curriculum rigor trumps just about everything else in predicting college success. . . . Of students who completed a high school curriculum at the highest levels of academic intensity. . ., 95 percent earned a bachelor's degree." But "no ethnic group in America comes close to attending high schools in which a rigorous college-prep curriculum is universally available," the report states. ". . . getting beyond Algebra II in mathematics and taking three Carnegie units in laboratory sciences (biology, chemistry, and physics) is a huge predictor of college success."

"The consequences of graduating students without a strong background (and admitting them to two-and four-year colleges with spotty preparation) are severe," the report continues. ". . . high school graduates in 1992 had a remediation rate of 61.1 percent in community colleges and 25.3 percent at four-year institutions. . . . Just 9 percent of all college-ready graduates are African American or Hispanic. If students do not have the skills they need to perform well in college on entry, it is hard for them to complete their studies successfully."

If all American students are to attend schools offering a rigorous college-prep curriculum, the quality of teaching in those schools will need to improve to meet a higher standard. Sir Michael Barber, former senior advisor to former Prime Minister Tony Blair of Great Britain is quoted as saying that it is impossible for an educational system to be better than its teachers. The report notes the usual problems of science and mathematics courses being taught by out-of-field teachers, the unattractiveness of a teaching career by virtue of low salaries, and working conditions that cause an overall attrition in the teaching profession exceeding 50 percent every five years.

In addressing "Challenges in Admissions, Financial Aid and Degree Completion," the report laments that complex admissions processes and financial barriers discourage low- and moderate-income high school graduates from applying. "Annually, more than 405,000 students successfully completing a college-prep curriculum and prepared to enter a four-year college will not do so. . . high-achieving students . . . of limited means have about the same chance of attending college (78 percent) as a low-achieving student from a wealthier background (77 percent)." The present trend of states' cutting back support of state educational institutions in order to balance budgets against dwindling tax revenues is further aggravating this situation and ultimately undermining the states' own futures. The report also presents A Seven-Step Plan to Lower College Dropout Rates developed by The Education Trust. "What is needed," they write, "is the development of a culture on campus that includes the expectation that every admitted student will, in fact, graduate, and a determination to understand what is going on when students do not."

Lastly, the report notes the limitations imposed by present credit transfer policies and inadequacy of adult education opportunities.

"These challenges – the need for more early childhood programs, a pipeline that leaks like a sieve from grade 9 on, lack of college planning and counseling, inadequate secondary school rigor, questions about teacher quality, complex challenges on campus and the need to attend to adult learners – frame the responses required. In the 25 years since 'A Nation at Risk' was published, we have proceeded down a path that assumed the questions were well understood and the solutions on track. We have acted as though three different systems – preschool, K-12 and higher education – had so little in common with each other that they never needed to be considered together. And we have behaved as though the educational structures and behaviors that served the United States so faithfully and well in the second half of the 20th century would continue to fit our national purposes in the 21st."

"They will not," cautions the report, noting that if we rest on our laurels, other nations in the world, especially China, will leave us behind. To this end, the report recommends the following Ten-Point Action Plan for American Schools, Colleges and Universities:

I. *That states provide a program of voluntary high-quality, preschool education, universally available to 3- and 4-year-old children from families at or below 200 percent of the poverty line.*

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II. *That states and localities move toward professional norms for staffing middle and high school counseling offices and that colleges and universities collaborate actively to provide college information and planning services to all students (with a special focus on low-income students).*

III. *That states and local educational agencies adopt targeted interventions (starting in elementary and middle schools) focused on early warning signs of students in danger of dropping out, so as to identify such students and put an educational safety net under them.*

IV. *That governors, legislators and state education agencies work to provide a world-class education to every American student by aligning high school programs with international benchmarks tied to the demands of college, work and life.*

V. *That states, localities and the federal government step up to the crisis in teaching by providing market-competitive salaries, creating multiple pathways into teaching and fixing the math and science crisis.*

VI. *That public and private institutions of higher education continue to uphold the highest professional standards in admissions and financial aid and collaborate to make the admissions process more transparent and less complex.*

VII. *That federal and state officials encourage increased access by providing more need-based grant aid, making the process of applying for financial assistance more transparent and predictable, and finding ways to inform families, as early as the middle school years, of aid amounts likely to be available to individual students.*

VIII. *That academic leaders work to control tuition increases and that state officials maintain state support.*

IX. *That institutions of higher education set out to dramatically increase college completion rates by improving retention, easing transfer among institutions, and implementing data-based strategies to identify retention and dropout challenges.*

X. *A renewed commitment to adult education opportunities, one that supplements existing basic skills training and General Educational Development opportunities with a new "honors GED," and better coordination of federal and state efforts to provide adult education, veterans benefits, outreach programs and student aid.*

Among existing programs cited because they are targeted to achieving these recommendations are "America's Promise Alliance (led by former Secretary of State Colin Powell) . . . committed to a major program of dropout prevention"; "Achieve's American Diploma Project (a coalition of 33 states committed to aligned standards, assessments and graduation requirements)"; the "Declaration of Values to Guide a Profession" from the Task Force on Admissions in the 21st Century (which regards education as a process rather than a product and calls for revisiting college rankings); and "Achieving the Dream, a program funded by the Lumina Foundation for Education and others . . . one example of an initiative that puts the seven-point dropout prevention program into action."

Much of "Coming to Our Senses: Education and the American Future" has a lot in common with President Obama's four pillars of educational reform in his 10 March speech to the Hispanic Chamber of Commerce – and even more if one adds "providing higher education (including technical training) to all Americans," as the National Science Teachers Association did in presenting the President's "*five* pillars of a comprehensive education reform" (emphasis added) in its 16 March 2009 Internet Express. Likewise, the following "final thought" in this College Board report had a lot in common with the President's remarks in his 24 March news conference:

> . . . the economic bailout of our financial institutions will fail if it is little more than an effort to patch up what went wrong so that the system that just collapsed can stumble along as it did before. It is an illusion to believe that if a society is making money, it is creating wealth. Real wealth is created when societies invest in the future, including investing in the human capital of a productive people.

To advance its agenda, "The College Board has committed itself to preparing and issuing an annual evaluation report tracking national progress toward the goal of 55 percent and on indicators tied to the 10 benchmarks above – and to do this evaluation on a state-by-state basis wherever possible." They also provide a list of indicators they will be looking at in order to gauge the extent to which their recommendations are being implemented. "Coming to Our Senses: Education and the American Future" is available on-line at <http://professionals.collegeboard.com/profdownload/coming-to-our-senses-college-board-2008.pdf>.

As explained in the box on page 51, the Teachers Clearinghouse *Newsletter* is now being laid out on a PC with Microsoft Publisher. This allows us to make an electronic copy of the *Newsletter* for you as a pdf. If you would like one, please send an e-mail request to <JLRoeder@aol.com>.

Bartlett's experience

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> public health and strategic challenges of climate change. The intent of the summit is to reach members of the creative community and network executives who control the content of the entertainment sector of the national television industry. The objective is to expose this audience to possible scenarios describing the serious implications of climate change as determined by the CDC's task force on Climate Change and Public Health and global health and national security experts such as Dr. Dennis McBride, Academic President of the Potomac Institute; and Dr. Howard Frumkin, Director of the Center for Climate Change of the CDC [Centers for Disease Control]. In addition, members of the television community such as Patric Verrone, President, Writers Guild of America, West, and Lauren Zalznick, President, Bravo Cable Channel and of Oxygen and CEO of the NBC-UNI Green Council, will be presenters. The event will involve the participation of the Writers Guild of America, the NBC-UNI Green Council, the Centers for Disease Control and Prevention Task Force on Climate Change, the Academy of Television Arts and Sciences, and the Potomac Institute.

The program for the meeting noted that

> Entertainment attracts huge audiences. Characters in entertainment programs often become role models for their fans. Indeed, evidence from numerous studies around the world shows that such programs can quickly change social norms on the issues addressed – without losing audience ratings or being perceived as preaching to the audience.
>
> Population Media Center [affiliated with The Population Institute] has worked with writers and producers in many developing countries and we have seen their creations [soap operas] attract record audiences and, at the same time, demonstrate new ways to think about the rights and status of women, avoidance of AIDS, use of family planning, and protection of children from exploitation. In 15 countries where we have broadcast social-content serialized melodramas, we have been able to measure dramatic changes in behavior on the issues addressed, and at clinics large percentages [of the clients] name the programs as their reason for seeking health services.
>
> The strategy of entertainment-education now needs to be used to help viewers adopt climate-friendly behaviors – and to prepare viewers for some of the challenges that we face as a result of global heating.

The day was spent with speakers presenting up-to-date reports on topics such as the status of global warming in terms of public health, national security, scripts and scenarios for TV shows, and American attitudes toward the problem of global warming.

Bartlett's award

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> November to 19 November 2008. The Population Institute will be responsible for providing roundtrip economy airfare, local transportation, hotels and meals while you are in Los Angeles.

In November Al wrote me again to say that "Next Monday I head west to LA with a daughter to receive the award for writing. Here is a list of the other recipients. We're in pretty fair company." The "pretty fair company" to which he referred, according to the Population Institute press release, included "The Mayor of London [Boris Johnson] and a two time Pulitzer Prize winning editorial cartoonist [Don Wright]." The Population Institute's citation for Bartlett's Best Magazine Article Award stated that "Dr. Albert Bartlett will be honored with the award for *Best Magazine Article* for his article entitled 'Why Have Scientists Succumbed to Political Correctness?' Dr. Bartlett expresses concern over scientists identifying overpopulation as a cause of problems in their writings, but ignoring it in their recommendations for solving environmental problems."

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That evening at 6 p.m. there was a reception followed by a dinner for the award winners and members of the Population Institute. The dinner was followed by a talk by Professor Paul Ehrlich of Stanford University. The awards were then presented by former CNN Anchor Carol Lin and William Ryerson, President of the Population Institute. It was a great honor to be one of the award recipients.

Wednesday was free until mid-afternoon, so my daughter and I toured the nearby Getty Museum, which has a spectacular collection of fine art. In the late afternoon we were taken to the UCLA School for Public Health where the award winners were each asked to make a short presentation of their work relating to population to an audience that included staff and students of the School. After the seminar we were bussed to the home of former CNN anchor Carol Lin where we and her other Hollywood guests were treated to a lovely dinner.

On Thursday we returned to Boulder, carrying with us a very nice glass trophy as a symbol of the award.

I wish to express my most sincere thanks to John Roeder for publishing my article, "Why Have Scientists Succumbed to Political Correctness?" in the Spring 2008 issue of the *Teachers Clearinghouse for Science and Society Education.*

21st Century Skills Partnership develops Framework

In 2002 the Partnership for 21st Century Skills was founded by the US Department of Education, the AOL Time Warner Foundation, Apple Computer, Inc., Cable in the Classroom, Cisco Systems, Inc., Dell Computer Corporation, Microsoft Corporation, the National Education Association, and SAP. Five years later they issued "The Intellectual and Policy Foundations of the 21st Century Skills Framework," which "encapsulates the outcomes and support systems needed to prepare students for 21st century life" – at a time that much attention is being paid to what needs to be done in this regard, as indicated by several items in "News from Triangle Coalition" in this issue.

After providing background on the evolution of American education in the 20th century and what has been learned about learning and the role of technology in learning, the "21st Century Skills Framework" turns to the question, "What learning is needed for the 21st century?" Seeking to "ensure the promise of tomorrow" "by combining the wisdom of the past with the insights and technologies of today" and realizing that "just as facts alone do not constitute true knowledge and thinking power, so thinking processes cannot proceed without something to think about," the Framework begins with "Core Subjects and Interdisciplinary Themes." Among the core subjects it lists English, reading, or language arts; foreign languages; arts; mathematics; economics; science; geography; history; and government and civics, stressing "depth over breadth of coverage." Moreover, the focus should be for students to learn these core subjects in a context that is meaningful for them. This can be further enhanced by such interdisciplinary themes as global awareness; financial, economic, business and entrepreneurial literacy; civic literacy; and health literacy. It is also noted that "those who speak two or more 'professional languages' and can 'see the world from two or more different perspectives' have the cognitive diversity needed to formulate innovative solutions to complex problems."

But more than this will be required in the 21st century. The next section of the Framework, on Learning and Innovation Skills, lists Critical Thinking and Problem Solving, Creativity and Innovation, and Communication and Collaboration. The "most desirable jobs – the ones least likely to be automated or outsourced – are those that require *expert thinking* and *complex communication*. Expert thinking . . . comprises the skills of critical thinking and problem-solving. . . ." "When we engage in high-quality thinking, we function both critically and creatively; we produce and assess, generate and judge the products of our thought."

The Framework sees "problem-solving as encompassing a set of skills. To successfully solve a problem, we must first be able to formulate it as a problem." Then we need to determine "what resources and strategies we need to solve it," which implies "skills in information literacy." We also need "persistence and tolerance for ambiguity to keep searching for a solution if our initial attempts are unsuccessful." We also "need to know how to reach out to others to tap their expertise to solve the complex problems we face today," because "problem solving has a social dimension. . . . Successful problem solving in the 21st century requires us to work effectively and creatively with computers, with vast amounts of information, with ambiguous situations, and with other people."

Although "traditional education . . . has valued conformity over novelty of thought," the Framework stresses that "in today's world of global competition and task automation, innovative capacity and a creative spirit are fast becoming requirements for personal and professional success." Professor Yong Zhao of Michigan State University is quoted as observing that "Would-be education reformers often cite crisis indicators such as poor performance of U.S. students in math and science relative to their international peers . . . but they seldom mention what until now has been the secret of the U.S. economic advantage – the risk-taking, creative and can-do spirit of its people."

In emphasizing the importance of communication and collaboration skills, the Framework notes that "as technology gives rise to global work teams that span time zones, nations, and cultures, it is more imperative than ever that tomorrow's graduates be clear and effective communicators." The Framework also notes that "communication competencies such as clearly articulating ideas through speaking and writing are related to collaboration skills, such as working effectively with diverse teams, making necessary compromises to accomplish a common goal, and assuming shared responsibility for collaborative work."

The Framework then moves on to consider Information, Media, and Technology Skills. According to the Framework, "the worlds of work, higher education, and personal life increasingly demand the ability to 1) *access* information efficiently and effectively, 2) *evaluate* information critically and competently, and 3) *use* information accurately and creatively." While "today's youth are digital natives" and "may speak 'technology' with greater fluency than their digital immigrant parents," the Framework recognizes that "they do not always do so with as much sophistication as they imagine, as much wisdom as their parents would wish, or as much competence as their teachers would like." It asks, "with all their immersion in

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Political Correctness

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do not address the current problem of overpopulation in the U.S. and the world.

We can demonstrate that the Earth is overpopulated by noting the following:

A SELF-EVIDENT TRUTH: If any fraction of the observed global warming can be attributed to the actions of humans, then this, by itself, constitutes clear and compelling evidence that the human population, living as we do, has exceeded the Carrying Capacity of the Earth, a situation that is clearly not sustainable.

As a consequence, it is AN INCONVENIENT TRUTH that all proposals or efforts at the local, national or global levels to solve the problems of global warming are serious intellectual frauds if they fail to advocate that we address the fundamental cause of global warming namely overpopulation.

We can demonstrate that the U.S. is overpopulated by noting that we now (2008) import something like 60% of the petroleum that we consume, around 15% of the natural gas that we consume and about 20% of the food we eat. Because the U.S. population increases by something over 3 million per year, all of these fractions are increasing. The annual production of conventional petroleum in the U.S. peaked in 1970 and is now only a fraction of what it was at the peak. Natural gas production in North America is reported to have peaked in spite of the drilling of hundreds of new gas wells annually. In a nutshell, the U.S. in 2008 is unsustainable.

Let's look at two prominent examples of this political correctness. The book, *An Inconvenient Truth*[1], was published to accompany Al Gore's wonderful film by the same name. On page 216 Gore writes, "The fundamental relationship between our civilization and the ecological system of the Earth has been utterly and radically transformed by the powerful convergence of three factors. The first is the population explosion…"

This makes it clear that Gore understands the role of overpopulation in the genesis of global climate change. The last chapter in the book has the title, "So here's what you personally can do to help solve the climate crisis." The list of 36 recommended actions starts with "Choose energy-efficient lighting" and runs through an inventory of all of the usual suspects without ever calling for us to address overpopulation!

As a second example, in the *Clearinghouse Newsletter*[2] we read the statement, "Human Impacts on Climate" from the Council of the American Geophysical Union (AGU). The title recognizes the human component of climate change. We recognize that this component is roughly proportional to the product of the number of people and their average per capita annual resource consumption. The last paragraph of the AGU statement starts with the sentence, "With climate change, as with ozone depletion, the human footprint on Earth is apparent." The rest of the paragraph suggests what must be done, and it's all the standard boilerplate. "Solutions will necessarily involve all aspects of society. Mitigation strategies and adaptation responses will call for collaborations across science, technology, industry, and government." There is no mention of addressing the overpopulation which the statement recognizes is the cause of the problems!

A few years ago I wrote an article calling the attention of the physics community to this shortcoming[3]. To my amazement, most of the letters to the editor responding to my article supported the politically correct unscientific point of view [4,5]. Many journalists look to the scientists for advice. The scientists won't talk about overpopulation, so the journalists and the reading public can easily conclude that overpopulation is not a problem. As a result, we have things such as the cover story in the 9 April 2007 issue of *TIME*: "The Global Warming Survival Guide: 51 Things You Can Do to Make a Difference." The list contained such useful recommendations as "Build a Skyscraper," (No. 9, p. 74) but not one of the 51 recommendations deals with the need to address the main cause of global warming, namely overpopulation!

What's one to do when scientists and political leaders demonstrate their understanding of the fact that overpopulation is the main cause of these gigantic global problems, yet the scientists' recommendations for dealing with the problems never call for addressing overpopulation?

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Political Correctness

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POSTSCRIPT, added 8 March 2009

On 9 January 2009 members of five leading scientific organizations joined to hold a briefing on global climate change for members of Congress, their staffs and other policy makers. (*Science,* **323**, 1182 (27 February 2009)). The organizations listed were the American Association for the Advancement of Science, the Ecological Society of America, the Geological Society of America, the American Meteorological Society and the Pew Center on Global Climate Change. "The talks were held in conjunction with the House Science and Technology Committee, the Senate Energy and Natural Resources Committee and the Senate Commerce, Science and Transportation Committee."

The story in *Science* reported that:

> Although mitigation strategies are still being pursued, adaptation may be the watchword of the near future. . . .
>
> Recent studies . . . suggest that if atmospheric carbon dioxide levels reach concentrations of 450 parts per million by midcentury – a likely scenario, according to the researchers – rising sea levels and severe fluctuations in rainfall are inevitable.
>
> "Every year of emissions means a commitment to climate change for more than 30 generations," said [a speaker who is] now a senior scientist at the U.S. National Oceanographic and Atmospheric Administration.
>
> . . . a University of Michigan law and environment professor, warned the staffers that the United States is "currently going in the wrong direction" in limiting climate change emissions. To bring emissions down, he noted, nations must transform the global energy structure through renewable fuels, carbon capture technologies, and more efficient energy consumption.

These climate change scientists went on to urge such things as carbon cap-and-trade systems, emissions taxes and letting the market choose which plan to follow. It was noted "that governments could help by raising the performance efficiency standards of cars and appliances."

It is obvious to every scientist who participated in this important briefing that the critical task is to reduce our total annual emissions of greenhouse gases. It is equally obvious that the annual emissions are proportional to the product of the size P of the population multiplied by the average annual *per capita* emission of greenhouse gases. Yet these scientists limit their recommendations to things that are Politically Correct; they tell members of Congress that things are getting worse. And when the scientists talk about what must be done they focus on "adaptation" and on the reduction of per capita emissions.

Why is it that the scientists (and our environmentalists) never mention the fact that growing U.S. and world populations are the major driving force that is causing the continuing increases in the annual emissions of greenhouse gases both nationally and globally?

POSTSCRIPT, added 23 March 2009

The John H. Chaffee Memorial Lecture of the National Council for Science and the Environment was given in Washington, D.C., by the distinguished scientist John P. Holdren, 17 January 2008. His title was "Meeting the Climate-Change Challenge." Approximately a year after giving this lecture, President-Elect Barack Obama announced that he had selected John P. Holdren to serve as Assistant to the President for Science and Technology. In this role he will be the President's Science Advisor and he will direct the Office of Science and Technology Policy. President-elect Obama called Holdren "one of the most passionate and persistent voices of our time about the growing threat of climate change."

In his Chaffee lecture, Holdren summarized the major aspects of our knowledge of the causes and effects of what he called "global climate disruption." He said we have three options; "mitigation, adaptation, and suffering." Holdren says, "the human-caused carbon dioxide emissions are the biggest piece of the problem. They're about half of it and their share is growing." Holdren then explained that

> Emissions of CO_2 from fossil fuel equal population, times GDP [Gross Domestic Product] per person, times energy per unit of GDP, times CO_2 released to the atmosphere per unit of energy. And this equation then tells us what the options are. We could reduce the growth of energy by reducing population growth, by reducing the growth of GDP per person, or by reducing the ratio of energy to GDP.

Holdren goes on to say that "Limiting population growth has social and political sensitivities; slowing [growth of] GDP per person, [has] economic liabilities."

The Lecture closes with details and generalities about what must be done to reduce the emission of greenhouse gases. Holdren lists a number of specific things followed by generalities such as "We need to pursue a new global

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What are the Many Concerns Today for Earth Systems Science?

by Michael J. Passow
Earth Sciences Correspondent

Introduction. In the past few months, I've been able to participate in annual conferences sponsored by the Geological Society of America, the American Geophysical Union, and the American Meteorological Society. Together, these organizations include tens of thousands of sciences, academics, students, and government agents focused on the Earth and Space Sciences. As we begin the "International Year of Planet Earth," a review of the featured sessions from these conferences gives an excellent overview of the major concerns in this sector of science and society.

Many of these critical themes are obvious to those concerned with science, technology, and society: the impact of climate change, sustainability in view of finite and diminishing resources, continuing support for basic scientific research, and adapting to dramatic trends around our globe, such as increasing urbanization. The key question underlying almost all of what I attended was, "How can we stop talking 'to the choir' and reach the wider world, especially decision-makers?"

Part 1: Joint Meeting of the Geological Society of America, Soil Science Society of America, American Society of Agronomy, Crop Science Society of America, Gulf Coast Association of Geological Societies, Gulf Coast Section SEPM, and Houston Geological Society, 5 – 9 Oct 2008, Houston, TX. Several years of planning produced the largest collaboration of plenary sessions, technical sessions, and exhibit hall participants ever for these societies. Although many of the planned field trips had to be cancelled because of Hurricane Ike damage several weeks earlier, there was still much to see and enjoy in downtown Houston.

Featured presentations to kick off "Celebrating the International Year of Planet Earth" included "Questions about the Earth the Moon Told Us to Ask" by Apollo 17 astronaut Harrison Schmitt; "In Search of the Deepest cave on Earth" by speologist Alexander Klimchouk; "A Field Geologist Looks at a Digital World" by Judith Totman Parrish, current GSA President; "Target Atmospheric CO_2: Where Should Humanity Aim?" by James Hansen of NASA; and "World Fossil Fuel resources: How Much Is Left? How Valid Are Predictions about Future Production" by Peter J. McCabe of Australia.

Other major public lectures dealt with such issues as "The Impending Global Water Crisis: Geology, Soils, Agronomy, and International Security"; "Energy and the Global Market"; "Are We Obligated to Help Apply as well as Create Knowledge to Enhance and Protect Our Private and Public Forests?"; "Processes Regulating Methane Emissions from Wetlands and What We Might Expect with Climate Change"; and "Adam's Gardens: Biodiversity and Traditional Food Production of Indigenous People of Northwestern North America."

One personal conference highlight involved an invited keynote talk to the American Geological Institute's Member Societies Council to present "NESTA's Perspective on K – 12 Earth Science Education." As 2008 – 2010 President of the National Earth Science Teachers Association, it was my honor to join with the President of the National Association of Geoscience Teachers, the New Jersey State Science Supervisor, and a leading geoscience educator from Michigan to provide representatives from more than thirty professional societies that number more than 40,000 professionals with overviews of what Earth Science teachers and students currently face. We hope to stimulate action by these groups that will benefit K – 12 and university level instruction.

It was also my privilege to raise the banner for K-12 education at the annual meeting of the GSA Associated and Affiliated Societies. Most of these focus solely on science research or economic exploitation of Earth's resources, but were receptive to hearing about ways to support developing the next generation of geoscientists.

The other personal highlight was to preside over the technical session I proposed on "Professional Society, Organization, Institution, and Federal Agency Achievements Supporting K -12 Teachers and Students." This brought together formally for the first time at a GSA meeting representatives from different programs so they could share what they are doing. Roberta Johnson, NESTA's Executive Director, provided an overview of what NESTA provides, along with results of our recent member needs survey. Chris McLelland described the GSA Teacher Advocate Program. James Brey presented the American Meteorological Society K-12 Teacher Enhancement program. Wendy Van Norden delivered a call-for-action based on years of experience in high school Earth Science teaching. Michael Hubenthal of IRIS (Incorporated Research Institutions for Seismology) analyzed whether the thousands of posters they have created and distributed are "wallpaper or instructional aids."

Additional presenters described state, regional, and national programs run by various universities and organizations. Hilary Clement Olson delivered the final talk on "The TXESS Revolution: A Teacher Professional development Program to Advance Earth and Space Science in Texas." Given the recent news stories about decisions on what to teach by the Texas Board of Education, it was

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especially heartening to learn of this pro-active strategy to strengthen science education in that state.

Those interested can learn more about some of these presentations and many more through the GSA meeting search engine available at <http://www.geosociety.org/meetings/searchabstracts.htm>. It may also be possible to view selected webcasts and recorded sessions.

Part 2: American Geophysical Union Fall Meeting, 15 – 19 Dec 2008, San Francisco, CA. By far, the AGU Fall Meeting is one of the largest, most prestigious showcases for international science. This year, more than 17,000 assembled from around the globe to share cutting-edge investigations and be inspired through lectures presented by leading investigators in many fields. The themes of the featured lectures and "Town Hall Meetings" provide one of the best guides to what are the major concerns in the scientific community. Here are some of the highlights: Michael Jones (Google Earth's Chief Technical Advocate) recapitulated "The Spread of Scientific Knowledge from the Royal Society to Google Earth and Beyond." James Hansen delivered the Bjerknes Lecture on "Threat to the Planet: Dark and Bright Sides of Global Warming." Other named lectures placed the spotlight on such themes as "Lessons from the Pliocene Warm Period and the Onset of Northern Hemisphere Glaciation"; "The Phoenix Mission Explores the Martian Arctic"; "The Story of O: The Evolution of Earth's Oxygen Cycle and Its Relevance to Life Outside of Our Solar System"; and "Chlorofluorocarbons: The Oceans' Inadvertent Canary." Visual presentations of these and other are available at <http://www.agu.org/webcast/fm08/>.

The heart of any AGU meeting are the hundreds of oral and poster sessions in which scientists and students share results of recent research. The huge Moscone Center pulses from dawn to dusk as the thousands of attendees rush from room to room and building to building to catch the next talk on their "must-see/hear" lists. If you are interested in what was presented, you can always make a search through the abstracts at <http://www.agu.org/meetings/fm08/index.php/Program/HomePage>.

For K–12 educators, each year the AGU Committee on Education and Human Resources organizes a GIFT (Geophysical Information For Teachers) Workshop around a cutting-edge theme. As the International Polar Year (IPY) draws to an end, this year's GIFT brought forty teachers together with scientists and educators to learn about Arctic and Antarctic research.

On the first day, Dave Carlson of the IPY shared the importance of this type of international scientific cooperation for addressing urgent, significant problems and building connections across nations that last far longer than the immediate project. In particular, he discussed the discovery of a new species of Antarctic octopus, and how subsequent investigations revealed biogeographic distributions associated with the opening of the circum-Antarctic current.

Jim White (University of Colorado/INSTAAR) described ways in which ice cores help solve global climate uncertainties, especially those associated with positive and negative feedback systems. Louise Huffman followed up with information garnered through the ANDRILL (Antarctic Drilling) Project, and led the teachers through some hands-on activity developed by K – 12 teachers who have participated in various aspects of ANDRILL. More about this can be found at <www.andrill.org/education>.

Day 2 began with Elena Sparrow (University of Alaska/IARC) sharing activities developed to foster students' scientific thinking based in part on GLOBE (see Reference #5, this issue). Missy Holzer (Chatham HS, NJ) and David Robinson (Rutgers University) described last summer's fieldwork in Svalbard, studying the "Arctic from Top to Bottom." In the final portion of the program, I presented an overview of the importance of deep-sea drilling aboard the Research Vessel JOIDES Resolution.

Part 3: 89th American Meteorological Society Annual Meeting, Phoenix, AZ, 11 – 15 January 2009. "Urban Weather and Climate: Now and the Future" was the theme for this year's gathering of scientists, government and industry representatives, students, and a few K – 12 teachers in the newly-opened (as in three days before the start of the meeting) Phoenix Convention Center. AMS President Walt Dabberdt and the organizing committees view trends in recent years as leading to a "perfect storm" resulting from convergence of climate change, urbanization, population growth, and increasing coastalization around the world.

Four world-class speakers addressed more than two thousand attendees in the Presidential Forum to open the scientific portion of this meeting. Dr. Kai Lee (David and Lucile Packard Foundation) discussed the future impact of the fact that, for the first time in human history, more people live in urban than in rural areas. He speculated on how this continuing pattern of rapid urban growth challenges human development and human rights. Julian C. Hunt (University College London and member of the House of Lords) shared his research into modeling greenhouse emissions from growing cities, and policies that could reduce their vulnerability to environmental hazards. Dr. Susan Avery (Woods Hole Oceanographic Institution) focused on the impacts of agricultural and energy emissions on coastal cities, and how they might become part of the solution. Mary Glackin (NOAA Undersecretary for Oceans and Atmosphere) brought a unique perspective on how effective partnerships can be

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fostered to adapt to the challenges. She especially considered how to meet the increased demand for trustworthy urban environmental information through government, academic, and private sector efforts.

Over the next four days, thousands of scientists shared their latest research efforts and engaged in their "town meetings." Examples of these included "Progress in the Relationships between NWS and America's Weather Industry"; "Community Input for the National Academies' Climate Change Study"; and "Integrated Solutions for Environment and Health—Your Research Can Inform Public Health Decisions." More about the Presidential Forum, town meetings, scientific program, and other conference highlights will be found at <http://www.ametsoc.org/MEET/meetpastinfo.html>.

Once again, the AMS meeting began with a "WeatherFest" during the Sunday afternoon before the official opening of the scientific program. More than sixty exhibitors entertained and enlightened several thousand visitors of all ages with hands-on activities about weather- and ocean-related themes. Many of the area's television weather crews were present to meet their viewers. (FYI: I represented the Consortium for Ocean Leadership's Deep Earth Academy and had a very popular booth—I distributed hundreds of pieces of a very delicious seven-layer cake with sea-blue icing to represent the layers of sediment and rock beneath the ocean floor.)

Summary. The multifaceted ways in which the Earth Sciences help us understand how society behaves and which point out possible solutions to current and future problems were on display in all these meetings. The key, as mentioned previously, is to expand this knowledge from the relatively few thousands in the "choir" who attended the conferences to the hundreds of thousands teachers who can make their students aware of its existence. From there, it needs to reach decision-makers and the hundreds of millions or even the billions of people whose daily life decisions will affect and be affected by how they interact with the Earth System.

Finally, these meetings took place during and after the 2008 Presidential Election, so much of the informal discussions among participants focused on the prospects for better support for and increased influence of Science during the new Administration. The level of enthusiasm was especially high at the AGU and AMS meetings in the weeks before President Obama took the oath of office.

(*Editor's Note*: In addition to being the 2008-2010 president of NESTA (National Earth Science Teachers Association), Dr. Michael Passow also presents Earth2Class Workshops for teachers at Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY 10964, <http://www.earth2class.org>, and teaches science at Dwight Morrow High School. 274 Knickerbocker Rd., Englewood, NJ 07631.)

Bartlett's award

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Bartlett's article was published in the Spring 2008 issue of this *Newsletter*. When I told him that I planned to reprint it as part of the coverage of his award, he graciously responded with an updated version you can read in this issue. He also kindly recorded his impressions of going to California to receive the award, in an accompanying story. Feeling honored to have published Bartlett's article, the Teachers Clearinghouse rejoices with Bartlett about the recognition he receives. Congratulations, Al!

Political Correctness

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framework for mitigation and adaptation. We need to ramp up investments in energy-technology research. And we need to expand international cooperation." Holdren's recommendations contain no mention of the need to address population growth which he had noted "has social and political sensitivities."

21st Century Skills

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technology, do students know how to use technology to problem solve, analyze, communicate, and collaborate effectively?"

The last set of skills on the Framework's list is Life and Career Skills. The Framework points out that "academic and cognitive skills, essential as they are, are not all that is necessary for a successful life. In our global technological age, young people also need to work with and learn from diverse groups, be flexible in a variety of work and social settings, and be adaptable to changing times. They need to demonstrate leadership and take responsibility for results, show initiative and resourcefulness, and be productive and accountable for their actions."

"The Intellectual and Policy Foundations of the 21st Century Skills Framework" is available on-line at <http://21stcenturyskills.org>.

As explained in the box on page 51, the Teachers Clearinghouse *Newsletter* is now being laid out on a PC with Microsoft Publisher. This allows us to make an electronic copy of the *Newsletter* for you as a pdf. If you would like one, please send an e-mail request to <JLRoeder@aol.com>.

RECOMMENDED SCIENCE AND SOCIETY EDUCATIONAL RESOURCES

1. Hal Herring, "Burning Down the House to Keep Warm," *Miller-McCune*, **1**(4), 24-33 (Sep 08).

Our Spring 2005 issue reported how the energy plan developed by former Vice President Cheney and many members of former President Bush's cabinet envisioned continued reliance on fossil fuels. This article describes what the Bush Administration allowed in order to achieve it – through orders to the Bureau of Land Management in 2003 to reduce or eliminate "impediments to oil and gas leasing," at the expense of habitat of mule deer, pronghorn antelope, and sage grouse, and harvesting coal bed methane by injecting "fraccing fluids" into below ground seams of coal. This technique, developed by Halliburton in 1949, originally used a mixture of napalm, gasoline, crude oil, and sand as a fraccing fluid, but more recently the aforenamed hydrocarbons have been replaced by diesel fuel, although aromatic hydrocarbons and fluoride compounds have been found in the fluids by the EPA, which held in 2004 that the fraccing process did not threaten drinking water supplies. Moreover, the energy Policy Act of 2005 exempted hydraulic fracturing from the Safe Drinking Water Act. Also exempted was salty water produced by the fracturing of the coal.

2. Michael Haederle, "Flagship Trooper," *Miller-McCune*, **1**(4), 39-47 (Sep 08).

This article describes "Earthship" housing, which maximizes passive solar heating through window placement and thermal mass and electrifies with photovoltaic cells, and its developer, Michael Reynolds. Robert Saltzman, an associate of actor Dennis Weaver, an early advocate of "Earthship" housing, spoke about it on 10 February 1996 at the eleventh National STS Meeting in Crystal City, VA.

3. Philip D. Weyman, "The Interdisciplinary Study of Biofuels," *Science Teach.*, **76**(2), 29-34 (Feb 09).

This article describes a series of activities – on biodiesel, greenhouse gases, and hydrogen fuel cells – available from the "Engaging Inquiring Minds Through the Chemistry of Energy" website, by which the timely topic of biofuels embraces biology, chemistry, and physics. Two caveats to the reader apply: 1) on p. 30 the statement that "Biofuels store the energy from the Sun without increasing atmospheric CO_2. . . ." can be misleading, since fossil fuels have already stored energy from the Sun without increasing atmospheric CO_2 as well. It's when the fuels are burned that CO_2 is released, and the emissions from biofuels are only replacing carbon dioxide that photosynthesis removed from the atmosphere to make the biomass in the first place, thus making biofuel combustion "carbon neutral" while fossil fuel combustion is "carbon positive." 2) on p. 33 the statement "records cumulative power in kilowatt-hours" is a flagrant error that should have been caught in the editorial process – "power" should be replaced by "energy." An interesting conversion factor is presented – 0.58 kg CO_2/kWh, "calculated by considering the total amount of CO_2 emitted by U.S. power plants in 2006 divided by the U.S. electric power output that same year" – but, here again, "power" should be replaced by "energy."

4. MaryKay Orgill and Kent J. Crippen, "What's So Big About Being Small?" *Science Teach.*, **76**(2), 41-48 (Feb 09).

The National Center for Learning and Teaching in Nanoscale Science and Engineering (NCLT) has identified eight "Big Ideas of Nanoscience": Size and Scale, Structure of Matter, Size-Dependent Properties, Forces, Self-Assembly, Tools and Instrumentation, Models and simulations, Nano and Society. This article presents a curriculum to teach these big ideas interdisciplinarily, providing a science focus, a mathematics focus, an inquiry question, opening topic questions, activities, and concluding topic questions. The authors present extra detail on their presentation of the subunit on Size-Dependent Properties and how it employs Bybee's 5E instructional model (Engage, Explore, Explain, Elaborate, Evaluate). Most of the activities come from M. G. Jones, M. R. Falvo, A. R. Tayloer, and B. P. Broadwell, *Nanoscale Science: Activities for grades 6-12* (NSTA, Arlington, 2007) and NCLT.

5. Ted Singletary and Rickie Miller, "Instant Integration: Just Add Water," *Science Teach.*, **76**(2), 54-60 (Feb 09).

This article presents the Global Learning and Observation to Benefit the Environment (GLOBE) hydrology protocols, which teachers can be trained to use to contribute to a worldwide database and which all teachers can use. Included in the database are measurements of water transparency, water temperature, dissolved oxygen, electrical conductivity, salinity, pH, alkalinity, nitrate concentration, freshwater macroinvertebrates, and marine invertebrates.

6. Andrew E. Dessler and Steven C. Sherwood, "A matter of humidity," *Science*, **323**, 1020-1021 (20 Feb 09).

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This article discusses the "water vapor feedback" aspect of global warming from increased carbon dioxide and other greenhouse gases in the atmosphere – the increased capacity of the atmosphere to hold water vapor after other greenhouse gases have warmed it. Because water vapor is itself a greenhouse gas, this capacity for added water vapor in the atmosphere could further increase greenhouse warming, if relative humidity holds constant in the average, and observations show that it does. The result roughly doubles the warming that would otherwise occur.

7. David G. Victor and Danny Cullenwood, "Making Carbon Markets Work," *Sci. Am.*, **297**(6), 70-77 (Dec 07).

"Traditional fossil-fuel energy is so abundant and inexpensive that climate-friendly substitutes have little hope of acceptance without robust policy support," these authors write. ". . . the development of an international system that can slow climate change is only starting now, nearly a decade after Kyoto."

For the 55% of its carbon dioxide emissions that come from buildings and transportation, the European Union has set goals for improved energy efficiency. For the 45% that comes from electric power generation they have implemented a "so-called cap-and-trade system modeled on a successful program created by the U.S. during the 1990s to reduce sulfur dioxide. . . ." A cap-and-trade system has proved more acceptable to the electric power industry than a carbon tax, especially when the emission credits are initially given to the emitters. Freely-given credits are worth only what is paid for them, and the E.U. learned this in their first trial period of 2005-2007. "Tightening the screws" for the next trading period (2008-2012) has seen the cost of an emissions credit rise from $1 per ton of carbon dioxide to $30 per ton. Also essential for the functioning E.U. system is its monitoring institutions.

In contrast to the top-down approach of Kyoto, the E.U. system is part of a bottom-up approach, which is being joined by a similar system in northeastern and western states of the U.S. weary of waiting for national leadership.

At the time that the developed world has recognized the need to restrain its carbon dioxide emissions, emissions from the burgeoning economies of China and India are increasing three times as fast as those in the developed world, though this can be offset by the "clean development mechanism" of the Kyoto treaty, whereby a developed country can claim carbon dioxide-reducing credit for a project in a developing country.

At the same time, the "clean development mechanism" has been abused by developers who sought high-emissions baselines so that they could claim emissions credit valued more highly than the cost of the devices installed to reduce them -- $12.7 billion in credits in return for the cost of only $136 million to remove HFC-23 (trifluoro methane), a manufacturing by-product that has 12,000 times the greenhouse effect of carbon dioxide.

Though China and India are unlikely to reduce carbon dioxide emissions for environmental reasons, energy security is motivating China toward more efficient energy use, which could cut carbon dioxide emissions by 1000 megatons per year. And India's interest in nuclear energy could reduce its carbon dioxide emissions a further 150 megatons per year. Add to this the E.U. efforts reducing 200 megatons per year and clean development mechanism projects reducing another 170 megatons per year gives a possible total reduction of 1520 megatons per year.

The authors close with three recommendations:

1) a carbon tax in the U.S., because they feel it is less corrupt; moreover, a known tax allows for better planning than the uncertain volatile cost of emissions credits;

2) a price ceiling on emissions credits, should Congress choose a cap-and-trade system, with all credits auctioned publicly;

3) engaging emerging economies in carbon emissions reduction;

4) policies and regulations that lead to development and adoption of new technologies.

"Although we need to get the science and engineering right, the biggest danger lies in failing to craft human institutions and policies that encourage people to reduce their emission of greenhouse gases," they conclude.

8. *Ecology and Society*, on-line at <http://www.ecologyandsociety.org>.

The most recent issue of this on-line journal, volume 13, issue 2, can be accessed without charge at <http://www.ecologyandsociety.org/vol13/iss2/>. In addition to an editorial, a guest editorial, a "perspective," it contains 35 sizeable scholarly articles, 8 "syntheses," 11 "insights," and one "response," dealing with ecological issues all over the world.

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9. Paul R. Epstein, William Moomaw, Christopher Walker, with Archie Kasnet and Mary B. Rice, *Healthy Solutions for the Low-Carbon Economy: Guidelines for Investors, Insurers and Policy Makers* (Center for Health and the Global Environment, Harvard Medical School, 2008), available on-line at <http://chge.med.harvard.edu/programs/ccf/healthysolutions.html>.

This 35-page booklet is based on the well-known wedges of Pacala and Socolow as means to reduce carbon emissions. After introducing these wedges, 16 "Technologies for Early Adoption" are described, followed by eight "Technologies Warranting Further Study." In the latter case are coal with carbon capture and storage, and nuclear, where it was somewhat surprising to read that "The risk of death for people living within 30 miles of coal-fired plants is three-to-four times that of people living at a distance" and (given the low radiation dosage for living near a nuclear plant) that "communities adjacent to nuclear facilities in the U.S. and U.K. have increased rates of leukemia and other childhood cancers." Furthermore, the Supercolliding Super Conductor project is incorrectly stated as a cost overrun in the nuclear industry (it was a high energy physics project). A supplement containing further information about the technologies discussed in the parent document is available from the same website. In addition to considerations of the physical environment, this document and its supplement also bring up health issues not given as thorough a treatment elsewhere, as perhaps befits a document prepared by Harvard Medical School.

10. Shahid Naeem, "Lessons From the Reverse Engineering of Nature," *Miller-McCune*, **2**(3), 56-71 (May/Jun 09).

In contrast to an evolving web of predators and prey, "Eden was a place without evolution and without ecology." Yet we have approached Eden and the Peaceable Kingdom in transforming what was once an Equitable Realm into a Domesticated Kingdom in which "50 percent of land has been converted to agriculture and domestic livestock grazing" and "oceans once fished heavily are seeing increased amounts of aquaculture," while "we relegate wild species to parks, zoos, gardens and seed banks." Now "the few species we would encounter in the most productive landscapes . . . are no longer part of an intricate web of millions of interacting species structured by ecological and evolutionary principles." This represents a decrease in biodiversity, and, according to a review of studies on the effect of biodiversity, "88 percent . . . demonstrated that declining biodiversity generally led to a reduction in the amount of biomass in the ecosystem, not just of plants but of microorganisms and animals too." "As the average number of species found in each square of Earth's surface declines, so to will its biomass . . . and its contribution to a stable, life-supporting biosphere."

"Because the Domesticated Kingdom is designed to channel resources to humans, our kingdom is one in which all other species serve at the pleasure of ours. This is a biotic feudal kingdom in which we harbor and protect those species that serve us." But because the Domesticated Kingdom doesn't provide the biodiversity needed for "a stable, life-supporting biosphere," Naeem would have humans transform their Domesticated Kingdom into a new Equitable Kingdom, which is "structured and governed not just by human social processes such as politics and economics, but also by ecological and evolutionary requirements. Rather than functioning solely to feed and fuel humanity, the social, political, and economic processes of the Equitable Kingdom are designed to ensure the proper biogeochemical functioning of the biosphere." Moreover, "In assuming the responsibility for [its] biogeochemical regulation, humans become the most significant species in [this] new Equitable Kingdom . . . By assuming the responsibilities of the paragon position it has always yearned for as a species, humanity can become the steward the Earth never had."

11. Matt Palmquist, "The Salt Mine Solution," *Miller-McCune*, **2**(3), 14-16 (May/Jun 09).

The solution is to the problem of nuclear waste storage, and the salt mine is WIPP (which became an acronym in its own right from the Waste Isolation Pilot Plant) in New Mexico. Although WIPP could "store all of the nuclear waste humans could create in the next 10,000 years," it doesn't meet the requirement that storage of spent fuel rods from commercial nuclear power plants allow their retrieval for subsequent reprocessing to extract plutonium. This is because the heat generated by the waste canisters causes the "plastic" salt around them to fill in the gaps between them and render their contents irretrievable. Meanwhile, WIPP has been receiving and storing military nuclear wastes for the past ten years.

12. Michael Scott Moore, "Tilting at Turbines," *Miller-McCune*, **2**(3), 30-39 (May/Jun 09).

A dam and a "barrage" of underwater propellers to generate electric power from the tides, installed at the mouth of England's Severn River, could generate enough electrical energy over its estimated 12-year lifetime as four modern nuclear plants operating half as long. The cost of the tidal power project is comparable to that of the four nuclear plants, and the electrical energy generated by

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either approach would be carbon-free. Each has its environmental cost – radioactive waste from the nuclear plants, and damage to wildlife (including spawning salmon and eel) from the tidal plant. Critic Stuart Ballard raises the question, "if a barrage is built, and then whoever's building it agrees that it will have a final life – can that be called renewable energy?"

13. Charles A. S. Hall and John W. Day, Jr., "Revisiting the Limits to Growth After Peak Oil," *American Scientist*, **79**, 230-237 (May-June 2009).

M. King Hubbert correctly predicted that American oil production would peak in 1970. Two years later *The Limits to Growth* modeled the future interaction of population, food, natural resources, industrial output, and pollution and predicted that continuation of "business as usual" would eventually lead to abrupt decline. The Arab Oil Embargo a year later gave us a first taste of a natural resource shortage, and the predictions of *The Limits to Growth* gained some currency. This would happen again at the end of the decade, when Iran cut off oil exports to the U.S.

But the 1980s proceeded as if the shortages of the 1970s never happened. Ecologist Paul Ehrlich lost a bet with economist Julian Simon when the price of five minerals declined during that decade, and "graduate training in energy analysis or limits to growth withered." These authors write that ". . . technology, combined with market economics or other social-incentive systems, has enormously increased the carrying capacity of the Earth for humans." They also write that "technological development is almost always associated with increased use of fossil fuels" and note that higher prices for oil and gas increased their supply from imports, while ". . . ecologists . . . shifted their attention away from resources to focus . . . on various threats to the biosphere and biodiversity."

Yet "even before the financial collapse in 2008 . . . newspapers were brimming with stories about energy- and food-price increases" and "had Ehrlich made his bet with Simon over the past decade, he would have made a small fortune, as the price of most raw materials, including the ones they bet on, had increased by 2 to 10 times in response to huge demand from China and declining resource grades." When the authors of this article label the graphs of *The Limits to Growth* for 1900-2100 with specific dates, they find that the predictions modeled three and a half decades ago have pretty much come to pass. Although they "do not necessarily advocate that the existing structure of the limits-to-growth model is adequate for the task to which it is put," they note that "it is important to recognize that its predictions have not been invalidated and in fact seem quite on target."

That this is so indicates that we have lived out the "business as usual" scenario since *The Limits to Growth* was first published. Indeed, the authors note that "renewable sources (other than hydropower or traditional wood) currently provide less than 1 percent of the energy used in both the U.S. and the world" and claim that we still live in a petroleum age, although "most environmental science textbooks focus far more on the adverse impacts of fossil fuels than on the implications of our overwhelming economic and even nutritional dependence on them." Thus, although our present petroleum age "will soon end," they write that "a key to the future is the degree to which fossil and other fuels will continue to be abundant and cheap."

14. Chris Mooney, "Vaccination Nation," *Discover*, 58-60, 62, 64-65, 75 (June 2009).

"It's not hard to scare people," Paul Offit, the author of *Autism's False Prophets*, is quoted as saying. "But it's extremely difficult to unscare them." The first "false prophet" was British gastroenterologist Andrew Wakefield, who found that 12 children with behavioral disorders also had intestinal inflammation, which he attributed to the MMR (measles, mumps, and rubella) vaccine in a 1998 article in *The Lancet*. The consequent decreased use of the MMR vaccine in Britain led to an increased incidence of measles there.

Another reason for concern about vaccines was a common anti-bacterial agent, thimerosal, which contains ethylmercury. Though this does not last as long in the body as the more infamous methylmercury, the U.S. government ordered that the thimerosal content of vaccines administered to children under age 6 be reduced to no more than trace amounts (except for influenza).

Although studies by the Institute of Medicine (a branch of the National Academy of Sciences) and three 2009 federal court cases have vindicated both the MMR vaccine and thimerosal, there is still concern that increased vaccination exemptions can make the diseases they are designed to protect against a danger to society once more. Feeling that trust is as important as research, Roger Bernier of the Centers for Disease Control has brought together "average citizens with scientists and policymakers to reach joint recommendations on vaccines . . . to break down boundaries between the experts and everybody else. . . ."

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REVIEWS OF SCIENCE AND SOCIETY EDUCATIONAL RESOURCES

Jeff Hawkins with Sandra Blakeslee, *On Intelligence* (Times/Holt, New York, 2004), 262 pp. $25. ISBN 0-8050-7456-2.

1979, the year that Jeff Hawkins received his bachelor's in electrical engineering from Cornell, was also the year in "first fell in love with brains" – by reading "Thinking About the Brain," an article by Francis Crick in the special issue of *Scientific American* on that topic that year. Finding no support from either M.I.T. or his employers in the computer industry to pursue his passion to apply how the brain works to building intelligent machines, he opted seven years later to get a Ph.D. in biophysics from UCal-Berkeley. With the money earned from inventing the Palm Pilot in 1997 he set up the Redwood Neuroscience Institute in 2002 to pursue that passion, and in 2004 he wrote this book to expound his theory of how the brain works and the promise it holds for developing intelligent machines.

Hawkins feels that artificial intelligence failed by trying to re-engineer the brain like a computer. Among the differences he cites between brains and computers, he notes that computers must be programmed, while a brain is self-learning; computer input must be perfect, while brains tolerate failure; and while computers are controlled by a central processor, there is no central control of the brain. In Hawkins's theory, the key to human intelligence is the (neo)cortex, a "new rind" which first appeared in mammals to cover the "old reptilian brain," six layers thick, each layer as thick as a business card. The cortex is organized into a hierarchy of regions, with sensory input fed into the lowest regions. Hawkins agrees with Vernon Mountcastle's conclusion that the similar appearance of parts of the cortex for different functions indicates that the cortex applies the same algorithm to input from all our senses.

What a lower cortical region will output to the next higher region depends on what it receives. If the input is a sequence or pattern that has been "learned" by repeated experience, the output to the next higher cortical region will be the "name" given to the sequence or pattern. The memory of what has been learned occurs in "the formation and strengthening of synapses," and the human brain has some 30 trillion of them, "apparently sufficient to store all the things you can learn in a lifetime." (pp. 48-49) Hawkins also points out that learning a sequence or pattern that is named is also flexible to allow for sensory input corresponding to different orientations of an object – a flexibility that computers engaged in character recognition cannot accommodate. Moreover, it is possible that a cortical region can predict the rest of a sequence or pattern after receiving the first few parts of it.

If the input to a lower cortical region is something new, it will output it directly to the next higher region until a region further up the hierarchy "decides" how to deal with it. Hawkins likens the interactions of the regions of the cortex to those in the hierarchy of military command: when an element of either hierarchy experiences difficulty dealing with or executing a directive, it is sent back up the hierarchy until it can be attended to. Meanwhile, the lower elements of the hierarchy are able to handle routine matters (sensing and responding to familiar input) on their own. The hierarchy also operates both ways, sending sensory input up and receiving motor input coming down. Hawkins has charted out special functions of each layer in a cortical region in both cases. In this way the brain forms a model of the world that is experienced by it. But while the body containing the brain is part of that world, the brain is not, because there are no sensory organs in the brain to provide input to it.

Although the cortex connects to and communicates with parts of the "old brain," it has largely subsumed the roles they play in pre-mammalian species – except for the hippocampus, which Hawkins says is still essential for remembering. He shares the view of Bruno Olshauser, voiced at the Redwood Neuroscience Institute, that the hippocampus, while connected to older parts of the brain, is an evolutionary *successor* to the cortex and acts as its uppermost region. Novel information, which is unrecognized by successive cortical regions, is passed up through cortical regions and thence to the hippocampus. If it is repeatedly recalled, it will subsequently be transferred "down" to the cortex; otherwise, "it will eventually be lost." (p. 171) This reminded me of 1985 workshops with Mary Budd Rowe in which she stressed the importance of taking time to download newly-acquired information from the short-term memory into the long-term memory – the hippocampus here would play the role of the short-term memory, and the cortex the long-term memory. Consciousness, Hawkins writes in two places, is "what it feels like to have a [neo]cortex." (pp. 194, 196)

In his final chapter, "The Future of Intelligence," Hawkins deals with his interest in applying what is learned about the brain to the building of intelligent machines. He notes that new technologies emerge in a form similar to that of the technologies they replace until they estab-

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lish a more useful form keyed to their use. So he expects it to be with intelligent machines, though he eschews humanoid robots (real humans would be less expensive and more useful), and he notes that the senses of intelligent machines need not be collocated with their cortex. The intelligent machine will create its own model of *its* world, he writes, and it will not have the emotional systems of humans, which are part of the "old brain."

The thirty trillion synapses of the human brain are equivalent in memory to 80 computer hard drives, Hawkins writes, and only now is the volume of human-made memory coming within range of that of the human brain. On the other hand, he acknowledges, there is no need that the capacity of an intelligent machine be as great as that of the human brain. The biggest problem in building intelligent machines will be the equivalent of the thousands of synaptic connections to each neuron, and Hawkins expects a solution similar to the central stations and relays used in telephony.

Because intelligent machines will not have the emotional baggage of humans, Hawkins does not see them as a threat to humanity, though, like any technology, they can be used by humans for good or ill. ". . . ethical issues [concerning intelligent machines] are like to be relatively easy compared with such present-day moral questions as those surrounding genetics and nuclear technology." (pp. 216-217)

Hawkins sees intelligent machines as tackling areas "AI . . . couldn't solve – speech recognition, vision, and smart cars." (p. 218) He likens the abilities of today's voice recognition systems to those of a human writing a transcript form listening to a language (s)he doesn't understand. This is why, he says, voice recognition systems succeed only with a restricted vocabulary. But an intelligent voice recognition machine would be trained through experience to understand whatever language is input to it. An intelligent vision machine can spot incidents of concern from security camera images that only a human eye can discriminate today, and it could do this with 100% alertness 24/7. And after it builds (from experience) a model of the environment in which it is to operate, a smart car can be trained to be either a front or back seat driver. As with all other intelligent machines, it could be available for duty 24/7 with 100% alertness. The memories of smart cars could also be cloned on the assembly line.

But neither the senses nor functions of intelligent machines should be limited to those of today's technologies. This expansion of the sense of sense is one of four areas, in fact, in which Hawkins sees intelligent machines expanding. Sonar and perception of other parts of the electromagnetic spectrum are only two examples. He also envisions a network of weather sensors which would allow an intelligent machine to understand weather and climates – on a continuous basis. Other types of sensors could enable a smart power grid (anticipating and detecting problems) or perception in the multidimensional space predicted by string theory. Moreover, intelligent machines with different sensory capacities can be joined to form an intelligence of multisensory capacity.

Another area in which Hawkins sees intelligent machines developing is replicability, already cited as a possibility for an assembly line of smart cars. These intelligent machines can also be allowed to continue to learn or be "reprogrammed' with a new set of experiences – say, to switch from English to French. The other areas for intelligent machines to develop in are speed and capacity. Silicon allows processing a million times as fast as neurons, and an intelligent machine with a capacity of a human brain could understand information at a millionfold increase in rate. This capacity would no longer be limited by the size of the infant skull, as limited by the maternal pelvis and the high metabolic cost of the human brain.

- John L. Roeder

Kenneth R. Miller, *Only a Theory: Evolution and the Battle for America's Soul* (Viking, New York, 2008). xi + 244 pp. $25.95. ISBN 978-0-670-01883-3.

Kenneth Miller co-authored the biology text used in the Dover, PA, school district. In this book, he writes very passionately about why the biology in his textbook should be taught without the encumbrances that are being sought by those who feel that life is the result of "intelligent design."

"The majesty of our Earth. The beauty of life," he quotes from a 2001 *NOVA* series. "Are they the results of a natural process called evolution, or the work of divine creator? This question is at the heart of a struggle that is threatening to tear our nation apart." (p. 7)

Miller initially felt it preposterous to think that evolution could "tear our nation apart," but his subsequent experience has since persuaded him otherwise. Calling evolutionists atheists and calling anti-evolutionists Luddites does not make for reasoned discussion, he says.

But ". . . evolution is only a placeholder in what is, in fact, a larger argument," he writes (p. 8). "To understand America's 'civil war' over evolution, we have to examine . . . questions about American science and culture."

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Miller feels that there is "something unique in the American character that bore the seeds of this conflict" and he's "downright proud of it." (p. 9) This uniqueness in the American character also made America "the greatest scientific nation in the world" (p. 9), because "disrespect for authority" (p. 11) has attracted and allowed scientists, who, by virtue of their profession, must be revolutionary, to pursue research outside the established order.

Miller's description in the preceding paragraph is "America's scientific soul, its deep and long-standing embrace of discovery, exploration, and innovation." (p. x) This is what he feels is at risk in the "evolution wars." Keeping its scientific soul is a choice America must make, and Miller "wrote this book to describe the nature of that choice and the realities of the struggle." (p. x)

Miller points out that creationists, with their belief in the literal truth of Genesis, needed to reject *all* of science, and this made their position untenable. But proponents of "intelligent design" (ID) promote their cause as a scientific theory, a revolutionary replacement for evolution in the tradition of quantum mechanics and continental drift, which would also enable new medical discoveries.

Michael Behe's argument for ID is what he calls "irreducible complexity" (p. 26) in living organisms, two examples of which, he claims, in chapter 2, are the clotting sequence and the flagellum – in either case, removing one component removes all functionality and thus would require an intermediate state in an evolutionary sequence that served no purpose. But in the following chapter Miller shows that neither is such, since the latter is cobbled together and the puffer fish can clot blood with three clotting factors missing. ID is needed only to achieve things evolution couldn't, Miller notes, but its designer had to do serial creation, never getting it quite right and copying from earlier work, putting in things that were unnecessary and leaving some things out.

By presenting itself as a competing scientific theory, Miller points out that ID co-opts the mission of science to search for order in the universe – and if it can win the battle against evolution, it can win battles against other ideas in science opposed by creationists. Thus, ID becomes more insidious than creationism, and this is the source of Miller's concern about the fate of "America's scientific soul."

While Miller would argue that evolution is the design from which life emerges from the laws of the universe, the "Committee for the Renewal of Science and Culture" of Discovery Institute (which has spearheaded ID) applied the language and tactics of the academic left on behalf of the academic right in a strategy known as "The Wedge":

> The proposition that human beings are created in the image of God is one of the bedrock principles on which Western civilization was built. . . . Debunking the traditional conceptions of both God and man, thinkers such as Charles Darwin, Karl Marx, and Sigmund Freud portrayed humans not as moral and spiritual beings, but as animals or machines who inhabited a universe ruled by purely impersonal forces and whose behavior and very thoughts were dictated by the unbending forces of biology, chemistry, and environment. . . . our strategy is intended to function as a 'wedge' . . . with a positive scientific alternative to materialistic scientific theories, which has come to be called the theory of intelligent design (ID)." (p. 175)

While the ID "scientists" have yet to come up with the competing scientific theory that the "Wedge" playbook calls for, ID has nevertheless captured considerable attention from the news media, which are accustomed to presenting balanced coverage of "both sides" of "controversial issues," and has found its way onto the agenda of many school boards. In these venues ID has been able to appeal to American public opinion and target K-12 education, where public opinion matters most.

In his last chapter, "Devil in the Details," Miller describes this stage of "America's 'civil war' over evolution" the same way as Charles Dickens opens *A Tale of Two Cities*. It is the "worst of times," because "if evolution is indeed the cornerstone of modern biology, how can America consider itself a modern scientific nation when a majority of its citizens reject that cornerstone as unsound?" (p. 215) It is the "best of times," because "there is something in the American ideal of individualism that resonates with science, that rewards achievement, that encourages risk, invention, and discovery." (pp. 215-216)

He also seeks to explore the possibility of a peaceful resolution between the opposing sides of the war:

> Evolution speaks directly to our conception of who we are, where we come from, and how we should regard ourselves with regard to the rest of the living world. . . . . many regard evolution as the cutting edge of a dangerous and destructive movement – a drive to secularize society and to undermine the traditional values that they believe have built our country. For many Americans, if evolution threatens the moral foundation of society, the issue of whether it is scientifically correct is secondary. (p. 193)
>
> . . . evolution isn't "just a theory"; it's the glue that binds the biological sciences together . . . an indicator whose

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> presence signals the health or sickness of the entire scientific enterprise. . . . Intelligent design, regardless of its origins, has struck a responsive chord with the American people. . . . The real question [is] where it wants to go. (p. 195)

"Many who find the movement attractive insist that all they are really asking for is an honest appraisal of the evidence for and against the theory of evolution," which is not possible "so long as 'Darwinists' maintain their stifling control over education and free inquiry. . . . But the goals and tactics of the ID movement go far beyond simply getting a fair hearing against evolution. What they seek, as explained in the Wedge document, is nothing less than the overthrow of materialism and its cultural legacies in favor, as Phillip Johnson put it, of a 'theistic science,' a new kind of science that would use the Divine not as ultimate cause but as a scientific explanation." (p. 196)

> . . . if there is one characteristic that has distinguished Western science from every form of inquiry in human history, it is its uncompromising insistence that nature itself must be the source of answers for questions about the natural world. . . . Once the supernatural becomes a valid element in scientific inquiry, science will cease to be an empirical search for the truth of the natural world . . . It will cease to explore, because it already knows the answers. (pp. 197-198)

The possibility of such a conclusion to the "evolution wars" is the concern that caused Miller to write this book. If ID persuades the American people that "a stifling orthodoxy has seized control of the scientific community," (p. 198) then "rallying cries of 'fairness' and 'balance'" (p. 199) will change the way science is presented to schoolchildren. This in turn will damage the image of traditional science in the eyes of schoolchildren and eventually change the way science is practical. The ID movement sees the scientific village infested with secular humanists and feels that it must "destroy the village in order to save it." (p. 201)

Miller finds an irony in the anti-Darwinist posture of conservatives in that evolution in particular and science in general are governed by procedures associated with structures and processes typically cherished by conservatives:

> In a certain sense Darwin's theory of evolution by natural selection is unadulterated Adam Smith translated into the language of biology. The unthinking acts of individual organisms, seeking no more than survival and reproductive success produce biological novelty just as surely as venture capitalists foster innovation. (p. 204)

> The scientific community, more than any other institution in our society, is a free marketplace of ideas where only the fittest prevail, and the unwillingness of ID to subject itself to competition in that marketplace speaks volumes. (p. 205)

He also finds some historical parallels between "America's 'civil war' over evolution" and the Civil War – between the skirmishes in "Bleeding Kansas" which pitted slaveowners against free-soilers and the skirmishes between evolutionists and anti-evolutionists on the Kansas State Board of Education, and that, just as Gettysburg marked the high-water mark of the Confederacy, a courtroom battle about another Pennsylvania town called Dover has so far represented the high-water mark of ID.

- John L. Roeder

David Michaels, *Doubt is Their Product: How Industry's Assault on Science Threatens Your Health* (Oxford, Oxford, 2008). $27.95. ISBN 978-0-19-530067-3. xii + 372 pp.

Reference #7 of our Fall 2008 issue is based on this book, and reading it prompted me to read the entire book, written by an epidemiologist at George Washington University who served as Assistant Secretary for Environment, Safety, and Health in the US Department of Energy in President Clinton's second term. In this heavily documented volume (20% of its pages are filled with references, and on p. xii even the author cites "what may be an overabundance of references"), he marshals evidence to show how the "product defense industry" operates – by "manufacturing uncertainty" as a result of pitting their own research, which their The Advancement of Sound Science Coalition calls "sound science," against research based on the practices of the scientific community, which they call "junk science," and thereby generate a "controversy," which plays well to the media, "who are mired in the trap of believing that there must be two sides to every story." "Maybe there are two sides," writes Michaels, "and maybe one has been bought and paid for."

The array of materials considered by Michaels runs quite a gamut – tobacco, asbestos, BNA, benzidine, lead, benzene, ortho-toluidine, chromium, diacetyl, and beryllium (the last in his capacity as Asst. Secy. of USDOE). But he credits Rachel Carson's *Silent Spring* in 1962 and the Surgeon General's smoking report and the end of the asbestos cover-up two years later with causing Americans to demand protection of their health and their environment. The response was the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the Mine Safety and Health Administration, the National Highway Traffic Safety Administration, and the Consumer Product Safety Commission, all in the Nixon presidency.

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But there are still "tricks of the trade" which the product defense industry continues to practice. One is a misleading reanalysis of the raw data which raised the question of toxicity of a substance in the first place. Another is industry-sponsored research, which typically looks "at a relatively small group of workers for a relatively short period of time and fail[s] to find any negative impact," or studies a sample of workers healthier than the general population with which it is compared, lumps together workers with different exposures, or "confounds" the factor being studied and another factor causing the same disease. Worse still is a "meta-analysis," which can lump a good study with other less reliable studies and thereby "bury" a critical point surfacing only in the one good study. Scientists employed by the industry can have their reanalyses, industry-sponsored research, or meta-analyses published in "vanity" journals and have them peer-reviewed by other scientists in the industry. Michaels reports that when he was working at USDOE he was outraged that scientists there were not outraged by this practice – at least to the point of exposing it to the public. What enables these "tricks of the trade" is the nature of epidemiological studies, that they can deal with only *probable* consequences of various exposures, while industrial or environmental activists are looking for certainty – that harm will definitely or definitely not, respectively, result.

Michaels also guides his readers through the consequences of judicial decisions and federal legislation. He calls the 1993 U.S. Supreme Court decision in *Daubert v. Merrell Dow* (*"Daubert"*) "the most influential Supreme Court ruling you've never heard of." *Daubert* replaced the "*Frye* test," which since 1923 had required that expert scientific testimony reflect "general acceptance" of the scientific community, with a "*Daubert* test," which requires both reliability and relevance and allows defendants to issue a "*Daubert* challenge" to what they allege to be "junk science" from the plaintiff, thus gutting the plaintiff's case, if the judge agrees with the challenge.

Because the implementation of *Daubert* has befriended industrial defendants more than individual plaintiffs, industry has sought to have *Daubert* rules apply to hearings at federal regulatory agencies as well. Because judges have tended to implement *Daubert* piecemeal by looking at each piece of evidence separately rather than all the evidence in total and have sought scientific evidence in terms of certainty rather than the greatest likelihood that can be assessed from the evidence known, Michaels is very concerned that *Daubert* could do more damage in regulatory agencies than it has done in the courts.

In addition, recent Republican-controlled Congresses have also done some favors for the product defense industry. Senator Richard Shelby (R-AL) sneaked the Data Access Act, which guarantees FOIA (Freedom of Information Act) public access to all data produced by federally-funded research scientists at nonprofit institutions, into the 1999 omnibus appropriation bill. This allowed industry access to data it could reanalyze (one scientist had previously refused to release her data for this reason), but the Data Quality Act, sneaked into the 2000 Treasury and General Government Appropriations Act by Rep. Jo Ann Emerson (R-MO) did more. It allowed "affected persons" to request "corrections" to information disseminated by federal agencies. And in 2003 the Office of Management and Budget announced a "Peer Review and Information Quality" program which sought an additional peer review of actions with greater than $100 million/year impact. Though its scope was scaled back after unified opposition by the scientific community, led by the National Academy of Sciences, on the grounds that it would result in costly delay with no benefit, it remains as an example of industry's attempt to thwart all regulation.

Nor was the executive branch of the federal government exempt. Michaels reports that the second Bush Administration "stacked advisory panels with individuals chosen for their commitment to the administration's allies and ideas rather than to the best and latest science." (p. 193) It also acted to minimize concern about atmospheric consequences of fossil fuel emissions, oppose reduction of the standard for concentration of arsenic in drinking water, and ease the rule for formaldehyde emission from plywood, and rewrote a Bureau of Land Management report to relax grazing restrictions, spread misinformation that abortions increase the risk of breast cancer, and defended junk food to the World Health Organization.

With all of this behind us, Michaels advocates what he calls a "Sarbanes-Oxley for Science," grounded in twelve recommendations whose basic premise is that "The distortion of scientific knowledge for partisan political ends must cease if the public is to be properly informed about issues central to its well-being, and the nation is to benefit fully from its heavy investment in scientific research and education." (p. 245)

- John L. Roeder

A NEW LOOK?

If this issue of the *Newsletter* looks different, you're right, although we didn't try to make any drastic changes. The old Macs that allowed us to produce it with PageMaker since 1989 still work, but the printers connected to them no longer print with acceptable quality. This delayed combined issue is the result of learning to use Microsoft Publisher on a PC.

RESOURCES

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15. Matt Jenkins, "Mother Nature's Sum," *Miller-McCune*, **1**(5), 44-53 (Oct 08).

The concept of "ecosystem services" originated in 1997, when Robert Costanza and 12 other researchers estimated the economic value of 17 ecological benefits – such as carbon sequestration in forests, water filtering in wetlands, wildlife habitat, and ecotourism – in a paper titled "The Value of the World's Ecosystem Services and Natural Capital" and published in *Nature*. Their total was $33 trillion per year, nearly twice the annual gross global product. In 2001, more than 1300 scientists working on the Millennium Ecosystem Assessment looked at the health of 24 ecosystem services and found many seriously degraded.

According to Stanford ecologist Gretchen Daily, "Earth's ecosystems constitute 'natural capital,' a kind of ecological 'principal' that, when managed properly, generates a sustainable flow of interest that supports life on the planet. But traditional economics is infamous for ignoring the real environmental cost of doing business." But Daily has critics who charge that requiring payment for ecosystem services would allow the owners of "natural capital" to "extort more and more money from the government for each attempt to protect the environment." John Echeverria of Georgetown University is cited as describing "the two main competing ways to protect nature – through outright government regulation or by paying landowners to do what's best for the environment – and he has warned that payments can erode a societal sense of environmental responsibility."

After raising the pros and cons of having to pay for ecosystem services, author Jenkins acknowledges that they "are clearly a product" but then finds himself asking "will there be a buyer?" "That," he writes, "after all, is what it will take to make the concept really go" and adds that "in the U.S., nothing will do more to turn ecosystem services into widespread reality than a cap-and-trade framework for greenhouse gases." "But if a cap-and trade system for carbon would certainly bring lots of money into the mix," he goes on, "it's far less clear where the deep pools of money will be found to pay for other ecosystem services like pollination."

16. Tom Jacobs, "The Man Who Bridges Troubled Waters," *Miller-McCune*, **2**(1), 14-19 (Jan/Feb 09).

"Two-and-one-half to five million people die every year because of a lack of access to safe, clean water," Aaron Wolf is quoted as saying in this article. "That's on the same level of magnitude as AIDS or malaria." Because of the importance of water to human health, Wolf also says, "it is simply too important to fight over."

This article describes water treaties that have survived conflict between Israel and Palestine and between India and Pakistan and the value contributed by Wolf, who combines a knowledge of geography and natural resources with an ability to implement it in the diplomatic arena. One emergent key to this has been invoking the spiritual traditions that various parties bring to the table: Wolf notes that "all spiritual traditions . . . seem to tap into water as healing, soothing and cleansing."

17. Michael Haederle, "Core of the Problem," *Miller-McCune*, **2**(1), 54-63 (Jan/Feb 09).

If you would like to work in an environment maintained at a constant -24^{o}C, you might like a job at the National Ice Core Laboratory in Denver. If you'd just rather read about how they store and analyze samples from the West Antarctic Ice Sheet Divide Ice Core, read this article. This project, a follow-up to the Greenland Ice Sheet Program from 1971 to 1993, is expected to end in 2012.

Infusion Tips

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England's Severn River, could generate enough electrical energy over its estimated 12-year lifetime as four modern nuclear plants operating half as long. The cost of the tidal power project is comparable to that of the four nuclear plants, and the electrical energy generated by either approach would be carbon-free. Each has its environmental cost – radioactive waste from the nuclear plants, and damage to wildlife (including spawning salmon and eel) from the tidal plant. Which alternative would you choose?

4. National Public Radio's "Morning Edition" on 28 May 2009 described a new espresso machine at Blackwell's book store in England. It churns out fully-hardbound books to order at the rate of 100 pages per minute. Like Amazon's Kindle, this is made possible by digitized versions of books and means an end to waiting for titles not in stock. Which would you rather read, an "espresso" book or a Kindle? Which form would be of greater benefit to public libraries?

As explained in the box on page 51, the Teachers Clearinghouse *Newsletter* is now being laid out on a PC with Microsoft Publisher. This allows us to make an electronic copy of the *Newsletter* for you as a pdf, which you can share with your friends. If you would like one, please send an e-mail request to <JLRoeder@aol.com>.

Clearinghouse Update

From time to time we update our readers on situations which have been described in our *Newsletter*.

A Newly-Illustrated Darwin

The Fall 2005 issue advocated an update of Richard Leakey's 1979 illustrated and updated version of Charles Darwin's *On the Origin of Species* as a best possible educational response to attacks on including evolution in secondary science curricula. David Quammen, whose biography of Darwin was part of the lead story of our Spring 2007 issue, has now brought forth an illustrated version of the first edition of Darwin's landmark work (Quammen's favorite edition), enriched not only by illustrations but also by excerpts from *The Voyage of the Beagle*, Darwin's *Autobiography*, and *The Life and Letters of Charles Darwin*. It was published in 2008 by Sterling, and the ISBN is 918-1-4027-5639-9.

NEED Materials now Available Online

The Spring 2005 issue reported a workshop presented by the National Energy Education Development (NEED) Project and the materials obtained at the workshop. Although NEED workshops are still worth going to, you can now obtain their materials online at their website, <www.need.org/curriculum.php>. Materials can be browsed for by subject matter, title, or grade level. Especially recommend are the NEED Energy Info Books, available at elementary, middle, and high school levels.

Google vs. the publishers

The following was written by American Institute of Physics Executive Director Fred Dylla in his 3 November 2008 electronic newsletter as part of his continuing concern about the effect of electronic media on print media:

> Last week we witnessed several events in the world of publishing that will affect AIP and its Member Societies. On Wednesday, October 29, much of the print, broadcast, and online news media ran stories on the following seemingly unrelated events: Google's agreement with publishers and authors concerning online access to books; a reorganization and consequent significant layoff of staff at Time Inc., the world's largest magazine publisher; and an announcement by the *Christian Science Monitor* to end its daily print edition.
>
> There is a connection among these events to AIP's business—let's start with the Google settlement. The contentious issue was Google's much heralded and widely appreciated book scanning project, which began in 2004 in collaboration with several large research universities. Google's plan to upload the scanned books onto its online platform for full access worldwide was considered a noble goal for an organization that is now the world's largest information provider. Google was on safe ground with the scanning of books in the public domain. However, in 2005 the company became involved in a lawsuit filed by the publishers and authors of books that were still under copyright. The settlement reached last week appears to be a win-win arrangement for all of the parties. Google has agreed to a $125 million settlement, negotiated out of court, which will partially compensate authors and publishers of previously scanned copyrighted material. A significant portion of this fee will be used to set up a new online registry for access to scanned material. This registry will allow users to view without charge up to 20% of a scanned book and to view the entire book for a fee. Parties agreed to a revenue-sharing plan, with Google receiving 37% and the remainder going to the authors and publishers. If Google sells ads within this registry, the resulting revenue will be divided equally. This agreement gives readers access to a huge library of books, and it provides authors and publishers with appropriate recognition and compensation. For scientific publishers, such as AIP, that are struggling to meet increasing demands for online content and contending with pressures for open and free access, the Google agreement sets an important precedent by accommodating the desire for widespread online access and the need for fair compensation.
>
> Regarding the developments at Time Inc. and the *Christian Science Monitor*, the decline of financial viability of newspapers and magazines in this country is disturbing. Professional news reporting by accredited journalists is being taken over by a cacophony of blogs on the Internet and 24-hour streamers on cable TV channels. Newspapers and magazines have not found a sustainable business model in the Internet era. The subscription and ad revenue from the disappearing print editions has not been replaced by comparable income in the digital editions, which give away the content and return far less ad revenue. If the peer-review system managed by scientific publishers were to disappear, the scientific community would lose its certification of scientific results. The lessons for scientific publishers are clear, following the line of the Google agreement. We must constantly strive to stay near the forefront of the Web technology that allows new ways to display and deliver our content to a wide audience. At the same time, the audience needs to value the content enough that the producers receive compensation via some combination of author, host institution, or reader fees.

Taking a stand on author deposit mandates

American Institute of Physics Executive Director Fred Dylla in his 2 February 2009 electronic newsletter continued to speak out about his continuing concern about the effect of electronic media on print media:

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Update

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There is an accelerating pressure on publishers to transition to untested business models in scholarly publishing that involve open-access schemes. This is a major issue for AIP and its Member Societies because scientific publishing is our most important activity. We engage in scholarly publishing in the interest of science and its practitioners. Our record in scholarly publishing is impressive. The physics community has been known for its rapid adoption of new technologies and business model innovation—from the invention of the web by the high-energy-physics community almost two decades ago, to robust online distribution platforms, to the innovative arXiv e-print server that serves many fields of physics, to experimenting with different business models, such as articles on demand and tiered subscriptions.

The journal business is under considerable pressure because an entire generation has grown accustomed to surfing the web for information and expects it all to be free. Unfortunately, there are *always* costs associated with the production and dissemination of intellectual property—whether it is an artistic work such as a movie or music, or a publication, such as a book or a peer-reviewed journal. The newspaper business has not found a viable model in its transition to offering a mixed print-based/web-based product. We regularly witness the jettison of reporters and feature departments, and even the large national dailies are searching for financial lifelines through ancillary products and businesses. We have seen the disappearance of science reporters, which is one important reason why AIP revamped *Inside Science News Service* last year, to be geared to reporters who don't have a science background.

Scholarly journals' strong connection with research institutions and libraries has helped maintain a certain level of stability during this transition. However, budget cuts at libraries and increasing outside pressures to make scholarly information more accessible have led to government initiatives that mandate free public access to journal articles. Last week the National Research Council (NRC) held a public symposium on the most visible mandate passed by the US Congress in December 2007, which requires that all publications funded by the National Institutes of Health (NIH) be deposited by their authors to the NIH public website (Pub Med Central) within 12 months of publication. Most scholarly publishers, including AIP, have gone on record in opposing the creation of this one-size-fits-all unfunded mandate for a large fraction of the federally funded biomedical research in the US. *The NRC Symposium on Author Deposit Mandates for Federal Research Grantees* debated the issue of whether the mandate should be extended to all federal agencies that fund research. From the standpoint of most web users and librarians, this directive sounds appealing. From the standpoint of a journal publisher like AIP, which invests significantly in peer-review management, copyediting, digital translation, and online hosting and archiving of the journal, this directive would devalue the publisher's investment after 12 months, undermining the viability of the journal business.

I gave a presentation at this symposium, stressing the scale and nature of the current and prevalent business model, which is underpinned by institutional subscriptions. Access to scholarly research has improved immensely based on this model. AIP allows its authors to post copies of their peer-reviewed articles on both their personal and institutional websites and adjusts institutional subscriptions based on the size of institution. I cautioned that seemingly well-intentioned public policy often has unintended consequences. Given the present turmoil in the global economy, this is not the time to be mandating significant changes in the well-established business model that supports essential scholarly communication within the scientific community.

Developing a tolerance for peanuts?

The issue of allergic reactions to peanuts was first broached as an Infusion Tip in our Fall 1998 issue. It has been updated subsequently in our Winter 1999, Spring 1999, and Winter/Spring 2002 issues, with the Spring 1999 update being to report identification of the gene responsible for the allergic reactions. News accounts on 16 March 2009 of a meeting of the American Academy of Asthma and Immunology reported that a team from Duke University and Arkansas Children's Hospital Research Institute enabled five previously allergic children to gradually build up tolerance to peanuts. It was noted that these children had "slightly lower allergic sensitivity than the average subject" and that this was only the beginning of much needed research. Also reported was a vaccine against peanut allergies containing peanut protein bioengineered not to contain the component that triggers the allergic reaction. Presumably this took advantage of the gene identification reported back in 1999.

Bioengineering to offset global warming?

An Infusion Tip in this issue asks students for their opinion on geoengineering to offset global warming. National Public Radio's "Morning Edition" on 9 April 2009 reported that Presidential Science Advisor John Holdren said that global warming prospects were so severe that consideration was being given to *bio*engineering to cool planet earth – *e.g.*, constructing artificial trees to suck carbon dioxide out of the air.

A rejoinder on ethanol from corn

Responding to concerns that allocation of land to grow corn to make ethanol fuel has caused corn for food to be less plentiful and more expensive and that making ethanol is wasteful of water and (fossil fuel) energy,

(continued on page 55)

Update

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Chuck Woodside wrote in the *Omaha World Herald* on 25 March 2009 that there's "scarcely a 'kernel' of truth" in the charges against corn ethanol. While ethanol production increased between 2001 and 2006, he wrote, its "water consumption decreased 27%, electricity usage declined by 16%, and total energy use went down by 22%." Moreover, "the total amount of cropland dedicated to American ethanol production in 2007 was only 0.6% of cropland worldwide."

As the CEO of KAAPA Ethanol in Minden, NE, and Secretary of the Renewable Fuels Association, Woodside is clearly interested in showing the corn ethanol industry in the most favorable light. According to the *Statistical Abstract of the United States*, between 1990 and 2007 the acreage planted in corn increased 29%. At the same time, the yield increased 27%, making for an overall production increase of 65%. The energy required to increase the yield is not given, but it is curious that Woodside quotes the percentage of land for *American* ethanol production in terms of cropland *worldwide*. Given that world cropland is 15 times that in the U.S., American ethanol production requires 9% of *American* cropland, and this is not insignificant.

Sequestering carbon dioxide for soda pop

National Public Radio's "Morning Edition" on 10 April 2009 reported on a carbon dioxide sequestration project at a Huaneng Co. power plant in Beijing. It diverts less than 1% of the carbon dioxide emissions for absorption by a chemical solvent, after which the carbon dioxide is purified, cooled, and compressed to its liquid state, then sold for use in fire extinguishers, making dry ice, or further purified (to 99.9% purity) for use in carbonated beverages (which, when drunk, re-emit he carbon dioxide). Although less than 1% of the 5 million tons of carbon dioxide emitted by the plant are captured, the sale of the captured carbon dioxide covers the cost of capturing it. Neither is the "chemical solvent" identified nor is it explained why only such a small percentage of the carbon dioxide emissions is economically captured.

FORTHCOMING MEETINGS

5 July – 15 August 2009, The Fifth Annual World Nuclear University Summer Institute, University of Oxford. For more information, visit <www.world-nuclear-university.org>.

30 November - 4 December 2009, Materials Research Society Fall Meeting, Boston, MA. For more information, visit <www.mrs.org/fall2009>.

Rodriguez: nutrition and health

Obesity is determined by the amount of body fat versus amount of body muscle. It is quantified by the body mass index, which relates adult weight versus height (for adults over 20 years old except body builders). People with a body mass index greater than 30 are classified as obese.

Nutritionist and Calhoun parent Jairo Rodriguez spoke to Calhoun Upper School students about obesity and related health matters at Town Meeting on 14 May. He showed a sequence of U.S. maps to illustrate the increase in the percentage of adults classified as obese over the past 20 years, essentially to the point of doubling. About two thirds of Americans (195 million) are overweight, he said, and 90 million of them are obese. There are 400,000 Americans weighing more than 400 pounds. Nor is obesity limited to the U.S. It's increasing in the rest of the world as well.

What made this possible, Rodriguez said, was a cheaper way to produce sugar. In years past, sugar from fruit was expensive to produce, but about 30 years ago fructose became cheap to produce from corn. Sugar consumption is up (each American consumes an average of 168 pounds per year), while vegetable consumption has remained static. This comes in large part from energy drinks, which have now become more than a $5 billion per year business. When energy drinks are consumed without exercise, they increase bodily intake of sugar, also bodily intake of coffee. When their consumption is combined with that of alcohol, they give the body the feeling that it can handle an increased amount of alcohol, and the counteracting depressive effect of alcohol can produce possible death. Even by themselves, some energy drinks have deleterious side effects like diarrhea and dehydration.

Regardless of the sugar consumed, Rodriguez pointed out, the liver converts it to fat. And food products that have replaced sugars with alcohol sugars (like sorbitol or xylitol) are actually adding Calories, he went on, since sugars provide 4 Calories per gram, while alcohol sugars provide 7 Calories per gram. Body weight, he was quick to add, is determined by a combination of caloric intake and caloric output – and this is why exercise is important. He also noted that the key to health is cardiac output and oxygen delivery, not physical appearance.

In addition to having a diet with caloric intake matched to caloric output, Rodriguez also emphasized having a diet properly distributed among proteins, carbohydrates, and fats. A diet without fat, he observed, reduces the body's ability to make hormones.

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BESAC points up materials as key to secure and sustainable energy future

In Reference #1 of our Fall 2008 issue Graham Fleming and Mark Ratner described the product of their committee convened by the Basic Energy Sciences Advisory Committee (BESAC) of the US Department of Energy to identify the "grand challenges in energy sciences," which has taken the form of *Directing Matter and Energy: Five Challenges for Science and the Imagination*, available on-line at <http://www.sc.doe.gov/bes/reports/list.html>. In addition to this committee report there are eleven reports of workshops on basic research needs, one foundational and ten specialized (on advanced nuclear energy systems, catalysts for energy, clean and efficient combustion of 21st century transportation fuels, electrical energy storage, geosciences, the hydrogen economy, materials under extreme environments, solar energy utilization, solid-state lighting, and superconductivity), also available on-line at the URL above. Since then BESAC was charged "to conduct a study with two primary goals: (1) to assimilate the scientific research directions that emerged from these workshop reports into a comprehensive set of science themes, and (2) to identify the new implementation strategies and tools required to accomplish the science." This is done in a 13-page booklet, *New Science for a Secure and Sustainable Energy Future*, also available on-line at the same URL.

As this booklet sees it, "the United States faces a threefold energy challenge": energy independence, environmental sustainability, and an economic opportunity. We are presently dependent on importing 16 million barrels of oil per day, a "deficit" that "has nearly tripled since 1970." This imported oil, along with other fossil fuels, accounts for "about 85% of U.S. national energy supply." But creating "next-generation clean energy technologies that do not depend on imported oil" would position the U.S. "not only [to] provide solutions at home but also [to] create global economic opportunity." As the booklet recommends, "The vision for a secure and sustainable energy future entails moving from spending hundreds of billions of dollars to import a third of our energy supply to the development, deployment, and export of new carbon-free energy technologies invented and manufactured in the U.S."

But, the booklet goes on, "the magnitude of the challenge is so immense that existing energy approaches – even with improvements from advanced engineering and improved technology based on known concepts – will not be enough to secure our energy future." In order to attain the "three strategic goals" of "making fuels from sunlight," "generating electricity without carbon dioxide emissions," and "revolutionizing energy efficiency and use," we will need to convert "sunlight to electricity with double or triple today's efficiency," store "electricity in batteries or supercapacitors at ten times today's densities," and operate "coal-fired and nuclear power plants at far higher temperatures and efficiencies."

As the second part of the booklet recognizes, "innovative new materials and chemical processes are the agents of change in achieving the vision," as was also recognized in the April 2008 issue of the *Bulletin* of the Materials Research Society reported in our Fall 2008 issue. A secure, sustainable energy future requires materials that

- Increase the efficiency of nuclear and coal-burning electric plants by allowing higher temperatures (p. 3)
- Generate photovoltaic power with greater efficiency as well as less cost (the Generation III materials referred to in the MRS *Bulletin*) (p. 4)
- Catalyze reactions to eliminate toxic waste products or to make new chemical fuels (pp. 4-5, 8-9)
- Store more electrical energy with less mass and greater charging rates (pp. 6, 9, 10)
- Produce solid-state light with fourteen times the efficiency of incandescent bulbs (pp. 6, 8)
- Transmit electric current more reliably and with lower energy losses (p. 7)
- Withstand nuclear radiation (p. 9)
- React with to sequester carbon dioxide (p. 9).