TEACHERS CLEARINGHOUSE
FOR SCIENCE AND SOCIETY EDUCATION
NEWSLETTER

Sponsored by the Association of Teachers In Independent Schools

Affiliated with the Triangle Coalition for Science and Technology Education

Vol. XXIX, No. 1
Winter 2010

UNEP's *Climate Change Compendium*

In his Foreword to *Climate Change Science Compendium 2009*, prepared by the United Nations Environment Programme (UNEP) for those attending the Conference on Climate Change in Copenhagen in December 2009, U. N. Secretary General Ban Ki-moon warns that "important tipping points, leading to irreversible changes in major Earth systems and ecosystems, may already have been reached or overtaken." (p. ii) Nine such tipping points, defined as "a critical threshold at which a tiny perturbation can qualitatively alter the state or development of a system," are subsequently listed, along with their transition time frame and the temperature increase relative to 1750 needed to reach them (see table at bottom of page).

Since 1750 average global temperature has increased by 0.6°C, but as the result of greenhouse gases already emitted, this temperature increase should rise to between 1.4°C and 4.3°C by the end of the 21st century. Moreover, in addition to increased carbon dioxide emissions, the efficiency with which land and oceans absorb them

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New York City's *Climate Change Program Assessment and Action Plan*

According to the *Climate Change Program Assessment and Action Plan* of New York City's Department of Environmental Protection (DEP), the Department has a dual function to respond to climate change: to reduce its own greenhouse gas emissions in order to limit climate change and to carry out its mission of providing New York City safe drinking water and disposing of its waste water within the context of whatever climate change occurs. To carry out this dual function, the Climate Change Task Force has developed a Climate Change Action Plan "to address the effects of . . . climate change on [New York City's] water supply, drainage, wastewater and water quality protection operations, and strategies for greenhouse gas mitigation." (p. 7) It includes five tasks, described in terms of challenges, progress, and priorities:

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Tipping element	Transition time frame	Temperature increase needed
Summer monsoon in India	1 year	Unknown
Monsoon in Sahara and West Africa	10 years	3 – 5°C
Arctic summer sea ice	10 years	0.2 – 2°C
Amazon rainforest	50 years	3 – 4°C
Boreal forests	50 years	3 – 5°C
Atlantic Ocean thermohaline circulation	100 years	3 – 5°C
El Niño Southern Oscillation	100 years	3 – 6°C
Greenland Ice Sheet	300 years	1 – 2°C
West Antarctic Ice Sheet	300 years	3 – 5°C

A new comprehensive web site for renewable energy educators

by Robert Ehrlich

The <rev-up.org> web site went live in July 2009, and it serves the needs of educators and students much better than prior sites because it is directly shaped and modified by users. In its current version, the web site helps teachers to plan and conduct courses and programs dealing with renewable energy using resources that best suit their needs, and it can also be of great value to students. The site is a repository of twelve categories of resources, including: career information, books, media, student projects, speakers, course notes, places to visit, college programs, current research, simulations, demos & kits, and internships. Thus, any visitor to the site is free to add new items in any of these categories, add comments on existing items, upload videos, or ask or answer questions to others. Currently, for example, over 100 internships have been added to the data base – some at universities, but many at private companies involved with renewable energy. Many of these entries have been added by users themselves. All items in any category can be easily sorted or searched – for example to find places to visit, guest speakers, or internships for students involved with renewable energy within a user-specified distance from his/her zip code, or to find books using calculus, published since 2005, and priced under $100.

The <rev-up.org> site uses a Content Management System that makes it easy for users to edit. It also uses advanced search engines and sorting algorithms to help users to locate information. The development of a renewable energy web site is not novel. There are over 100 web sites devoted exclusively to renewable energy information and education – including an excellent one maintained by the Department of Energy. However, none displays all the following attributes possessed by <rev-up.org>:

- A comprehensive source of renewable energy education resources in as many as 12 categories identified above
- The ability of users to update content, post reviews and link to videos
- A database that can be sorted to match the priorities of users
- Incorporation of user feedback into the continued development of the site

There are dangers, of which we are well aware with any web site where users are free to modify in a "wiki-like" manner. Thus, it is important to ensure that the contents are correct, verified and not defamatory or obscene. This is currently handled solely by myself, although at some point a panel of moderators will remove offending postings and edit postings for correctness, as with Wikipedia. I hope you will check it out, add content, submit an evaluation, tell your friends about it, and let me know if you would like to see it modified to meet your needs better.

(*Editor's Note*: Robert Ehrlich teaches at George Mason University. He wrote this piece to provide information about his "Rev-up" website in addition to that provided in our Fall 2009 issue.)

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.

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America's Energy Future charts America's Energy Future

In 2007 the National Academies (of Science and Engineering), together with the Institute of Medicine and the National Research Council, initiated a study of "America's Energy Future: Technology Opportunities, Risks, and Tradeoffs," with a goal of publishing five reports in the first phase of their initiative. The first, *The National Academies' Summit on America's Energy Future: Summary of a Meeting*, was published in October 2008 as a record of a meeting of the same title held in March of the same year. The four remaining reports were published in 2009 and are available on-line as follows:

1.America's Energy Future: Technology and Transformation, the full edition published with detailed chapters on efficiency, alternative transportation fuels, renewable energy, fossil energy, nuclear energy, and the power grid; also the summary edition published without these six chapters, both available at <http://www.nap.edu/catalog.php?record_id=12091>.

2.Liquid Transportation Fuels from Coal and Biomass: Technological Status, Costs, and Environmental Impacts, at <http://www.nap.edu/catalog.php?record_id=12620>.

3.Electricity from Renewable Sources: Status, Prospects, and Impediments, at <http://www.nap.edu/catalog.php?record_id=12619>.

4.Real Prospects for Energy Efficiency in the United States, at <http://www.nap.edu/catalog.php?record_id=12621>.

The goal sought by the Panels of the America's Energy Future initiative is an America less dependent on petroleum and less generating of greenhouse gases. The second Key Finding of *America's Energy Future* states that "the deployment of existing energy efficiency technologies is the nearest-term and lowest-cost option for moderating our nation's demand for energy." The second Overarching Finding of *Energy Efficiency* continues as follows: "The full deployment of cost-effective, energy-efficient technologies in buildings alone could eliminate the need to add to U.S. electricity generation capacity."

The Panel on Energy Efficiency Technologies is careful to distinguish between energy efficiency, making maximum effective "use" of the energy we have, from energy conservation, which suggests "using" less energy, with "use" in quotation marks because energy is actually transformed rather than "used." They find that, "with full deployment of cost-effective, energy-efficient technologies," U.S. annual energy "use" could fall from 99 quads (quadrillion Btus) in 2008 to 89-92 quads in 2020 and to 82-88 quads in 2030. Of these savings, 53% would come from buildings, which "use" 41% of U.S. primary energy; 12% would come from transportation, which "uses" 28% of U.S. primary energy; and 35% would come from industry, which "uses" 31% of U.S. primary energy.

That the least energy efficiency is anticipated to come from transportation makes energy "used" for transportation all the more critical, and the energy efficiencies recommended for transportation worth noting. The Panel on Energy Efficiency Technologies found that "evolutionary improvements in gasoline vehicles using ICEs [internal combustion engines] are likely to prove the most cost-effective technology for improving fuel efficiency and reducing petroleum consumption, at least through 2020." Thus, they say that "for the medium term, plug-in hybrid-electric vehicles (PHEVs) and the associated electricity fueling infrastructure could be deployed more rapidly and more cheaply than hydrogen fuel-cell vehicles and the associated hydrogen fuel production and distribution infrastructure." (p. 6)

The fifth Key Finding of *America's Energy Future* states that "there are limited options for replacing petroleum or reducing petroleum use before 2020, but there are more substantial longer-term options that could begin to make significant contributions in the 2030-2035 timeframe." According to *Liquid Transportation Fuels*, the U.S. imports 60% of its oil, and 70% of it is used as transportation fuel (14 million barrels per day). Two abundant U.S. resources that can reduce this are biomass and coal, each with "its own set of limitations and challenges." Competition for corn as a food crop precludes its use as a long-term biomass sources. The Panel on Liquid Transportation Fuels found that today's technology and agricultural practices could produce 400 megatons per year of cellulosic biomass, increasing to 550 megatons per year by 2020, and note that incentives would be needed to avoid competition with the food supply and avoid greenhouse gas-generating practices. They expect the technology to produce cellulosic alcohol to evolve over the next decade, by which time the 550 megatons per year of cellulosic biomass is expected to produce up to 2 million barrels per day gasoline-equivalent.

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Energy Future

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"To date, the only biofuels in the United States have been ethanol from corn grain and biodiesel from soybean, which accounted for less than 3 percent of U.S. transportation-fuel consumption in 2007," the Panel writes, noting that the fertilizer required to grow the corn and soybeans to be "making the reductions in greenhouse-gas emissions compared with petroleum-based gasoline small at best." This problem is not intended to beset biofuels from cellulosic biomass, but it will apply heavily to liquid fuels generated from coal, which will generate more than twice the carbon dioxide emissions as petroleum fuels. Implementing Carbon Capture and Storage (CCS) would thus be an imperative adjunct to generating liquid fuels from coal, which the Panel says "would have a relatively small effect on engineering costs and efficiency"; but they also note that unforeseen costs could arise as CCS is implemented on a large scale.

Another possibility considered by the Panel on Liquid Transportation Fuels is generating fuels from a 60%-40% combination of coal and cellulosic biomass, which would have the same greenhouse gas emissions as gasoline. Combining coal in this proportion with the aforementioned 550 megatons per year would produce 4 million barrels per day gasoline-equivalent. But, the Panel cautions, we need to start planning *now* for plants to do this by 2020. And mining the additional 820 megatons of coal to combine with the 550 megatons of biomass would require more than an 80 percent increase in coal production.

But while mixing biomass with coal in generating liquid fuels will lower the carbon dioxide emitted per unit of energy, this will not be true for coal burned to generate electricity. The third Key Finding of *America's Energy Future* states that "the United States has many promising options for obtaining new supplies of electricity . . . especially if carbon capture and storage and evolutionary nuclear plants can be deployed at required scales." The sixth Key Finding adds that "substantial reductions in greenhouse gas emissions from the electricity sector are achievable over the next two to three decades through a portfolio approach involving the widespread deployment of energy efficiency technologies; renewable energy; coal, natural gas, and biomass with carbon capture and storage; and nuclear technologies." The Executive Summary of *America's Energy Future* then goes on to state explicitly:

> To enable this portfolio approach in the electricity sector, the viability of two key technologies must be demonstrated during the next decade to allow for their widespread deployment starting around 2020:
>
> - Demonstrate whether CCS technologies for sequestering carbon from the use of coal and natural gas to generate electricity are technically and commercially viable for application to both existing and new power plants. This will require the construction before 2020 of a suite (~15-20) of retrofit and new demonstration plants with CCS featuring a variety of feedstocks, generation technologies, carbon capture strategies, and geologic storage locations.
>
> - Demonstrate whether evolutionary nuclear plants are commercially viable in the United States by constructing a suite of about five plants during the next decade.
>
> A failure to demonstrate the viability of these technologies during the next decade would greatly restrict options to reduce the electricity sector's CO2 emissions over succeeding decades. The urgency of getting started on these demonstrations to clarify future deployment options cannot be overstated. (p. 5)

Thus the main energy sources envisioned for the electricity sector portfolio are coal and nuclear. The remainder is to be provided by renewable technologies, which are addressed by the Panel on Electricity from Renewable Resources in *Renewable Sources*. They observe that non-hydro renewables presently generate only 2.5% of U.S. electricity and that this would rise to only 8% by 2030 under a "business-as-usual" scenario. Increasing this further, they add, requires coordination of policy, technology, and capital investment.

But there are constraints, they note. Generation of electricity from renewable energy resources must take place *where* the resources are located and *when* they are providing energy, and there may be opposition to land use for renewable electricity generation. This will require extending and strengthening the electrical transmission grid and preferably increasing its intelligence, so that it knows where and when renewable electricity is being generated.

Ultimately U.S. land-based solar can produce 3500 times the annual U.S. electricity demand of 4000 TWh/yr, and wind can provide 10-20%, but the Panel expects them to provide only 10% of total U.S. electricity by 2020, and 20% by 2035, at which point back-up generation or storage technologies will need to be included, because of the intermittency of these sources. They do note, however, a scenario developed by the U.S. Department of Energy that would achieve sufficient capacity by 2030 to generate the full 20% of U.S. electricity by wind.

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Re-Energizing STEM Ed

The topic of the first plenary session at the Joint Meeting of the American Association of Physics Teachers (AAPT) and the American Physical Society (APS) in Washington, DC, on 13 February 2010 was "Re-Energizing America's FOCUS in STEM Education." Addressing this topic were Linda Slakey of the National Science Foundation (NSF), speaking on "Catalyzing Widespread Implementation of Good Teaching Practice"; Shirley Malcom of the American Association for the Advancement of Science, speaking on "The Value of Diversity in STEM"; and Robert Moses of The Algebra Project, speaking on "The Algebra Project's Strategy to Accelerate the Nation's Bottom Quartile Students' Math Education and Get Them Ready for College Math."

After noting that good practice in STEM (Science, Technology, Engineering, Math) education called for 1) good use of the classroom and laboratory and 2) good tools for personal study, Slakey asked, "Who could argue with that?" The devil's in the details, she went on, and she began her pursuit of those details by observing that anything that engages students in the classroom enhances their learning. The same is true, she added, for peer groups and online homework, things that give students immediate feedback.

Physics got into PER (Physics Education Research), Slakey continued, because physicists wondered why students found it difficult to learn. Other disciplines have approached teaching more in the vein of classroom management, she said. We are indebted to PER for learning about student misperceptions and for developing the Force Concept Inventory and other concept inventories.

Slakey stated that in addition to fostering new insights into learning, NSF is also interested in fostering the teaching of new developments in physics. But this requires a different approach at the high school and college level, she noted. In high school physics is usually not taught by physicists and in college professors don't always know how to enhance learning. Thus, she observed, high school teachers need to learn more physics and college teachers need to learn more PER.

Another issue that colleges need to address, Slakey emphasized, is the preparation of precollege physics teachers. If college faculty don't consider high school teaching as worthy of their best students, they deserve the quality of the students they get, she said, observing that disciplines set the standard by which teaching is valued.

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Fourth Physics Education Symposium addresses preparing and retaining physics teachers

The title of the American Association of Physics Teachers Fourth Annual Symposium on Physics Education in Washington, DC, on 16 February 2010 was "Educating Physics Teachers: A Call to Action for Physics Departments." Three speakers addressed three key aspects of recruiting, preparing, and retaining physics teachers: Mary Ann Rankin about what the UTeach program at the University of Texas (UT) has done to attract and train teachers, Sheila Tobias about making science teaching a more respected profession, and Stamatis Vokos about what can be done to triple the number of physics teachers America presently produces.

Rankin, who is Dean of the College of Natural Sciences at UT, explained that UTeach began in 1997 as a partnership between the colleges of education and science at UT and the Austin (TX) school district. It produces between 500 and 600 new science teachers per year, and 85% of them are still teaching after five years (the time after which 50% of new science teachers typically leave the profession).

UTeach begins with field experience courses – to draw students into teaching at the outset – Rankin went on. Although they graduate fully certified, they take only nine credit hours in the college of education. Many science majors discover a true enjoyment of teaching science, she added.

The indication of the success of a program is the degree to which it is replicated, and the National Mathematics and Science Initiative led by former Undersecretary of Education Tom Luce selected 13 universities from 52 that applied to replicate UTeach.

But, Rankin conceded, for UTeach to train more physics teachers, more physics majors are needed. To determine how to attract more physics majors, UTeach enlisted an external consultant, whose focus groups showed students finding passion in their professors about physics but not about their teaching. Moreover, the physics professors made no connections between the content of their courses and students' daily lives – and they didn't answer "why" questions. So, Rankin related, UT launched a campaign to have these concerns addressed in

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Re-Energizing STEM Ed

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Slakey then singled out the success of the PTEC (Physics Teacher Education Coalition) model and noted that its success has caused NSF to encourage development of similar programs for the other science disciplines. To this end, she said that NSF has escalated the amount of funding in its largest grants in order to achieve this type of cultural change, with their next round of funding overtly labeled "Transforming STEM Education."

Another type of cultural change cited by Slakey was the inclusion of research experience for undergraduate majors, which has been recommended by the AAPT, APS, and other similar organizations. She asked these societies to think how they could build on their successes to bring this about.

Malcom noted that the sciences bring diversity in their ways of looking at the world but rued that the STEM community does not look like the general population. Groups of people with a lower percentage of interest in STEM and pursuit of STEM degrees are less likely to support STEM and also represent a pool of potential STEM degree holders that has been undertapped. "We have a lot of problems on this globe, and we will need all the talent we can get to solve them."

She recalled how Nobel Physics Laureate Abdus Salam recalled in *Ideals and Realities* what he had been able to do in his own developing Pakistan to interest students in physics. But, in addition to attracting world-class STEM teachers to interest students from groups that are underrepresented in the STEM community, Malcom said, we need to eliminate the dysfunctionality of the system in which they are educated, which typically emphasizes teaching facts with no use of technology. To get the full potential realized to solve STEM problems, she urged, we need to find the diamonds in the rough and polish them.

Moses, who is the founder of The Algebra Project, invited the audience to come the next day to see the presentation by Algebra I students at Boys and Girls High School in Brooklyn, NY, of what they had learned. Such public presentations are encouraged by The Algebra Project, where equations are meant to describe rather than to be solved. Moses noted that The Algebra Project requires teachers to re-evaluate the process of learning as well as the process of teaching.

Physics Ed Symposium

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teaching physics and reach out to potential physics majors. UTeach graduates also came back to retrain UT faculty, to the great benefit of their teaching.

When Tobias described the content of the book, *Science Teaching as a Profession: Why it Isn't, How it Could Be*, which she recently co-authored with science teacher Anne Baffert, she pointed out that, in contrast with UTeach, she was focusing on the "sink" rather than the "source" of science teachers. Tobias began by observing that new elementary teachers often leave their positions after three years but then return about four years later, after they have started their own families. But when high school science teachers leave, she said, they don't come back, and she reported that Ken Futernick found that half the science teachers he interviewed were contemplating this.

Tobias reported that teachers she interviewed in Tucson complained about the deprofessionalization of science teaching and urged investigating the linkage between teacher satisfaction and student performance. This led her and Baffert to set up a website to conduct "listening tours," seeking to find what was needed for voices of science teachers to be heard.

Tobias said that she focused on science teachers because of the special nature of their subject matter and skills, responsibilities (for setting up laboratory equipment), and ability to get jobs in industry. What she and Baffert learned in their listening tours related to issues of responsibility, balance, and control, rather than salary. Many of their responsibilities, the science teachers felt, had been shifted to administrators. They regarded NCLB (No Child Left Behind) as a "distraction" and longed for connection with professional scientists. They wanted "*profession* development" more than "professional development" (a distinction Tobias said she learned from Shirley Malcom of the American Association for the Advancement of Science) – in both their *pre*-service as well as *in*-service. Because the economy will not allow teacher salaries to increase, Tobias felt that the perks noted in her research will be all the more important in increasing job satisfaction among science teachers.

Tobias closed by advertising for sale bumper stickers saying "No Teacher Left Behind" for $1 each. She also announced that her book will be published on 15 March 2010 by the NSTA Press for $19.95, after which time the free pdf previously accessible at <http://www.rescorp.org> would no longer be available. (*Science Teaching as a Profession* is reviewed in this issue of the *Newsletter*.)

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The Science of Magic

by Betty Chan
Biology Correspondent

I am always amazed by the responses I get whenever I tell people what I do for a living (a scientist working on developing new therapies for schizophrenia). Mostly, people start to tell me stories about a family member or friend who suffers from this condition. Although acutely aware that schizophrenia affects 2-3 million individuals in the US, hearing those personal stories about their loved ones' struggles with the disease brings about a sense of urgency to our work. There is one particular story that I must recount. During a recent cab ride to the airport, the driver inquired what my occupation was. Then, while looking at me via the rearview mirror and swerving all over the road, she told me about a man she was in love with a long time ago. He was, apparently, a wonderful gentleman, but he had 5 distinct personalities. Only 3 of them loved her back, and the relationship had to end. It was a sad story, although I was glad to arrive at my destination in one piece.

There is no question that psychiatric diseases are notoriously difficult to treat. They are often misdiagnosed, and current treatments alleviate some symptoms but have unwanted side effects. Although, much work has been carried out, understanding how the central nervous system functions is extremely challenging, and consequently, their diseases are difficult to treat. There is still much research that needs to be done in order to understand the brain and the processes that occur during its normal (and abnormal) functions. With this mind, I was really looking forward to attending the Neuroscience conference in Chicago 17-21 October 2009. This was an annual conference organized by the Society of Neuroscience, and it's a huge meeting where more than 30,500 neuroscientists and medical doctors gather to discuss and learn about the latest research in this field. This year was also the 40th anniversary of the society, which includes about 40,000 members around the world, a comforting relief that so many people are dedicated to understanding neuroscience.

The conference is so large that multiple sessions occur simultaneously, and I am often faced with tough decisions choosing which ones I wanted to attend. One of the sessions that I did go to was titled "Magic, the Brain, and the Mind," and the speakers were Apollo Robbins and Eric Mead. These are two renowned magicians, who were present to tell neuroscientists how they manipulate brains as a professional career. Dr. Tom Carew, current

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Rogoff and Ward grab attention with magic

On 20 November 2009 Jay Rogoff and Chris Ward showed the Physics and Chemistry Teachers Clubs of New York that they are not only excellent science teachers but also extraordinary magicians. Rogoff started things off by giving us an impression that we were going to see a chemistry demonstration by lighting a torch. But in just an instant he corrected any misimpressions we might have had. Rogoff transformed his torch into a wand and proclaimed that it would, indeed, be an evening of magic.

Ward then came in to describe what he called the psychology of magic; it also might be considered rules of etiquette among magicians, and he asked us to abide by them as well:

1) Don't perform at another performer's event.
2) Don't give away secrets by telling or giving a bad performance.
3) Don't touch another magician's equipment.

If you want to become a magician, Ward said, get a mentor – and both he and Rogoff offered their services. And if you use magic to teach science, he added, have your students deconstruct the trick rather than give it away.

In more of the vein of psychology of magic, Ward pointed out that magicians can get you *not* to see *one* thing by asking you to *focus* on *something else*, and he illustrated this by showing the by now familiar video of people, half dressed in white, half in black, passing basketballs. By asking us to count the number of passes among the players dressed in white, he was able to keep us from noticing the gorilla that entered and left the scene.

Rogoff then showed some magic based on chemistry, by claiming to transform the ancient elements of air and water into earth. He also transformed some water into air, with the aid of sodium polyacrylate, and he demonstrated that a cousin of sodium polyacrylate reacts with water to make fake snow.

Next it was the trick of writing one's initials on a sugar cube with a pencil, then placing the sugar cube in water (Rogoff said any liquid would work) and one's hand over the container, only to find the initials reappearing on one's hand. Rogoff presented this in the context of nonpolar solutes not dissolving in polar solvents, with

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The Science of Magic

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president of the Society for Neuroscience, did the introductions.

Eric Mead, a practicing magician for 20 years and who had his first performance at the age of 9, spoke first. He talked about memories and how they're made. He invited a participant from the audience. I often wonder whether the performer plants someone in the audience for these demonstrations, but this person seemed to be a legitimate researcher. Mr. Mead told her she'd be the star of the show and then asked her to remember 5 geometric shapes (and explained that an average person is able to store 7 items plus/minus 2 in his/her short term memory). Then he had the participant close her eyes and visualize a beach with an "X" drawn on the sand, sailboat with bright red sails and little houses in the background, and the sun shining in the sky. Then Mr. Mead snapped his fingers and asked the participant to recall the shapes. She was able to recall 4 shapes: X (on the sand), triangle (sailboat), square (houses), and sun (circle). She forgot the star, but as Mr. Mead said earlier, she was still the "star" of the show.

There was nothing scientific about the demonstration, and Mr. Mead explained that it was just to make a point about how memory works. A magician manipulates the way one remembers things. Mr. Mead presented an example: let's say a magician wants to get something out of his/her pocket, which itself is a purposeful act that the audience can easily remember. A beginner (or a not very good magician) would use distraction to trick the audience into not seeing the act. A more experienced one would manipulate the audience's memory by applying symmetry (putting both hands in his/her pocket at the same time) several times. This is to condition the audience, leading them to believe the hand movements are part of the show and therefore not place any importance. An advanced magician may say "I need a rubber band" to make it seem unimportant and not memorable.

The next speaker, Apollo Robbins, is also known as "the Gentleman Thief" because of the non-intrusive way of handling his participants while he pick-pockets them. He made national news when he pick-pocketed the Secret Service and withdrew watches, wallets, and a confidential presidential itinerary. At the talk, Mr. Robbins invited an audience participant, who apparently knew of this magician's credentials because he stood with both hands in his pockets. Mr. Robbins did a series of coin tricks and ended up removing the participant's cell phone and watch, and we were all further impressed when Mr. Robbins showed off the participant's watch on his own wrist! To perform this feat, Mr. Robbins explains that he controls the participant's attention using diversion. There are several ways to divert one's attention. One method is to use distraction, which relaxes the focus (participant is no longer standing with both hands in his pocket). A second way is to use personal space (breaking eye contact divides one's attention). Another way is to create movement that draws the eye. For example, drawing a half moon in the air creates several points of interest instead of drawing a straight line. Lastly, making dialogue with the person suppresses his/her senses. Mr. Robbins appearance on stage was rather brief, but he did pull out a wallet from his pocket and return it to its owner, Dr. Carew, before leaving the stage.

Rogoff and Ward

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water being polar and graphite (from the pencil) being nonpolar.

After than came rope tricks, which Rogoff found to be analogous to single, double, and triple bonds; and, when Rogoff transformed the three ropes of unequal length to three ropes of equal length, he called it "hybridization." This he followed with a rope and ring trick and a coin and Coke bottle trick. Rogoff's final tricks illustrated electromagnetism: He had a volunteer charge his hand by rubbing it so that it could raise a dollar bill in his other hand, and he showed that a suspended dollar bill was attracted to a neodymium magnet – he said that the ink contains enough iron to do this.

In addition to closing with some card tricks, Ward also shared a few tricks of the trade. One is called the "French drop," in which the magician pretends to place an object in his left hand with his right hand and holds up his left hand to distract observers while dropping the object (still in his right hand) into his pocket, then being able to show the disappearance of the object. Ward also pointed out that picking up chalk to write on the board allows for easy switching between "happy" and "sad" balls to illustrate how a "happy" ball made good on its guarantee of a million bounces but not a single one more. He then showed us the website he had created for us to learn about the techniques he had employed, by setting up a magic group on VITAL. The directions he supplied were very straightforward: Go on the web to <www.thirteen.org> and click on "Education," then on "Video Resources" to get the VITAL page. After completing the registration procedure, click on "My Groups" and sign up for group 5862. There you will find recoed You Tube videos, with annotations provided by Ward.

Shea reports NYC sustainability initiatives

John Shea is the CEO of the Division of School Facilities (DSF) for the New York City (NYC) Department of Education (DOE), the City's largest government agency. The mission of his Division is "providing a safe, comfortable, and clean setting that is conducive to the education and nurturing of our students in the most economic and efficient manner possible." It employs a skilled trades staff of approximately 600, plus 947 custodian engineers, 85 building managers, and about 250 administrative/ technical staff to oversee approximately 130 million square feet of floor space in over 1200 separate buildings throughout the City.

In the course of fulfilling its mission, DSF seeks to incorporate sustainable measures into the operation of its buildings, according to Jaimie Cloud's definition:

> Sustainability is a dynamic condition which requires a basic understanding of the interconnections and interdependency among ecological, economic and social systems. Sustainability means providing a rich quality of life for all, and accomplishing this within the means of nature.

The journey to sustainability is a process, Shea said, in speaking to the Physics and Chemistry Teachers Clubs of New York at New York University on 25 September 2009 about "Sustainability Initiatives of the NYC DOE," and it involves many stakeholders, the most important of which are children.

All new school buildings, Shea continued, are built to DOE Design and Construction rules. Sustainable measures are included in these rules because of Mayor Bloomberg's PlaNYC (reported in our Spring 2008 issue), a strategy to reduce NYC government's carbon emissions by 2017 to be 30 percent less than in 2006 and citywide emissions to be lower by the same percentage by 2030. NYC, Shea was proud to state, is the first public school system to join the Green Schools Alliance.

One goal of DSF is to enable students to learn how buildings operate so that they can play a greater role in the journey toward sustainability. One consequence of this is that Recycling Coordinators must come from the ranks of teachers rather than custodians. And because they are coordinating more than recycling, Recycling Coordinators have been renamed Sustainability Coordinators.

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NYAS hosts OPV symposium

"Soft Materials: The Future of Solar" was the topic of a symposium at the New York Academy of Sciences on 14 January 2010. The "soft materials" in question were organic photovoltaics (OPVs), whose structure consists of an acceptor and donor sandwiched between two electrodes. The first phase of the operation of an OPV is absorption of light, which leads to the excitation of an electron from the highest occupied molecular level (HOMO) to the lowest unoccupied molecular level (LUMO), leaving a "hole" behind in the HOMO. This combination of excited electron and hole is called an *exciton*, which then diffuses toward the junction between the acceptor and donor, at which point the electron goes to the acceptor, while the hole migrates in the opposite direction in the donor. The OPV generates its photocurrent when the electron is collected at the cathode and the hole at the anode.

The first of two keynote speakers at the symposium was Stephen Forrest of the University of Michigan, speaking on "Nanoscale Bulk Heterojunction Solar Cells by Vapor Phase and Solution Processing." Forrest began by observing that the biggest hindrance to developing solar energy is the continued discovery of fossil fuel reserves (which lowers their price and makes solar energy less competitive with them). But, he went on, the biggest reason to develop solar photovoltaic energy is to avoid greenhouse gas emissions ("the cheapest way to reduce carbon emissions is to leave the carbon in the ground," he said) and the importance of generating electricity for *all* people throughout the world. At 0.1%, solar photovoltaics are behind hydro and biomass (at 1% each) and wind (0.5%) worldwide, he added.

Forrest pointed out that his photovoltaic interest lies in organic photovoltaics because their lower cost enabled them to be more economically competitive with fossil fuels. He observed that absorption generates excitons in heterojunction cells (in which the donor and acceptor are mixed together) with efficiencies greater than 50%. His goal is to create bulk heterojunctions and to expand crystallinity over a wide range in order to enhance exciton transport (his reference to diffusion, which is the key to the efficiency of an OPV). This, Forrest said, requires large grain size in the crystals.

The only suitable organic material available, according to Forrest, is the OLED (optical light emitting diode) used in large flat screen displays, which is presently very expensive. Therefore, he is making his own organic crystals of phthallocyanine by vapor phase deposition. He

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OPV symposium

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also reported making bulk heterojunctions by oblique angle deposition and found the greatest efficiency at 60 degrees. The efficiencies of 2% he is achieving right now are no match for silicon's 24%, he conceded, and his present costs still exceed those for silicon. But he was determined to continue his research. Having assembled his organic crystals onto a potassium bromide substrate, his next step is to assemble them onto glass. Forrest observed that all materials being used in photovoltaic systems today are experimental and that the more efficient a solar cell is, the shorter its lifetime, because it is carrying more current.

The second keynoter was Gilles Dennier of Konarka Technologies, speaking on "Future Challenges for the Industry of Organic Photovoltaics." Dennier began by observing that the world energy supply almost doubled between 1971 and 2007 and that during that time electricity generation had multiplied by 3.2, thus increasing at a 60% greater rate than actual energy supply. He continued observing that photovoltaic production is increasing rapidly in time, though there may be a 2009 slowdown due to the economy, with Chinese production doubling every year and currently producing 7000 megawatts per year.

The total installed photovoltaic capacity worldwide, Dennier said, is near 14,000 megawatts. He also noted that the photovoltaic market, which began in Germany right after World War I, is driven largely by political considerations, such as government subsidies, and that human activity in mid-Europe parallels photovoltaic generation during the day. As efficiencies of semiconductor photovoltaic cells have grown in time, Dennier went on, so also have the efficiencies of organic photovoltaics grown, increasing at 5% per decade since their beginning in 1999. More importantly, he said, organics allow much greater flexibility for chemists to achieve bandgaps of desired design. Konarka's business goal is to print OPVs onto plastics.

Konarka is using a former Polaroid production line in New Bedford, MA, to make two-watt solar bags, which can be used to energize cell phones and portable audio devices. Rolls of OPVs can be mounted on shading elements and are now mounted on San Francisco bus shelters. Tests of Konarka's materials have now passed 1000 hours at 65^{o}C, the basis for providing a three-year guarantee. In contrast with silicon, the efficiencies of Konarka's OPVs increase with temperature. In addition, Dennier reported, they also have a lower energy payback time and a lower carbon footprint.

Prior to the two symposium keynote speakers, the symposium heard two reports by local graduate students.

NYC sustainability

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The technical side of the journey to sustainability involves the Green School Guide, changing the energy budget structure, energy audits, powering down computers at night, intelligent metering, green roofs, and renewable energy. The Environmental Protection Agency's Portfolio Manager software is being used to diagnose a building's energy consumption and identifies opportunities for improvement. Incandescent light bulbs have been replaced by compact fluorescents, and windows have been replaced by more efficient glazing. Ten percent of the City's energy budget is allocated to energy conservation projects, in addition to money from Federal Energy Efficiency and Conservation Block Grants.

On the educational side, Shea saw the need to develop curricula on sustainability. He added that he has been happy to see many schools insert a reference to "green" or "sustainable" into their names.

Andrew Mutter of City University of New York spoke about his goal to make photocells from proteins, taking advantage of the discrete energy levels that result when proteins are separated into their helical bundle backbones. And Athanasios Bourtsalas of Columbia University spoke of his work with "nantennas," nano-rectennas, which stimulate electrons to oscillate with the frequency of incoming light. They have a theoretical efficiency greater than 85%, he reported, can absorb light of any frequency, and their cost is less than that of silicon photovoltaics, he said, but present technology does not exist to scale them up.

Energy Future

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It would require 140,000 workers, 100,000 turbines, an investment of $100 billion, and reduce annual carbon dioxide emissions by 800 megatons. The Panel considers this scenario to be doable but indicates that transmitting all this electricity may be problematic.

A common theme at the end of all the reports cited is acknowledgment of the barriers, some political and some technological, that "are likely to delay or even prevent the accelerated deployment of the energy-supply and end-use technologies described in this report," as described in the eighth Key Finding of *America's Energy Future*. "Policy and regulatory actions, as well as other incentives," it goes on, "will be required to overcome these barriers."

Looking and Listening for the Electric Car

by John D. White, Technology Correspondent

Over a century ago, electric cars were silent and odorless. They still are. To protect blind pedestrians, lawmakers now consider requiring noisemakers similar to truck backup signals to beep while electrics move forward at low speeds. For once, they are anticipating problems of the next generation of cars. Steam engines powered 19th century sea and land transportation. Diesel-, kerosene-, and gasoline-based vehicles dominated the next 100 years in the air as well. As trains did long ago, 21st century automobiles appear to be shifting to electric power. In 1900 there was doubt about [1] whether to build a network of roads and gas stations without enough cars to justify it, or [2] whether investors should bother to build a fleet of cars until this infrastructure was in place. The classic question of "Which came first, the chicken or the egg?" was sidestepped in this case. The roads and cars grew together. Now the same question about the next generation of cars has been answered with electric cars. The network for them is already in place with power lines and gas stations already in service.

Modern locomotives employ electric traction motors powered either by onboard diesel-fired generators or contacts to high-voltage power near the tracks. In contrast to trains, the next decades of automobiles seem destined to run with *onboard* electric battery power. The purer versions rely on batteries alone, while the hybrids use batteries supplemented by small internal combustion engines. The latter may run on diesel oil, gasoline, alcohol, compressed natural gas (CNG), liquefied natural gas such as propane or butane (LNG), or a variable mixture of fuels. To the present, hybrid car producers have been reluctant to equip their cars for external charging at home or at such public sites as schools, mall parking lots, or train stations.

The near-term market has emerged for hybrids and battery-driven pure electrics because of high gasoline prices and lack of infrastructure for alternative fuels. There exists neither a distribution network for alternative fuels such as CNG or LNG, nor for a quick exchange with charged batteries for a fee. A pilot effort to provide such replacement batteries in a hurry is planned for tiny Israel soon. Success there might not be reproducible elsewhere except in urban areas. Current battery technology precludes a charging time equal to refilling a gasoline tank.

Even though next-generation quiet, "clean" diesels have sold fairly well in Europe, with low-sulfur diesel now costing more per gallon than gasoline in the US, no such car market has developed here. Prospective buyers of the pricey new diesel autos probably would dislike refueling amid fleets of large trucks. Demand for petroleum dropped with the worldwide recession beginning in 2008. Even though no refineries have been built in the United States for decades, existing capacity has exceeded demand in this country for months. However, foreign suppliers of petroleum have curtailed exports enough to maintain artificially high prices, just as they have done since the creation of OPEC in the 1970s. Airlines have been bankrupted or at least staggered by fuel costs, while most automobile makers faced poor sales of their most profitable, *i.e.,* fuel-thirsty, models. Europeans have long expected very high after-tax gasoline prices, but Americans, who also drive greater distances, at last seem ready to purchase vehicles that cost far less to drive. We may be entering the post-Hummer era.

"All-electric" means lacking a supplementary engine. The Tesla luxury sports car and the BMW Mini E Cooper contrast sharply in price but both offer silent, quick performance. Lithium-ion batteries make possible increased range and acceleration compared with older, heavier, lead-acid storage. Some entrepreneurs in California have begun retro-fitting hybrids so owners can charge batteries fully at home in about eight hours with 220-volt AC lines or about double that time with 110-volt only. With technology similar to parking meters, commercial charger services in business zones could provide workday top-offs at a profit and still give equivalent motive power at half the price of gasoline, according to advocates.

Toyota's Prius and Ford's Escape and Fusion hybrids have dominated North American sales to late 2009, but face competition from Chrysler, General Motors, Mazda, Mercedes, and Nissan models within the next year or two. With so many US and Canadian households owning two or more cars, one can envision a quick transition to owning an electric economy model for local driving only and recharging it once or twice a week in the garage or driveway. The other vehicle, a gasoline-only SUV or minivan, would serve less often, being reserved for vacation travel, towing a boat, hauling large loads, or transporting the Little League team to a picnic.

A friend recently insisted I take a brief look at her Mini E Cooper. The space between seat and trunk sacrificed to hold the batteries was smaller than I had expected. The gas filler door carried a warning not to try to pump any fuel. In place of a hole for gasoline, a socket waited for the supplied heavy-duty cord to connect at home to a power outlet. I was impressed by its appealing body reminiscent of a charming little British Mini of earlier decades. Turning to walk to my car, I was startled to realize the cute little yellow vehicle had already moved halfway past me toward the main street without making

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Electric Car

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any sound that I could hear, even though I was just inches away.

The first excerpt below appeared over a year ago and described this car I saw in January 2010, and the second excerpt hints at what we may expect very soon from the same chassis.

> Jan. 5 [2009] (Bloomberg) — BMW is signing up green-minded drivers to test an all-electric Mini Cooper with two seats, just enough storage space for a gym bag, and a range of only 120 miles before recharging, all for triple the cost of the gasoline-powered model. BMW's Mini Cooper, almost four feet shorter than a Toyota Camry, becomes electric by sacrificing its back seat to fit a 570-pound (260-kilogram) battery. What the Mini E lacks in comfort and range it may pick up in cute and cool points. The noise-free engine goes from zero to 60 in 8.5 seconds, more than enough muscle to compete in Manhattan traffic on a recent test drive. <http://www.bloomberg.com/apps/news?pid=20601100&sid=alRDfve6had0&refer=germany>

> The PML Mini QED has a top speed of 150 mph, a 0-60 mph time of 4.5 seconds. The car uses a small gasoline engine with four 160 horsepower electric motors — one on each wheel. The car has been designed to run for four hours of combined urban/extra urban driving, powered only by a battery and bank of ultra capacitors. The QED supports an all-electric range of 200-250 miles and has a total range of about 932 miles (1,500 km). For longer journeys at higher speeds, a small conventional internal combustion engine (ICE) is used to re-charge the battery. In this hybrid mode, fuel economies of up to 80 mpg can be achieved. <http://www.treehugger.com/files/2006/08/the_hybrid_mini.php>

While the lithium-ion battery may relieve us from high oil prices, it may present a different problem instead. Most lithium comes from shallow deposits in salt beds of Chile, Argentina, and China. News in recent weeks revealed that foreign conglomerates are negotiating deals to produce the metal from a high-altitude desert in the remotest parts of Bolivia. At least half the world's known deposits of lithium lie there in the huge salt flats of Uyuni, Coipasa, and Pastos Grandes. Since the 1500s, foreigners, aided by compliant governments, grew rich cruelly exploiting Indian miners of silver and tin. Angry voters in 2006 chose the current socialist administration of popular indigenous hero Evo Morales. He is certain to demand far higher lithium prices and better treatment for Bolivians. With the example of OPEC, can O**L**EC be far behind? (See *Latin American Herald Tribune* article: <http://www.laht.com/article.asp?ArticleId=350488&CategoryId=14919>)

Physics Ed Symposium

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Vokos reported on the report of the National Task Force on Teacher Education in Physics (T-TEP), which he chaired, under the auspices of the Physics Teacher Education Coalition (PTEC). There are 23,000 physics teachers in the U.S., Vokos said, but of the 1200 new teachers needed each year only 400 have a physics major or minor. Meanwhile, physics enrollment is growing.

Vokos explained that the charge to T-TEP was to identify best practices in preparing physics teachers and how the number of prepared physics teachers could be increased. Data were collected by mail and visits to teacher preparation institutions. They found the following results:

1) Less than a quarter of physics departments and education schools have recent physics teacher graduates.
2) All of the most active physics teacher programs have local champions, with little support from their institutions.
3) Institutional context figures significantly in the engagement of physics departments in physics teacher education.
4) Few institutions have strong collaboration between physics departments and schools of education.
5) Programs do little to develop physics-specific pedagogical expertise of teachers.
6) Few programs provide follow-up support for new physics teachers.
7) Few programs provide coherent professional development for in-service teachers.

But, Vokos rejoined, in spite of the dismal nature of many of T-TEP's findings, that many programs had *some* of the elements of a good program.

T-TEP made 13 recommendations – four of them related to commitment, six to quality, and three to capacity. Many of their recommendations urge many of the institutions involved with teacher preparation – physics departments, colleges of education, school districts and systems – to recognize and act on their joint responsibilities for physics teacher preparation. "Whatever is good for teachers is good for physics majors," Vokos concluded.

The synopsis of the T-TEP Report is available online at <http://www.ptec.org/taskforce>.

"Filtering the Green Noise"

Tim Razzaq is the Founder and CEO of BOOST (Building Open Opportunity Structures Together). To further the mission of his organization, Razzaq convened a symposium on "Filtering the Green Noise" in Princeton, NJ, on 17 October 2009. To do this, he invited five SMEs (subject matter experts) to comprise a panel: 1) Jeana Wirtenberg, President and CEO of Transitioning to Green™ and editor of *The Sustainable Enterprise Fieldbook*; 2) Alex Argento, Vice President of PuraTerra; 3) Anastasia Harrison, Principal of Eco Solutions NJ; 4) Ira Eisenstein of Strictly Business; and 5) Kyle Van Dyke, architect of KVD Studio.

Razzaq opened the symposium by stating that "No one knows all the answers" while adding that "Everyone is a stakeholder." "Sustainability is all about diversity, and it's also about synergy," he continued. He added that BOOST is creating a website to list green jobs.

The panel began with brief presentations to impart the scope of their expertise, then fielded questions from those in attendance. Wirtenberg cited her background in psychology, which she now applies to transitioning people to jobs in the green economy (from today's present "gray" economy). To this end, she has identified 625 new occupational titles in the green economy in eight categories. Making the transition to the green economy requires imaginative thinking that doesn't hang on to the past, she said. Wirtenberg listed the seven following characterizations of sustainable enterprises: 1) a long-term, collaborative, holistic, systems-oriented mindset; 2) pursuit of a triple bottom line (people and the planet as well as profit); 3) generation and regeneration of five capital stocks (human, social, natural, manufactured, and economic); 4) sound ethics and governance; 5) transparency and accountability; 6) provision for stakeholder opportunity to participate in decision-making; and 7) influence to promote meaningful change for everyone.

Argento listed two aspects of materials he deals with: 1) materials for solar heating, and 2) salvage materials (materials that are "waste" from one home remodeling project can be used for another such project). He noted that he also works with manufacturers who recycle materials and recommends Thomas Friedman's *Hot, Crowded, and Flat*.

Noting that we face a large number of products claiming to be "green," Harrison emphasized the importance of understanding the information on their labels. Only in this way can we make the best decisions regarding green

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Green Applies 'Backward Learning' to Chemistry

In the academic study of the arts, the principles necessary to create a work of art such as a painting or a poem or a musical composition are discovered by studying the completed work. In this way the student encounters the beauty arising from the use of these principles at the very beginning, with the pleasure of this encounter stimulating the desire to understand what stands behind such an accomplishment. The method of learning of the arts is close to how we learn outside of the academic world, how a child learns from the start. We don't learn the alphabet before we hear people speaking. We don't learn the colors or the shapes of common objects before seeing the world around us. The wonders of sound and shape and color intrigue us and stimulate our desire to figure out what is going on and what it all means.

Professor Mark M. Green of Polytechnic Institute of New York University wrote this in the preface to *Learning the Fundamentals of Organic Chemistry Backwards: A Story Telling Historical Approach*, which he described at the 23 October 2009 meeting of the Physics and Chemistry Teachers Clubs of New York. This approach, he pointed out, has two points of emphasis: 1) to show the full complexity of the systems to be studied at the outset, and 2) to explain the historical evolution of our present understanding. For his first example to illustrate this approach, Green began with the first chapter of his book, "From Cellulose and Starch to the Principles of Structures and Stereochemistry." He starts out with diagrams of starch and cellulose in abbreviated notation, something he said is usually not gotten to until page 950 in a conventional organic chemistry textbook. He then uses this as a basis for teaching about molecular structure, tetrahedral bonding of carbon, isomers, and the experimental basis for understanding these topics. He showed a slide of 17 chemists and explained how each contributed to our present understanding of structures in organic chemistry.

Green went on to say that his second chapter, "From Galactosemia to the Properties of Six-Membered Rings – An Introduction to the Mechanisms of Chemical Reactions" – continues the theme of structure, this time within the context of galactosemia, a disease whereby galactose from lactose in mother's milk poisons infants. For the historical basis of this understanding, another 11 chemists were cited. Next he poited out that his third chapter – "Carbocations: From the Synthesis of High Octane Gasoline to the In Vivo Production of Terpenes" – recounts improvements in the structure of gasoline which helped the British against the Germans in the Battle of

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'Backward Learning' Chemistry

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Britain. Here he cited the contributions of 16 more contributing chemists and pointed out that the chemistry involved here is the same as that by which the body makes cholesterol and, thence, sex hormones.

Chapter 4 – "Aromatics: a Word That Came to Mean Something Other Than Odor in the Chemical Sciences" – recounts Faraday's determination of the formula of benzene and Kekulé's determination of the structure of benzene. Here Green cited 14 more scientists responsible for the historical development, one of them, Hűckel, who was not promoted because he was a physicist working on chemistry. Chapter 5 – "Catabolism, Anabolism, Metabolism, Carbanions and Carbonyl Chemistry: Fatty Acids, Glucose, and the Citric Acid Cycle" – discusses the structure of fats and their metabolism, also the Krebs cycle, and 15 more chemists are cited. The last chapter he has written so far – "A Great Deal Can Be Learned About Organic Chemistry From the Study of Polymers and the Monomers from Which They are Made" – starts with the discovery of polyethylene. The chemistry of branching which follows, Green said, is the same as that for making birth control pills. He cited the work of 12 chemists in the historical evolution of the chemistry of this chapter. He added that he has two more chapters to write – on "Classic Synthesis" and "Elastomers."

In closing, Green recounted the change in the teaching of organic chemistry when Morrison and Boyd first published their seminal text on the subject, which introduced mechanisms along with the descriptive chemistry which had previously been the mainstay of the subject. He feels that the teaching of organic chemistry is now at a point of needing another new approach, and he hopes that his will be the one. He noted that veterans of his course at Polytechnic have had an easier time in taking their MCATs.

Searches for Habitable Planets

The Kepler satellite – in heliocentric orbit – started making observations on 1 May 2009. It will continue to monitor over 100,000 stars for three and a half years, precisely enough to idenetify transits of orbiting planets. William J. Borucki of the NASA Ames Research Center reported on the first 43 days of observations at the Joint Meeting of the American Association of Physics Teachers (AAPT) and the American Physical Society (APS) in Washington, DC, on 16 February 2010. Although the goal of the Kepler mission is to identify Earth-size planets, only one of the five exoplanets that Borucki reported was smaller than Jupiter. Moreover, they all had orbital periods of single digits numbers of days and were closer to their stars than what we would regard as the "habitable zone." Borucki also reported that at least three transits are needed to confirm orbital periodicity.

Later the same day Alan Boss of the Carnegie Institution reported on the search by NASA's Space Interferometry Mission for Earthlike planets by observing the wobble in signals from stars. Boss reported that the spectra of exoplanets indicate the presence of carbon dioxide, water, and methane.

"Filtering the Green Noise"

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products, she said; and, given that information, not everyone will make the same decision. When pressed by a questioner on her advice in reading labels, she responded, "If it contains ten ingredients with more than three-syllable words, put it back on the shelf." Her advice elsewhere in the symposium was in "using" energy, "slow and steady wins the race" – "don't spike your use of energy."

Ira Eisenstein spoke about his experience in dealing with energy issues and conducting inspections. He felt that for every situation and budget there was an optimal solution. For those unable to afford double glazed windows, he suggested the alternative of storm windows. He advocated window air conditioners and electric heaters to provide local supplemental cooling and heating that is less expensive than comparable cooling and heating of an entire house. In response to concern about the mercury contained in fluorescent lighting, Eisenstein stated that Home depot and Lowe's will accept fluorescent bulbs for disposal and that Radio Shack will accept their batteries for recycling.

Last on the panel was Van Dyck, whose skepticism about the word "green" gave rise to the title of the symposium. Rather than "green," Van Dyck said, he looks for solutions that are clear, simple, fresh, healthy, and sustainable. Sustainability, he added, requires processes rather than prescriptions.

At the end of the symposium, Wirtenberg, who served as technical editor for Carol McClelland's forthcoming *Green Careers for Dummies*(Wiley,2010), said that the American Management Association's *Creating a Sustainable Future: A Global Study of Trends 2007-2017* (2007) envisioned three future scenarios for planet Earth: 1) everyone gives up, and humans become extinct; 2) people muddle toward sustainability, but they are too concerned about themselves and don't look enough at the big picture; 3) people adopt a global-minded sustainability mindset. Only the third is viable, she observed, and she encouraged us to collaborate to achieve it.

Ferguson speaks on Nuclear Issues

The Federation of American Scientists was born after World War II to give scientists from the Manhattan Project a forum in which to express their ethical concerns about nuclear issues. The Federation's current president, Charles Ferguson, carries on this tradition, as can be seen from his appearances at the Joint Meeting of the American Association of Physics Teachers (AAPT) and the American Physical Society (APS) in Washington, DC in February 2010.

On 15 February, Ferguson described a project on which he is working with Frank Settle of Washington and Lee University and Mary Spruill of National Energy Education Development (NEED) to educate policy makers, students, and the general public about energy issues, with funding by the Lenfest and Richard Lounsbery Foundations. Their products include publications, workshops, a multimedia website at <www.cfr.org>, and an addition to Settle's Alsos web database at <alsos.wlu.edu>. The publications include *Nuclear Energy: Balancing Benefits and Risks* (2007), an article in the Jan/Feb 2009 issue of *Foreign Policy*, and Ferguson's forthcoming book, *Nuclear Energy: What Everyone Needs to Know* (Oxford University Press, 2010).

Ferguson added that he doesn't see a "nuclear renaissance" in the sense that nuclear energy will make a dent in fossil fuel consumption. Because current nuclear plants will soon be retired in large numbers, it will be a challenge to replace them and build new plants to keep up with increased energy demand to maintain the same percentage of U.S. energy from nuclear.

The next day, at a session on Physics and Society Education, Ferguson spoke about nuclear terrorism from his "Perspective from a Policy Physicist." Ferguson reported that right after the terrorist attacks of 11 September 2001, he was ordered to draft a letter to Secretary of State Colin Powell about use of a "dirty" bomb. However, he maintained that radiological dispersal devices are weapons of mass *disruption* but *not* of mass *destruction*. You need two million smoke detectors, he said, to make a radiological weapon that is portable, easily dispersed, or highly radioactive.

Moreover, he went on, there are only about 14 common radioactive isotopes whose half lives lend themselves to making an effective radiological weapon – those with half-life ranging from days up to a thousand years. Isotopes with short half-lives emit all their radiation in a short period of time. Isotopes with long half-lives emit their radiation at too slow a rate to be of concern.

When it comes to development nuclear weapons, because it is easier to make a "gun"-type weapon from enriched uranium, like that dropped on Hiroshima without even being tested beforehand, as opposed to a plutonium weapon requiring spherical implosion, Ferguson urged being on guard against highly-enriched uranium. Separating the first 3% of uranium-235 from the more abundant (but unfissionable) uranium-238, Ferguson said, was the hardest (in terms of separative work units required), so Iran's claim to enrich uranium to 20% is not a big achievement over what they already have. Ferguson also said that a uranium "gun" device can be made with uranium enriched to the level of 80% uranium-235.

FORTHCOMING SCIENCE & SOCIETY EDUCATION MEETINGS

27-29 Apr 2010, World Nuclear Fuel Cycle 2010, Munich, Germany, sponsored by the World Nuclear Association, Carlton House, 22a St. James's Square, London, England SW1Y 4JH, <www.world-nuclear.org>.

27-30 Apr 2010, Bill & Melinda Gates Foundation presents World Conference on HIV/AIDS Stigmatization, Living Hotels Auditorium, Aberdeen, Scotland. This conference will bring together 1,705 representatives of NGOs/CBOs and numerous numbers of interested individual participants from all over the world. The conference will be conducted on participatory bases with satellite plenary and simultaneous sessions followed by general and small group discussions. For purpose of registration to participate in this Conference, leave a return email at: (secretariat@bill-melindagatesfoundation.org).

10-12 May 2010, Energy Efficiency Global 2010, Washington DC, Convention Center, hosted by the Alliance to Save Energy. For information, contact Mindy Berman at <mberman@ase.org>, (310)-915-5947. To register, visit <http://eeglobalforum.org/registration.html>.

27-30 Jun 2010, International Society for Technology in Education (ISTE) annual conference, Denver, CO. Visit <http://center.uoregon.edu/ISTE/2010/program/themes_and_strands.php>.

UNEP's *Compendium*

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has decreased, resulting in "a carbon cycle that is generating stronger-than-expected and sooner-than-expected climate forcing." (p. 8) This echoes the words of Achim Steiner, UNEP Executive Director, in the *Compendium*'s Preface, that, since the 2007 report by the Intergovernmental Panel on Climate Change (IPCC), "even more rapid environmental change is underway with the pace and the scale of climate change accelerating, along with the confidence among researchers in their forecasts," with "the Arctic . . . emerging as an area of major concern" – it could be "nearly" ice-free by September 2028 and "virtually" ice-free by September 2037. (p. iii)

An ice-free Arctic in September would mean crossing the third tipping point listed above, and this is only one of several climate changes which greenhouse gases already emitted have "committed us to," among them damage or destruction of coral reefs from acidification, sea-level rise, mountain glacier loss that will disrupt irrigation and hydroelectric systems, and hydrologic cycle changes and poleward shift of arid climate. How much the sea level will rise depends on the degree to which carbon dioxide becomes more abundant in our atmosphere. An increase to 600 ppm is expected to result in a sea-level rise between 0.4 m and 1.0 m, which an increase to 1000 ppm is expected to raise the level of the ocean by 1.9 m. In any case, "continuing carbon dioxide emissions in the future means further irreversible effects on the planet, with attendant long legacies for choices made by contemporary society." (p. 11) The irreversibility of these effects means that we cannot wait until "later" to deal with them.

Earth's Ice

This is the state of the Earth portrayed in the first section of the *Compendium*, titled "Earth Systems." The next three sections deal with three aspects of the Earth system – Ice, Oceans, and Ecosystems. The first of these sections divides "Earth's Ice" into three categories, comprising the following percentages of the total and leading to the following rise in sea level if completely melted:

It is the last category, comprising the smallest percentage, that is currently dominating sea-level rise; this category is also affecting people dependent on it for agriculture. The World Glacier Monitoring Service tracks 30 reference glaciers and has found their mean loss rate since 2000 to double that between 1980 and 1999, and this is believed to result from positive feedback mechanisms (such as albedo change) as well as climate forcing (measured in watts per square meter). At their current rate of shrinkage, from 1779 hectares in 1894 to 260 hectares in 2008, glaciers in the Spanish Pyrenees are expected to disappear by 2050. Retreat of Himalayan glaciers endangers feeding of the Indus, Ganges, and Brahmaputra Rivers in the long term and can lead to glacier lake outburst floods in the short term.

Although melting of ice in the Arctic Ocean does not increase sea level, it does reflect climate change. Arctic ice is retreating more rapidly than the 2007 IPCC report projected, with a greater percentage of it being more vulnerable fresh ice. This is attributed to variability in atmospheric and ocean circulation as well as radiative forcing and is the basis for Steiner's aforementioned predictions of when the Arctic Ocean would become ice-free in September. A September ice-free Arctic is expected to be followed by a year-round ice-free Arctic, and inland warming that will affect both infrastructure and ecosystems through thawing of permafrost.

Sea-level rise *does* result from transfer of land ice to the ocean – from either melted land ice flowing to the ocean or broken-off land ice sliding into the ocean, some believed to result from surface melt percolating down through the ice to form a lubricating layer on which the land ice can slide into the ocean, others believed to result from the disruption of termini of glaciers. The latter cause is believed responsible for the increased glacial melting in Greenland, up 60% over that in 1998 by 2007. Similarly, ice loss from West Antarctica increased 60% in the same decade, and in most parts of Antarctica, increased south polar temperature has led to a continued decrease in the ice mass over Antarctica and a corresponding increase in sea level. Moreover, since ozone is

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Category	Percentage	Sea-level rise if totally melted (m)
Antarctic sheet	87	57 m
Greenland sheet	12	8 m
Glaciers and ice caps	1	0.7 m

UNEP's *Compendium*

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a greenhouse gas, restoring stratospheric ozone over the poles will provide even greater warming and ice melt.

Earth's Oceans

The *Compendium* notes that climate change further stresses oceans that have already been wracked by overfishing and notes that the tendency of ocean layers not to mix gives the oceans a thermal inertia which delays the transmittal of warming temperatures. In addition to the aforementioned transfer of land ice to the ocean, sea-level rise also results from the expansion of warmed ocean water. The average sea-level rise in the 20th century was 1.7 mm per year, but the rate the last decade of the century was twice that. Prior to 1990, ocean thermal expansion caused more than half of sea-level rise, but glaciers, ice caps, and ice sheets have now dwarfed thermal expansion's contribution to only 15%. Although "the glacier and ice cap reservoir will be exhausted by 2200," (p. 27) they will still make a greater contribution than the ice sheets during the 21st century. According to the *Compendium*, the 2007 IPCC report underestimated sea-level rise at between 0.18 and 0.59 m by 2100, because of lack of consensus on dynamic ice changes, but the best estimate of sea-level rise in the 21st century from all sources, including dynamic ice changes, is between 0.80 and 2.00 m.

Earth's Ecosystems

Climate change has most negatively affected tropical coral reefs and amphibians. Polar and mountain species, living in a confined habitat, are most particularly vulnerable to extinction. Also affected are predator-prey and other interacting species relationships in which the two species have different responses to climate change.

A model plotting distributional ranges of 1066 marine species through 2050 predicts a species turnover of 60%. Ocean acidification from carbon dioxide absorption will interfere with growth and metabolism of marine species that form calcium carbonate structures. Research is under way to determine how sea-level rise and windstorm intensification affect marine ecosystems, particularly along coasts.

The temperature increase, sea-level rise, and melting of ice sheets that will occur even after greenhouse gas levels in the atmosphere are stabilized are known as the "climate change commitment" already alluded to in the first section of the *Compendium*. Modeling the habitat of about 3000 Western Hemisphere species with 30 future climate simulations leads to a 10% loss of vertebrate fauna and a 90% species change in tundra, Central America, and the Andes. Novel climates in the tropics are expected to affect 12 to 39% of the Earth's surface and to lead to new species, and disappearing climates in mountain and polar regions, comprising 10 to 48% of the Earth's surface, are expected to lead to species extinction. But rather than attempt to restore traditional ecosystems or remove undesirable features of new ecosystems in novel climates, UNEP recommends fostering genetic and species diversity.

The expected novel tropical climates come from an expanded tropical belt, and the subtropical dry zones are expected to shift poleward. Although it is not clear whether this will increase rainfall in the Sahel, as happened between 5000 and 9000 years ago, the Mediterranean basin is expected to become more arid, with "huge implications for agriculture" (p. 39) in the Iberian, Italian, Hellenic, and Turkish peninsulas. A similar change toward a more arid climate is also forecast for the southwestern U.S., and it may already be underway. Even the Amazon rainforest is expected to be adversely affected in the form of decreased rainfall in the dry season. On the other hand, increasing the Amazon rainforest biomass by only 0.4% suffices to offset the fossil fuel emissions of Western Europe.

Increased polar temperatures will bring even further climate change because permafrost soils in polar regions store large amounts of carbon, which will be released, either as carbon dioxide under aerobic conditions or methane under anaerobic conditions (and both are greenhouse gases). As temperatures have increased in mountainous regions, plant species have been found to shift their habitat to higher altitudes. Higher temperatures are also expected to increase the damage done by insects to these plant species, with resulting threats to both agriculture and human health.

Systems Management

The final section of the *Compendium* focuses on the management of ecosystems to cope with climate change. This, the *Compendium* says, requires switching to environmentally-sound energy sources, ending deforestation, and managing nature resources sustainably. Favorable mention is made of the 2007 report, "Confronting Climate Change: Avoiding the Unmanageable and Managing the Unavoidable," by the U.N. Foundation and Sigma Xi (reported in our Fall 2007 issue), and subsections of this section are named for the subtitle of this report.

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UNEP's *Compendium*

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The *Compendium* states that "innovative approaches in modeling and interdisciplinary analytical terms" are enabling "design management systems that may enable the use of possible mitigation and adaptation actions at various scales in response to the changing climate." (p. 44) One such strategy is *directed evolution*, whereby humans favor the survival of preferred species by facilitating their migration to new habitat for which they are suited. The Norwegian international seed repository in the Svalbard archipelago can help with this. Akin to this strategy is *assisted colonization*, but in either case one needs to guard against introducing pests that will disrupt existing ecosystems – ***e.g.***, don't mess with areas for grazing livestock.

A special need for adaptation is agriculture, which will eventually need to double the Earth's food production as its 15 million square kilometers of cropland and 35 million square kilometers of grazing land experience both climate change and soil degradation (already affecting 84% of cropland). One promising approach is using land to provide integrated ecosystem services: "clean air and water, rich soil, and biological diversity, as well as food." (p. 47) As increasing population decreases agricultural land per capita and the environmental consequences of 20th century agricultural achievements prove unsustainable, programs are needed to enhance the viability of small farmers; and, for the cause of food security, agriculture cannot spare any of its output for biofuel.

The 40 million square kilometers of forests, almost a third of Earth's land surface area, absorb 30% of the carbon dioxide added to the atmosphere from fossil fuel burning and deforestation (which is the source of 17% of all greenhouse gas emissions) and store more than twice the amount of carbon in the atmosphere. Carbon dioxide emissions can be further reduced by using forest products rather than building materials like concrete, which require high carbon dioxide emission for their production. Because of the cost effectiveness of forests in reducing carbon dioxide emissions, REDD (Reducing Emissions from Deforestation and forest Degradation) is expected to emerge as a key element of future climate change mitigation. Another technique to retain carbon from plants in soil even after their demise is "biochar," in which biomass is cooked anaerobically to produce charcoal which is retained in the soil to enrich it (with 70% more carbon). Such soil was made by pre-Columbian dwellers along the Amazon River; it is called *Terra Preta*, Portugese for dark earth.

In the final subsection, titled "Avoiding the Unmanageable," the *Compendium* cautions *twice* that "a switch to environmentally sound energy sources; a halt to rampant deforestation in the tropics; sustainable management of fisheries, forests, agriculture and other ecosystem services; and development of innovative approaches to carbon sequestration from the atmosphere over decades to millennia . . . may not be sufficient to prevent dangerous and anthropogenic climate change." (pp. 51 *and* 53) Additional schemes to ward off anthropogenic climate change fall under the heading of geoengineering in two categories: carbon dioxide removal (CDR) and solar radiation management (SRM). In the former category are the following: 1) "fertilizing" the ocean with iron to stimulate growth of plankton, which in turn remove carbon dioxide from the air; 2) capture of carbon dioxide to be injected into reservoirs or the deep ocean (CCS); 3) capture of carbon dioxide from the atmosphere for synthesis into carbonates. In the latter category are the following: 1) injection of sulfate aerosols into the atmosphere (which would also decrease summer monsoons and reduce stratospheric ozone); 2) sunshades at Lagrangian points; 3) covering deserts with reflective films.

In 2008 authors of the 2007 IPCC report met with U.N. agencies to lay out "11 key priorities for science and climate change" (p. 53), including reprocessing data "to reflect new knowledge and to improve the flagging of errors and estimation of biases," expanding datasets "to include observations of the impacts of climate change and to account for autonomous or planned adaptation," a "harmonized set of scenarios of land use, land cover, and emissions databases to support both the climate and integrated assessment communities," and establishing a "community initiative that uses physical process studies, observations, and syntheses to obtain a consensus on the possible nonlinear responses of ice sheets to climate change, including their influences on rates of sea-level rise."

The UNEP *Compendium* can be obtained on-line at <http://www.unep.org/compendium2009/>.

Lean puts perspective on global temperature

There were waves of global warming in each half of the twentieth century, each following on the heels of a gradual cooling trend. After a maximum global temperature in 1998, there has been no further warming since 2002. This was the situation presented by Judith Lean of the U.S. Naval Research Laboratory to the Joint Meeting

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NYC's *Action Plan*

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1."Work with Climate Scientists to Improve Regional Climate Change Projections."

This is needed to minimize uncertainty in future planning for New York City's water supply, drainage, and waste water management. To reduce uncertainty about future climate change in New York City, DEP has commissioned the University of Connecticut to develop a Regional Climate Model with a finer mesh in space and time than that of present global climate models, which are unable to predict the extreme events such as storms, floods and droughts that DEP must be prepared to accommodate.

2."Enhance DEP's Understanding of the Potential Impacts of Climate Change on the Department."

DEP addresses the climate change impact in terms of three parameters: temperature, precipitation, and sea level. The twentieth century saw New York City's temperature rise by 1.9°F, its annual precipitation increase by 10% (4.2"), and sea level rise by a foot. By 2080 the temperature is expected to rise between 7.5°F and 8°F more, precipitation increase as much as another 10%, and sea level rise between 15.7" and 17.7" more.

Thus the following changes need to be prepared for: increased severity and frequency of droughts and flooding; washing of more nutrients and particles into reservoirs from increased precipitation and more frequent storms; encroaching salt fronts upon both the Hudson and Delaware Rivers; greater water demand from higher temperatures; greater water demand from longer growing seasons (between 12 and 27 days by 2035-2064, between 29 and 43 days by 2070-2099); reduced snowpack; increased pressure to make reservoir releases for ecological management; increased flooding and overwhelming of sewer capacity due to rainfall; infrastructure damage from more frequent coastal storms; backups in sewers due to rising sea level; and the effect on aquatic life of increased water temperature. And this must be done with the full realization that climate change renders historical records formerly used for preparations to be no longer reliable – already from 1952 to 2005 peak snowmelt in the Catskills has shifted from early April to late March.

Having to plan for more intense storms separated by longer periods without rainfall along with causes of increased water demand would require increasing the water supply's reservoir capacity; it is also expected to bring increased erosion, turbidity, debris in reservoirs, bacterial levels, phosphorus levels, and eutrophication. Longer periods without rainfall coupled with higher sea level could move the salt fronts of rivers farther upstream. In

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perspective on global temperature

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of the American Association of Physics Teachers and the American Physical Society in Washington, DC, on 15 February 2010, in her talk, "Surface Temperature Responses to Natural and Anthropogenic Influences: Past, Present, and Future."

Lean put the global temperature record into perspective by showing how it results from four basic causes, or "forcings": the natural forcings of solar variability and volcanic eruptions, land cover changes, internal oscillations (the North Atlantic Oscillation and the El Niño Southern Oscillation in the Pacific Ocean), and, lastly, anthropogenic forcings due to greenhouse gases and tropospheric aerosols. Of these, the only forcings that have any regularity are solar variability, arising from the 22-year sunspot cycle, and anthropogenic forcing, which steadily continues to rise. The reason for no further global warming since 2002, Lean pointed out, is that the solar variability reached the maximum of its cycle in 2002 and is now on a downward slide, thus counteracting the continued increase in anthropogenic forcing. But in a few years, Lean said, the solar variability will start on its upward swing and, added to the anthropogenic forcing, will produce a renewed period of global warming.

(*Editor's Note*: Given that in *An Inconvenient Truth* Al Gore cites 2005 as the warmest year on record (as of 2006), at variance with Lean's citation of 1998, Gordon Aubrecht II has graciously pointed out that Lean has chosen to use the East Anglia Climate Research Unit (CRU) data, whereas Gore uses the data from NOAA (National Oceanographic and Atmospheric Administration), which currently list the ten warmest years as 2005, 1998, 2003, 2002, 2006, 2009, 2007, 2004, 2001, and 2008. Aubrecht has pointed out that the CRU data ignore the Arctic temperatures as Hansen, *et al*., describe (J. Hansen, Mki. Sato, R. Ruedy, K. Lo, D.W. Lea, and M. Medina-Elizade, "Global temperature change," *Proc. Natl. Acad. Sci.*, **103**, 14288-14293 (2006), doi:10.1073/pnas.0606291103.) and thus understate the Earth's warming; Aubrecht prefers to use the NOAA and Goddard Institute of Space Sciences (GISS) data himself. This distinction between data sets is also made in Reference #18 in this issue.)

NYC's *Action Plan*

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addition to creating increased demand for water, higher temperatures would also reduce dissolved oxygen and increase algal growth.

More intense storms separated by longer dry periods will tax waste water disposal facilities as well. They will be further taxed in their ability to discharge waste water by rising sea level. In either case, more pumping equipment and more energy to run it would be needed. This would be further exacerbated by corrosion of equipment and biological treatment processes by saltwater intake. Increased water temperatures would also affect biological treatment processes as well. One consequence would be lower dissolved oxygen. Because discharged waste water must contain a prescribed minimum of dissolved oxygen, adjustments must be made, one of which at some Water Pollution Control Plants is removal of nitrogen, which fertilizes growth of algae which demand dissolved oxygen.

3."Determine and Implement Appropriate Adaptations to DEP's Water Systems."

". . . in order to minimize the impacts of climate change on its water systems, DEP must modify the assumptions on which its current planning and investments are based." This is all the more difficult because while "the extent of climate change is uncertain [the smallest time interval for general circulation models is three hours], . . . the requirements of engineering are very precise [New York City sewer design must accommodate the amount of rain falling in five minutes]." (p. 10) Completing Task 1 will facilitate completion of Task 2, which in turn will facilitate completing Task 4.

One important strategy to be implemented is water conservation. After the safe yield of the water supply system had been regularly exceeded over several decades, a water conservation program succeeded in reducing consumption below the safe yield. This is also important to preserve fire fighting capacity. Accommodating increased amounts of waste water is facilitated by reduction technologies as well – some examples are green roofs, vegetated ditches, and storm water reuse.

Because of barriers to renovating underground waste water systems, surface conduits for excess water from extreme storms are being considered. Additional equipment to accommodate increased coastal flooding also needs to be installed. In addition to accommodating flooding, protective measures need to be undertaken, such as elevating key facilities, especially if it can be done in conjunction with other remedial work. The ultimate in protection would be storm surge barriers, which "transcend just protecting DEP facilities," (p. 57) and would have to be undertaken with an agency with broader jurisdiction – *e.g.,* U.S. Army Corps of Engineers or the Port Authority of New York and New Jersey.

4."Inventory and Manage Greenhouse Gas Emissions."

This is an important part of the target of *PlaNYC* to reduce greenhouse gas emissions from New York City government by 2017, and DEP is responsible for 17% of this. Between 80 and 85% of DEP's greenhouse gas emissions come from wastewater management. One mechanism of reduction has been the installation of eight fuel cells at each of four of DEP's 14 Water Pollution Control Plants. These fuel cells have converted 253 million cubic feet of Anaerobic Digester Gas (which is 65-70% methane, 25-30% carbon dioxide) into 18.7 million kilowatt-hours of electrical energy. In addition, DEP owns or has under contract nearly 80,000 acres of forest to protect its watersheds and will solicit 50,000 additional acres per year. This provision of the Filtration Avoidance Determination issued by the US Environmental Protection Agency in 2007 also serves as a carbon "sink." Further increasing DEP's carbon sink is the planting of over 40,000 trees and shrubs over 400 acres of former landfill space near the Belt Parkway and Jamaica Bay in Brooklyn, and the amount of carbon thus sequestered would be further increased by a longer growing season, though this benefit could be offset by increased damage to vegetation from insects and weather.

5."Improve Communication and Tracking Mechanisms."

This is needed to implement Tasks 1-4 and to track the degree of progress made.

The first four of the five tasks are addressed in detail in the first four chapters of the *Climate Change Program Assessment and Action Plan*. The fifth chapter, titled "Potential Impacts and Adaptations Summary," summarizes in tabular form the topics covered in chapters two and three, under the headings of Potential Climate Change Effect, Potential Impact to DEP, and Potential Adaptation. The sixth chapter, titled "Climate Change Action Plan," lists the actions spelled out at the end of the first four chapters in response to the five tasks forming the framework of the *Plan*, the goals addressed, and the DEP bureau responsible for each. The NYCDEP *Climate Change Program Assessment and Action Plan* can be obtained on-line from the NYCDEP website at <http://home2.nyc.gov/html/dep/html/news/climate_change_report_05-08.shtml>.

AAAS and NAS on Climate Change and Evolution

Two scientific issues in need of greater public understanding are the threat of climate change and the evidence for evolution on the basis of natural selection. To this end, America's two premier science organizations – the American Association for the Advancement of Science (AAAS) and the National Academy of Sciences – have produced educational materials to assist teachers in producing a more scientifically literate citizenry.

The AAAS offers *Communicating and Learning About Global Climate Change: An Abbreviated Guide for Teaching About Climate Change*, a 32-page booklet containing excerpts from chapters 1, 3, 4, 8, and 5 of Project 2061's *Science For All Americans*, plus maps relating Project 2061 benchmarks, recommended readings, and websites. They also offer *Evolution on the Line: An Abbreviated Guide for Teaching Evolution*, a 26-page booklet containing excerpts from chapters 5 and 1 of *Science For All Americans* and chapters 5 and 1 of *Benchmarks for Science Literacy*, an AAAS Q&A, a list of high school biology textbooks, and "A Benchmarks-Based Evolution." Both booklets can be obtained for $3.95 each (including shipping and handling) or downloaded free at <http://www.project2061.org/publications/order.htm#TeachingGuides>. The AAAS also worked with the NOAA (National Oceanic and Atmospheric Administration) to develop an additional guide, *Climate Literacy: The Essential Principles of Climate Science*, which can be downloaded free at <http://www.globalchange.bov/resources/educators/climate-literacy>.

The website for the NAS efforts on climate change is <http://americasclimatechoices.org>. There you can learn of future reports deriving from a 30-31 March 2009 Summit on America's Climate Choices and download two 28-page booklets, *Understanding and Responding to Climate Change* and *Ecological Impacts of Climate Change*. Instructions are also provided for obtaining up to 25 hard copies of the first booklet.

It is interesting to note that both the AAAS and NAS use the term "climate change" rather than "global warming." *Understanding and Responding to Climate Change* points out that "the phrase 'climate change' is growing in preferred use to 'global warming' because it helps convey that there are changes in addition to rising temperatures." Divided into four sections – "About the Science," "How the Science is Done," "Impact of Climate Change," and "How Science Informs Decision-Making" – and citing almost 30 NAS and related reports, *Understanding and Responding to Climate Change* makes clear that human activities are known to underlie temperature increase, because increased emissions of not only carbon dioxide (about half absorbed by vegetation and the ocean) but also of methane and nitrous oxide have occurred while solar luminance and Earth's volcanic activity have remained constant for the past 30 years. The booklet also reminds us that in addition to greenhouse gas emissions, land use changes also effect climate change. Moreover, the factors effecting climate change are all human choices, which, along with population, are difficult to predict for the future.

Understanding and Responding to Climate Change lists not only increased temperature but also changes in water distribution and changing species habitat as an impact of climate change. And just as weather forecasting is useful for people in planning their day, climate forecasting is valuable information for those involved with emergency management, water management (especially for agriculture), insurance, power production, construction, and preparation for climate change (both prevention measures to eliminate it and mitigation measures to cope with it).

The booklet also observes that while the elimination of chlorofluorocarbons (CFCs) to reverse destruction of the ozone layer has been held up as an example of what must be done to prepare for climate change, solving the CFC emissions problem was easier, because alternate technologies were available and the number of CFC manufacturers was small. The biggest challenge to slowing climate change is the increased use of energy, and meeting it requires use of alternative energy sources and/or more efficient energy use.

Clearinghouse Update

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

The End for Centralia

Our Winter/Spring 2006 issue covered Yuri Gorokhovich's talk to the Physics Club of New York on 16 December 2005 about the underground coal fires in Centralia, PA. Although the Commonwealth of Pennsylvania had seized the buildings of Centralia by eminent domain in the early 1990s, a handful of residents had stayed on, in effect squatting in homes they no longer owned. According to the Associated Press on 5 February 2010, only five houses in Centralia remained occupied with fewer than a dozen holdouts, and Attorney Steve Fishman from the Pennsylvania Department of Community and Economic Development is cited as saying that the Commonwealth is "moving as quickly as possible to take possession of the remaining homes and get them knocked down."

News from Triangle Coalition

Public Draft of the College and Career Readiness Standards Released for Review

The National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO) have released the first official public draft of the college- and career-readiness standards in English-language arts and mathematics as part of the Common Core State Standards Initiative, a process being led by governors and chief state school officers in 51 states and territories. These standards define the knowledge and skills students should have to succeed in entry-level, credit-bearing, academic college courses and in workforce training programs. The college- and career-readiness standards have been informed by input from education and content experts and feedback from participating states. The NGA Center and CCSSO are encouraging those interested in the standards to provide feedback, which must be supported by research and evidence, by 21 October 2009 at <www.corestandards.org>.

After the feedback period, the standards are subject to review by the expert Validation Committee. The Validation Committee is comprised of national and international experts on standards. This group will review the standards development process and the substance of the standards to ensure they are research- and evidence-based. Members of the committee are being selected by governors and chiefs and will be formally announced in the coming weeks. The NGA Center and CCSSO will soon begin the process of developing the K-12 standards that will enable students to meet the validated college and career-readiness standards. Triangle Coalition member, CCSSO, is a nationwide, nonprofit organization composed of the public officials who head departments of elementary and secondary education in the states, the District of Columbia, the Department of Defense Education Activity, and five extra-state jurisdictions. Through its task forces and committees, the Council advances major education initiatives and addresses to a broad range of concerns about education. More details are at <www.ccsso.org>.

(*Editor's Note*: The preceding item was excerpted from the *Triangle Coalition Electronic Bulletin* for 24 September 2009 and reprinted with permission.)

NCTM Releases "Focus in High School Mathematics: Reasoning and Sense Making"

Triangle Coalition member, the National Council of Teachers of Mathematics (NCTM), has released a new publication, "Focus in High School Mathematics: Reasoning and Sense Making." The document suggests practical changes to the high school mathematics curriculum to refocus learning on reasoning and sense making. This shift is not a minor refinement but constitutes a substantial rethinking of the high school math curriculum. NCTM's new publication urges grounding all students in mathematics that connects them with real-world situations. According to NCTM, the more each mathematics lesson builds on the previous lesson and each year's math experience builds on the previous year's, the more students will be able to learn and retain as they progress from prekindergarten through college. Focusing on reasoning and sense making thus has the potential to streamline the curriculum and make it more powerful and effective. "Focus in High School Mathematics: Reasoning and Sense Making" is a conceptual framework to guide the development of future publications and tools related to 9-12 mathematics curriculum and instruction. The document highlights reasoning opportunities in five specific content areas of the high school mathematics curriculum: Reasoning with Numbers and Measurements, Reasoning with Algebraic Symbols, Reasoning with Functions, Reasoning with Geometry, and Reasoning with Statistics and Probability.

The National Council of Teachers of Mathematics was founded in 1920 and is a nonprofit, nonpartisan education association. With 100,000 members and 230 Affiliates in the United States and Canada, NCTM is the world's largest organization dedicated to improving mathematics education for all students. The Council's Principles and Standards for School Mathematics provides guidelines for excellence in mathematics education. Its Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics, released in 2006, identifies the most important mathematical topics for each grade level. These documents, and the new release, are available at <http://www.nctm.org/catalog/content.aspx?id=23485>.

Secretary Duncan Says Rewrite of 'No Child Left Behind' Should Start Now

U.S. Secretary of Education Arne Duncan recently said that the $24.8 billion in federal funds available annually to the nation's schools should support reforms that prepare students for success in college and careers. "I am calling on all of you to join with us to build a transformative education law that guarantees every child the education they want and need -- a law that recognizes and rein-

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forces the proper role of the federal government to support and drive reform at the state and local level," Duncan said his first major speech about the future of the Elementary and Secondary Education Act (ESEA) of 1965. The ESEA was reauthorized most recently in 2002 in what is known as the No Child Left Behind Act. In his speech, Duncan said that the NCLB law has significant flaws and that he looks forward to working with Congress to address the law's problems. He said the law puts too much emphasis on standardized tests, unfairly labels many schools as failures, and doesn't account for students' academic growth in its accountability system. "But the biggest problem with NCLB is that it doesn't encourage high learning standards," Duncan said. "In fact, it inadvertently encourages states to lower them. The net effect is that we are lying to children and parents by telling kids they are succeeding when they are not."

Duncan credited NCLB for highlighting the achievement gap in schools and for focusing accountability on student outcomes, and said he is committed to policies that work toward closing that gap while raising the achievement of all children. He said he wants the next version of ESEA to create tests that better measure student learning and to build an accountability system that is based on the academic growth of students. He also wants the law to create programs to improve the performance of existing teachers and school leaders, to recruit new effective educators, and to ensure that the best educators are serving the children that are the furthest behind. There are several planned forums where education stakeholders can offer input about the law. The forums are part of the department's "Listening and Learning" tour seeking public input about changes to the ESEA. By the end of the year, the secretary or a senior staff member will have led a listening and learning event in all 50 states. More details about ESEA are <http://www.ed.gov/about/offices/list/oese/legislation.gov>.

AAAS Receives NOAA and NASA Funding to Develop Climate Literacy Materials

Project 2061, AAAS's science literacy initiative, has received two grants to develop classroom materials to help middle-grade students understand important concepts related to climate and climate change. Funded by Triangle Coalition members, the National Oceanic and Atmospheric Administration (NOAA) and NASA, the grants will provide teachers, curriculum developers, and other educators with free, online access to resources focused on a variety of earth, ocean, and atmospheric phenomena. "Given the implications of global climate change, understanding the basics of climate science is a high priority for all students," said Jo Ellen Roseman, director of Project 2061. "These grants will enable us to use data from NASA and NOAA earth observations to engage students in interesting real-world phenomena and to design activities to help them make sense of the phenomena in terms of the underlying science principles," added Roseman, the principal investigator on the grants.

Over three years, a team comprised of Project 2061 staff and experts in climate science, middle-school science teaching, and other areas will develop, test, and promote the materials. The materials will include fundamental climate concepts aligned with science education standards, classroom activities, and assessment tools; when they're ready, they will be placed in an online, searchable database on the Project 2061 website. Teachers can then use the materials to enrich existing lesson plans or integrate them with new curriculum materials. It should take about two years before the first materials are available to teachers. The team will use data collected by NASA and NOAA on global observations of oceans, atmosphere, land surface, and the biosphere. The team will also address common misconceptions that many students have about key ideas related to climate and climate change.

(*Editor's Note*: The preceding three items were excerpted from the *Triangle Coalition Electronic Bulletin* for 8 October 2009 and reprinted with permission.)

U.S. Secretary of Education Duncan Says Colleges of Education Must Improve for Reforms to Succeed

U.S. Secretary of Education Arne Duncan recently called for America's colleges of education to dramatically change how they prepare the next generation of teachers so that they are ready to prepare their future students for success in college and careers. Noting that America's schools will need to hire up to 200,000 first-time teachers annually for the next five years, Duncan said that those new teachers need the knowledge and skill to prepare students for success in the global economy. "By almost any standard, many if not most of the nation's 1,450 schools, colleges, and departments of education are doing a mediocre job of preparing teachers for the realities of the 21st century classroom," Duncan said in a major speech at Teachers College, Columbia University. "America's university-based teacher preparation programs need revolutionary change -- not evolutionary tinkering."

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More than half of the nation's teachers graduate from a school of education. The U.S. Department of Education estimates that 220,000 students graduate from a teacher college every year. In recent years, several alternative certification programs such as High Tech High, The New Teacher Project, Teach for America, and teacher residency programs have emerged. But those programs produce fewer than 10,000 new teachers annually. According to Duncan, colleges of education need to make dramatic changes to prepare today's children to compete in the global economy. Teacher-preparation programs should ensure that new teachers will master the content of the subjects they'll teach and they will have well-

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Duncan: teacher training needs reform

"Schools of education have been renowned for being cash cows for universities." "Most states routinely approve teacher education programs, and licensing exams typically measure basic skills and subject matter knowledge with paper-and-pencil tests without any real-world assessment of classroom readiness." These are some of the hard-hitting claims of Secretary of Education Arne Duncan at Teachers College, Columbia University, on 22 October 2009, in which he argued that "America's university-based teacher preparation programs need revolutionary change – not evolutionary tinkering."

Duncan began by citing "three great educational challenges that make the need to improve teacher preparation programs all the more urgent." The first challenge was to prepare teachers to educate students for the information age, so that these students' education will prepare them for a 21st century job. Only in this way could education meet the second challenge – to serve as an equalizer of opportunity. In this connection Duncan believed "that education is the civil rights issue of our generation," but this could come to pass only if students in the neediest schools had fully qualified teachers. The final challenge Duncan cited for teacher preparation is to prepare enough teachers to replace the more than half of present teachers and principals who are Baby Boomers, soon to retire – but Duncan cited shortage of quality as well as quantity, quoting former President Lyndon Johnson: "tomorrow's teachers must not merely be plentiful enough, they must be good enough."

Only with a public school system staffed with rigorously-trained teachers, Duncan went on, could President Obama's goal "of having America regain its position as the nation with the highest proportion of college graduates in the world by 2020" be achieved. (See related article on p. 33 of our Winter/Spring 2009 issue; e-mail the editor at <JLRoeder@aol.com> if you do not have a

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Duncan: more students needed in STEM fields

Just one day after he spoke at Teachers College, Columbia University, Secretary of Education Arne Duncan spoke to the President's Council of Advisors on Science and Technology (PCAST). Instead of speaking here to science educators, he was speaking to scientists. Yet much of what he had to say was the same – except that it focused on the need for more students to major in STEM (science, technology, engineering, and mathematics) fields rather than for more (and better) teachers to teach them. In addition to lamenting scores in the Program International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) that do not indicate future American competitiveness in STEM fields, Duncan also lamented the low percentage of American students who declare STEM majors in college and get degrees in STEM fields – "only 23% of college freshmen declare a STEM major," and "just 40% of those that elect STEM majors freshman year receive a STEM degree within six years."

To address the need for more STEM college majors, Duncan sought to engage his audience of scientists to "find answers and explore ideas about how to engage the entire population around STEM subjects," "to build new curricula and use extended time to make science more interesting and relevant," and "to help students master STEM inside and outside the classroom." He suggested several topics to stimulate student interest in STEM fields, among them recycling, wind power, fuel economy, health and medicine, the environment, space exploration, and food production for the developing world. And he asked his listeners to "go back to your schools and institutions and make this quest for change . . . spread the word to every student and colleague. . . ."

Duncan said that the Obama Administration "is committed to raising standards, upgrading curriculum, and forming partnerships to improve the use and understanding of science and technology in college classrooms," just

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supported field-based experiences embedded throughout their preparation programs. Their ultimate goal should be to create a generation of teachers who are focused on improving student achievement and ready to deliver on that goal. Duncan highlighted emerging efforts to improve teacher education that are being led by the National Council for Accreditation of Teacher Education and the American Association of Colleges for Teacher Education, as well as individual colleges of education. Secretary Duncan's speech is available online at <http://www.ed.gov/news/speeches/2009/10/10222009.html>. (See related article in this issue.)

Subcommittee Looks Into the Potential Benefits of and Challenges to K-12 Engineering Education

On 22 October, the House Committee on Science and Technology's Subcommittee on Research and Science

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Duncan: teacher training needs reform

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copy.) The burden for this, Duncan said, is our colleges of education, which "produce about 220,000 certified teachers a year," while alternate routes provide less than 10,000. "And unlike independent alternative certification programs," Duncan added, "university-based teacher preparation programs have unique advantages – they are financially self-sustaining, have math and science departments on campus to assist in specialized training, they can provide rich content knowledge in the liberal arts, and they are in a position to research and test what works to improve student learning." This was all the more the reason for Duncan to lament that "college presidents and deans of the arts and science faculty ignore their teacher preparation programs – and yet complain about the cost of remedial classes to freshmen."

In the context of exhorting schools of education toward reform, Duncan quoted a 1995 report by the Holmes Group that "The education school should cease to act as a silent agent in the preservation of the status quo." He quoted former Teachers College President Arthur Levine that "teacher education is the Dodge City of the education world." And he also quoted former Stanford University President Donald Kennedy that "Only if the best institutions care about [public] schools and the schools of education will the public think they are worth caring about." Duncan then argued that "we should be studying and copying the practices of effective teacher preparation programs and encouraging the lowest-performers to shape up or shut down." Duncan cited teacher education programs that he felt *were* effective and characterized them as "coherent, up-to-date, research-based, and provide students with subject mastery."

Another characteristic of the programs Duncan praised, including the program at Teachers College, was the residency model of medical training, which places more emphasis on clinical experience and less on formal coursework. The full text of Duncan's speech at Teachers College can be accessed on-line at <http://www.ed.gov/news/speeches/2009/10/10222009.html>.

Duncan: more students needed in STEM fields

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as it is at the secondary level. To this end, he reiterated several of his points on improving secondary STEM education in his speech the day before at Teachers College:

- Calling on states to enhance teacher preparation and training, and to attract more and qualified math and science teachers to better engage students and reinvigorate those subjects in our schools
- Putting the best teachers in schools where they're most needed
- Closing down chronically underperforming schools and creating better ones
- Focusing on world-class standards to help states build their reforms.

Funds from the Race to the Top and Investing in Innovation programs could help, Duncan added.

But "it's not enough that STEM graduates envision only becoming physicists, chemists, [and] engineers," Duncan stated in his conclusion. "We must bring more of them – especially more of the best of them – into classrooms as teachers," he added. He asked his scientist listeners to remember that their "colleagues who became teachers have not failed as scientists – they are doing the important work of preparing the next generation of scientists."

The full text of Duncan's remarks is available on-line at <http://www.ed.gov/news/speeches/2009/10/10232009html>.

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Education held a hearing to examine the potential benefits of, challenges to, and current models for incorporating engineering education into grades K-12. In recent years, a small but increasing number of education stakeholders have advocated for pre-college engineering education. They argue that the current science, technology, engineering, and mathematics (STEM) education system is out-dated given the skills needed by today's 21st century workforce. "Engineering education in the K-12 level has the potential to encourage more students to enroll in undergraduate engineering degree programs and perhaps to attract more students to all STEM fields, and I am particularly interested in learning more about how pre-college engineering education can broaden the STEM pipeline by helping to make STEM learning tangible and exciting to more students," said Subcommittee Chairman Daniel Lipinski (D-IL). Among those who testified was Dr. Ioannis Miaoulis, President and Director of the Museum of Science, Boston, and Founding Director of Triangle Coalition member, the National Center for Technological Literacy. Dr. Mioaoulis' full testimony is available online at <http://democrats.science.house.gov/Media/file/Commdocs/hearings/2009/Research/22oct/Miaoulis_Testimony.pdf>. In his testimony, Dr. Miaoulis outlined four main reasons to introduce engineering in K-12 schools:

- First, engineering is rich in hands-on experiences. Children are born engineers, fascinated with building and taking things apart to see how they work. Describing these activities as engineering can help them develop positive associations with the field.
- Second, engineering brings math and science to life, demonstrating that they are relevant subjects thereby motivating students to pursue them. Relevance is particularly significant for girls and other underrepresented groups. Engineering pulls together many other disciplines, including math, science, language arts, history, and art, engaging children of differing abilities in problem-based learning, where teamwork is important.
- Third, to create a diverse, technologically literate workforce, we need to support engineering in K-12 schools. We must offer engineering education in K-12 classrooms to make careers more desirable and accessible to all children from all backgrounds.
- The fourth and major reason to start engineering early is that technological literacy is basic literacy for the 21st century. We live in a technological world. We need to understand how human-made things like shoes and band-aids are created, how they work, and how to improve them.

(*Editor's Note*: The preceding two items were excerpted from the *Triangle Coalition Electronic Bulletin* for 29 October 2009 and reprinted with permission.)

Secretary of Education Issues a Call to Teach

In November 2009, U.S. Secretary of Education Arne Duncan addressed students at the University of Virginia's Curry School of Education and told them that they are answering a call that is as important as any career available to them now and in the future. The Obama administration, said Secretary Duncan, sees elevating the teaching profession and expanding the pool of talent as critical to closing the achievement gap and promoting the nation's long-term prosperity. "Today's teachers and aspiring teachers in our colleges of education can help transform the lives of their students by boosting student learning and helping them access higher education and new economic opportunities. We need the next generation to answer the call to teach," Secretary Duncan said. "The single most important factor influencing student learning in our nation's schools is the quality of teaching. Students who have teachers who know their content and how to teach it effectively achieve substantially more than their peers who do not."

The Department of Education estimates a national need for 1.7 million new teachers by 2017 due to anticipated retirements and attrition. Included in the president's fiscal 2010 budget request is $30 million to support a national teacher recruitment campaign. If approved by Congress, the Department of Education would support the teaching profession by launching a comprehensive effort to recruit and provide support for students and professionals from other fields to become teachers. The campaign also would support the development of training programs to help candidates become qualified to teach, and provide information on alternative routes to enter the profession for nontraditional candidates.

$1.25M Grant to Develop STEM Teacher Training Institute

Arizona State University (ASU) is combining energy, innovation, and expertise in STEM education (science, technology, engineering, and mathematics) to develop a groundbreaking new institute that will produce a community of highly qualified middle school math and science teachers. The National Science Foundation (NSF) has awarded ASU a five-year, $1.25 million Innovation

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through Institutional Integration (I3) grant to develop The Modeling Institute, a collaboration of the university's most cutting-edge research in STEM education and teacher preparation. A multidisciplinary team of ASU researchers will drive the project under the auspices of the Center for Research on Education in Science, Mathematics, Engineering, and Technology (CRESMET) housed within the Mary Lou Fulton Institute and Graduate School of Education. The project integrates some of the university's most successful NSF-sponsored STEM education initiatives to maximize ASU's impact on K-12 education locally and nationally.

The Modeling Institute is designed to engage and empower teachers and their students as they work directly with bench scientists in systematic and sustainable education programs and scientific communities. ASU will accept 25 of the best qualified elementary school teacher applicants into the Modeling Institute for the first two years and an additional 50 teachers each of the following three years to produce 200 highly qualified math and science teachers over a five-year period. The teachers enrolled in the Modeling Institute will have the opportunity to earn a master's degree with an emphasis on strengthening their content knowledge in science, technology, engineering, and mathematics.

(*Editor's Note*: The preceding two items were excerpted from the *Triangle Coalition Electronic Bulletin* for 5 November 2009 and reprinted with permission.)

Doing What Works

The Doing What Works (http://dww.ed.gov) website from the U.S. Department of Education features practical suggestions about ways to support teacher effectiveness, use data to improve instruction, and turn around low-performing schools. For each topic, site visitors will find three kinds of information: essential concepts, recommended practices, and planning templates. Materials include expert interviews, videos, slideshows, diagrams, protocols, sample materials, and more. Materials are organized around real-life scenarios. For example:

- How can teachers in my school more fully use the mathematics assessment data we collect?
- How can we better track our preschoolers' development of language and literacy skills?
- How can we help teachers organize and use data to guide instruction for our English learners who need extra help developing literacy skills?
- How can we break down the isolation among teachers in our high school and get them working together to improve instruction?
- What professional development should we be looking at to help our teachers learn research-based instructional strategies, like using higher-order questions?

Study: U.S. Scientist and Engineer Supply as Strong as Ever but New Data Show Top Students Choose Careers in Other Fields

A new study, conducted with funding from the Alfred P. Sloan Foundation, finds U.S. colleges and universities are graduating as many scientists and engineers as ever before. Contrary to fears expressed by educators and employers, American students have not wavered in their interest in science and math studies over the past 30 years. The new report entitled, "Steady as She Goes? Three Generations of Students through the Science and Engineering Pipeline," is one of the most comprehensive analyses of a major longitudinal dataset to examine the transition of American students in science, technology, engineering, and mathematics (STEM) from high school into the labor force. While the data show no decline in students pursuing science and math, they do indicate that many of the highest performing students are choosing careers in other fields after graduation. "Over the past decade, U.S. colleges and universities graduated roughly three times more scientists and engineers than were employed in the growing science and engineering workforce," said the study's co-author Lindsay Lowell, Director of Policy Studies at Georgetown University. "At the same time, more of the very best students are attracted to non-science occupations, such as finance. Even so, there is no evidence of a long-term decline in the proportion of American students with the relevant training and qualifications to pursue STEM jobs."

"Despite decades of complaints that the United States does not have enough scientists and engineers, the data show our high schools and colleges are providing an ample supply of graduates. It is now up to science and technology firms to attract the best and the brightest graduates to come work for them," said co-author of the study, Hal Salzman, Professor of Public Policy at Rutgers, The State University of New Jersey. "Our problem is not a failure to educate enough science and math students, but an inability to induce our most talented young people to pursue careers within our high technology companies."

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Copies of the "Steady as She Goes?" report are available at <http://www.heldrich.rutgers.edu/uploadedFiles/Publications/STEM_Paper_Final.pdf>.

(*Editor's Note*: The preceding two items were excerpted from the *Triangle Coalition Electronic Bulletin* for 12 November 2009 and reprinted with permission.)

U.S. Department of Education Opens Race To The Top Competition

U.S. Secretary of Education Arne Duncan has released the final application for more than $4 billion from the Race to the Top Fund, which will reward states that have raised student performance in the past and have the capacity to accelerate achievement gains with innovative reforms. The U.S. Department of Education is asking states to build comprehensive and coherent plans built around the four areas of reform outlined in the American Recovery and Reinvestment Act. The application requires states to document their past success and outline their plans to extend their reforms by using college- and career-ready standards and assessments, building a workforce of highly effective educators, creating educational data systems to support student achievement, and turning around their lowest-performing schools. The $4.35 billion for the Race to the Top Fund is an unprecedented federal investment in reform. Duncan will reserve up to $350 million to help states create assessments aligned to common sets of standards. The remaining $4 billion will be awarded in a national competition.

To qualify, states must have no legal barriers to linking student growth and achievement data to teachers and principals for the purposes of evaluation. They also must have the department's approval for their plans for both phases of the Recovery Act's State Fiscal Stabilization Fund prior to being awarded a grant. The final application includes significant changes to the proposal released by the U.S. Department of Education in July. In Race to the Top, the department will hold two rounds of competition for the grants. For the first round, it will accept states' applications until the middle of January, 2010. Peer reviewers will evaluate the applications and the department will announce the winners of the first round of funding next spring. Applications for the second round will be due June 1, 2010, with the announcement of all the winners by Sept. 30, 2010. More information is at <www.ed.gov/programs/racetothetop>.

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

"Educate to Innovate" Campaign for Excellence in STEM Education

President Obama has launched the "Educate to Innovate" campaign, a nationwide effort to help reach the administration's goal of moving American students from the middle to the top of the pack in science and math achievement over the next decade. Speaking to key leaders of the STEM (science, technology, engineering, and math) community and local students, President Obama announced a series of high-powered partnerships involving leading companies, foundations, non-profits, and science and engineering societies dedicated to motivating and inspiring young people across America to excel in science and math. "Reaffirming and strengthening America's role as the world's engine of scientific discovery and technological innovation is essential to meeting the challenges of this century," said President Obama. "That's why I am committed to making the improvement of STEM education over the next decade a national priority."

The new partnerships, with accompanying major commitments from philanthropic organizations and individuals, mark a dramatic first wave of responses to the President's call at the National Academy of Sciences this spring for a national campaign to raise American students "from the middle to the top of the pack in science and math over the next decade." Each of the commitments – valued together at over $260 million in financial and in-kind support – will apply new and creative methods of generating and maintaining student interest and enthusiasm in science and math, reinvigorating the pipeline of ingenuity and innovation essential to America's success that has long been at the core of American economic leadership. President Obama has identified three overarching priorities for STEM education: increasing STEM literacy so all students can think critically in science, math, engineering, and technology; improving the quality of math and science teaching so American students are no longer outperformed by those in other nations; and expanding STEM education and career opportunities for underrepresented groups, including women and minorities.

(*Editor's Note*: The preceding item was excerpted from the *Triangle Coalition Electronic Bulletin* for 3 December 2009 and reprinted with permission.)

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Pearson Shares Vision of Innovative Assessments with Congress

Recently, Douglas Kubach, President & CEO of the Assessment & Information Group of Pearson Education, was invited to provide testimony in a hearing held on Capitol Hill by the U.S. House of Representatives' Committee on Education and Labor. "As an industry leader in the development, delivery, and analysis of standardized academic testing, we fully support the Administration's and Committee's goals of improving student learning, increasing college readiness and, ultimately, raising America's students competitive standing in today's global economy," said Kubach. In his remarks to the Committee, Kubach emphasized three factors for achieving success in meeting these goals: increased cooperation and collaboration among all stakeholders, preserving accountability while increasing transparency, and leveraging the opportunities presented by "going online."

Regarding the issue of cooperation and collaboration, Mr. Kubach said that "to successfully develop and implement higher-quality standards, all stakeholders will be required to collaborate and cooperate in new ways. Pearson is collaborating with Educational Testing Services and the College Board to understand how innovative approaches and best practices in assessment can contribute to a new Common Core Standards assessment system." Triangle Coalition member, Pearson Education, is a 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.

(*Editor's Note*: The preceding item was excerpted from the *Triangle Coalition Electronic Bulletin* for 7 January 2010 and reprinted with permission.)

Science and Engineering Indicators 2010

The state of the science and engineering (S&E) enterprise in America is strong, yet its lead is slipping, according to data recently released by the National Science Board (NSB). Prepared biennially and delivered to the President and Congress on even numbered years, "Science and Engineering Indicators" (SEI) provides information on the scope, quality, and vitality of America's science and engineering enterprise. SEI 2010 sheds light on America's position in the global economy. "The data begin to tell a worrisome story," said Kei Koizumi, assistant director for federal research and development (R&D) in the President's Office of Science and Technology Policy (OSTP). Calling SEI 2010 a "State of the Union on science, technology, engineering, and mathematics," he noted that "U.S. dominance has eroded significantly."

Over the past decade, R&D intensity (how much of a country's economic activity or gross domestic product is expended on R&D) has grown considerably in Asia, while remaining steady in the U.S. Annual growth of R&D expenditures in the U.S. averaged 5 to 6 percent while in Asia, it has skyrocketed. In some Asian countries, R&D growth rate is two, three, even four, times that of the U.S. In terms of R&D expenditures as a share of economic output, while Japan has surpassed the U.S. for quite some time, South Korea is now in the lead -- ahead of the U.S. and Japan. And why does this matter? Investment in R&D is a major driver of innovation, which builds on new knowledge and technologies, contributes to national competitiveness and furthers social welfare. R&D expenditures indicate the priority given to advancing science and technology (S&T) relative to other national goals. The Digest contains these and other key indicators such as number of patents, the globalization of capability; funding, performance and portfolio of U.S. R&D trends, and the composition of the U.S. S&E workforce. The report is available on-line at <http://www.nsf.gov/statistics/seind10/.>

(*Editor's Note*: The preceding item was excerpted from the *Triangle Coalition Electronic Bulletin* for 4 February 2010 and reprinted with permission.)

Using Data to Determine if High School Interventions are Preparing Students for College and Careers

The National High School Center has released a report to guide educators in collecting and analyzing valuable student achievement data that can help them determine if and how high school interventions for underprepared students are working to effectively prepare them for college and careers. Policymakers across the nation are placing an unprecedented emphasis on the need for all high school students to graduate with the knowledge and skills required to excel in college and the workforce. However, evidence indicates that too many of today's high school students do not graduate college- and career ready. Furthermore, meeting college- and career-ready goals is especially challenging for students who enter high school inadequately prepared to master a rigorous curriculum. The report, *Using the Right Data to Determine if High*

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School Interventions Are Working to Prepare Students for College and Careers, discusses research on the relationship between students' academic preparation gaps in eighth grade and their likelihood of achieving college- and career-readiness by the end of high school. It also explores the datasets that state and local education agencies can create as a way to evaluate the benefits of interventions for students at varying achievement levels, and provides direction for high schools and districts once they obtain student data. Major findings from this analysis include:

- Most students – especially low-income and minority students – were not meeting college and career readiness targets in Grade 8, indicating that there were gaps in their academic preparation on entering high school.
- Given current high school practices, students with large academic preparation gaps in Grade 8 have a low probability of meeting college and career readiness performance targets in high school.

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Assessing students for college/career readiness

The problem of high school graduates unprepared for college or career, profiled on pp. 30-31 of our Winter/ Spring 2009 issue, is now addressed by Chrys Dougherty's report, *Using the Right Data to Determine if High School Interventions Are Working to Prepare Students for College and Careers* from the National High School Center. Dougherty writes that "College- and career-readiness performance targets are test scores that indicate that a student is on track to be academically prepared for college by the time he or she finishes high school." (p. 2) He seeks to establish those targets by linking students' test scores with their college outcomes, then seeks to "backward-map the upper-grade performance targets to lower grades," so that students in lower grades can be identified by their college/career readiness and interventions made to upgrade this readiness by the time of their graduation.

The first step was done by researchers at the Texas Higher Education Coordinating Board who "linked scores on the Grade 11 Texas Assessment of Knowledge and Skills (TAKS) to scores on a higher-education placement test used in college to identify whether students were in need of remediation." Similarly, "researchers at ACT linked student scores on the Grade 12 ACT English, Mathematics, Science, and Reading tests, respectively, to student grades in introductory-level college courses in English composition, college algebra, biology, and social science subjects," (p. 3) such that students would earn a grade of B or higher with a 50% probability and a grade of C or higher with a 75% probability.

The second step was done by researchers at NCEA (National Center for Educational Achievement) who "backward-mapped Grade 11 TAKS targets to the Grades 3-10 TAKS . . . while ACT researchers identified Grade 8 EXPLORE and Grade 10 PLAN test scores associated with a 50% probability of hitting the Grade 12 ACT benchmark." (p. 3)

Dougherty then considered five groups according to their academic preparation: group 0 college/career ready; group 1 up to half a standard deviation below group 0 in their readiness; group 2 between half and a single standard deviation below group 0; group 3 between one and one-and-a-half standard deviations below group 0; and group 4 more than one-and-a-half standard deviations below group 0. He then identified 39% of 8th grade African-Americans and 32% of 8th grade Hispanics in Texas as being in groups 3 and 4; and the same for 54% of 8th grade African-Americans and 31% of 8th grade Hispanics in Arkansas. 77% of 8th grade African-Americans and 82% of 8th grade Hispanics in Texas were identified as not college/career ready; and the same for 82% of 8th grade African-Americans and 90% of 8th grade Hispanics in Arkansas. Of the 8th graders in Texas, members of groups 1, 2, 3, and 4 had respective probabilities of 30%, 10%, 3%, and 1% of becoming college/career ready by grade 11. Of the 8th graders in Arkansas, members of groups 1, 2, 3, and 4 had respective probabilities of 37%, 15%, 4%, and 1% of becoming college/career ready by grade 12. Dougherty also assesses the pivotal role of Algebra II: the respective percentages of groups 0, 1, 2, 3, and 4 who took this course by grade 11 in Texas and were college/career ready were 87%, 49%, 22%, 10%, and 2%; the corresponding percentages who took Algebra II by grade 12 in Arkansas and were college/career ready were 77%, 43%, 19%, 6%, and 3%.

Noting that "performance targets for college and career readiness had been set in only a relatively small number of states," Dougherty writes that "we are still in the early stages of learning 'the feasibility and rapidity with which the academic learning of students who enter high school multiple years behind grade level can be accelerated.'" (pp. 6, 7)

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- Students in the lowest academic preparation group were less likely to complete or be taking mathematics courses beyond Algebra II by their senior year.
- Students in the lower academic preparation groups are unlikely to meet college-readiness targets even when they have completed or are taking an extra mathematics course beyond Algebra II.

To summarize, when students enter high school with large academic preparation gaps, high schools have great difficulty getting those students to college- and career-readiness targets. The National High School Center serves as a central source of expertise on high school-related issues for the Regional Comprehensive Centers, a national network developed by the U.S. Department of Education. *Using the Right Data to Determine if High School Interventions Are Working to Prepare Students for College and Careers* can be accessed online at <http://www.betterhighschools.org/docs/NCEA_CollegeCareerReadiness.pdf>.

(*Editor's Note*: See additional separate story in this issue.)

Growing Excellence Gap in K-12 Education

A new report from the Indiana University Center for Evaluation and Education Policy (CEEP) finds that achievement gaps among high ability students from different economic, racial, and linguistic backgrounds in the U.S. are large and growing, and some of the top achieving groups aren't performing as well as in the past. *Mind the (Other) Gap!: The Growing Excellence Gap in K-12 Education* is a comprehensive study of student achievement test results from every state by CEEP, a center of the Indiana University School of Education. The report estimates it could take 72 years to close the gap between whites and Hispanics in grade four mathematics; 31 years to close the gap between whites and blacks; and 128 years to close the gap between grade four English Language Learners (ELL) and non-ELL students. The report defines the "excellence gap" as the difference in the proportion of students in different demographic groups who score at the advanced level on student achievement tests. The report analyzes the state-by-state results of the National Assessment of Educational Progress (NAEP), nicknamed "The Nation's Report Card," which assesses subject-matter knowledge for students in grades four, eight, and twelve across the country, as well as state assessments.

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Narrowing "Excellence Gaps" key to maintaining America's competitive advantage

While success in narrowing the achievement gap among demographic subgroups of K-12 students in the U.S. at the level of minimum competency has been attributed to the No Child Left Behind Act (NCLB, 2002), *Mind the (Other) Gap! The Growing Excellence Gap in K-12 Education* finds concern about gaps that persist among the same demographic subgroups at the level of *high* achievement. The authors of this report from the Center for Evaluation & Education Policy at Indiana University – Jonathan A. Plucker, Nathan Burroughs, and Ruiting Song – have gathered most of their data from the National Assessment of Educational Progress (NAEP), "which has tracked student reading and math achievement since the early 1970s" in "four basic categories: below basic, basic, proficient, and advanced." (pp. 1, 4)

They found the gap narrowing evidenced by NCLB to be a continuation of what NAEP data had already been showing at the basic level, but they found gaps at the advanced level that were essentially holding steady in reading at grades 4 and 8 and widening in math (for Whites *vs*. both Black and Hispanic, for non-FARM *vs*. FARM (reduced-price lunch eligible), and for non-English Language Learners (ELL) *vs*. ELL). When they used the NAEP 90th percentile scores rather than the scores for advanced achievement, they found that the gap widening disappeared but noted that "smaller excellence gaps caused by declines in performance among leading groups" – as occurred with the Reading Grade 8 tests – "do not represent educational progress and therefore should not be viewed as a success." (p. 16)

When the authors look at the "excellence gaps" by individual states, they find "no consistent pattern" and thus "no clear model to be identified for narrowing gaps for all students." (p. 13) Moreover, "even among the states with improving excellence gaps, in most cases it would take decades – an average of 29 years – for the gaps to close completely . . . a timeline that is somewhat beyond the goals of NCLB." (p. 18) Noting that "the federal government has played little role in gifted education" (p. 24), they speculate that "the decentralization of gifted education funding and policy could be one of the reasons for persisting and widely varying excellence gaps" and observe that "school districts with greater resources

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Using multiple methods for data analysis from 2000 to 2007, the report concludes that excellence gaps on most NAEP results at grades four and eight are growing. The report also finds mixed evidence of progress when presenting the results on a state-by-state basis. In the few cases where the excellence gaps are shrinking, some are shrinking because the top-achieving group is performing more poorly than in the past. Among the key findings in the report:

- In both grades four and eight reading and mathematics, the excellence gaps among different racial groups widened. In grade four mathematics, the growth was particularly stark -- the percentage of white students scoring at the advanced level increased by 5 percentage points, while the percentages of black and Hispanic students increased by only 1 percentage point.

- The excellence gap in grade four mathematics between genders is widening. The percentage of male students scoring at the advanced level in grade four increased by 4 percentage points to 7 percent; female students increased by just 2 percentage points to 4 percent. In grade eight, the percentage of male students scoring at the advanced level increased by 3 percentage points to 8 percent while female students increased their percentage by 3 percentage points to 6 percent.

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Narrowing "Excellence Gaps"

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(which tend to be Whiter and more affluent) would be more likely to provide gifted education programs to their talented students," while "poorer districts, which often have greater Black, Hispanic, and ELL populations, would be unable to provide their students with the same opportunities." (p. 25)

But, as becomes clear at the end of *Mind the (Other) Gap!*, the reason to narrow the "excellence gaps" is not just to achieve educational equity. The authors note that with fewer foreign-born science students and scientists now attracted to careers in the U.S., maintaining the competitive advantage of the American economy requires investing more in gifted American students, particularly in underperforming subgroups as their proportion increases. To this end, they make the following recommendations:

1. Make Closing the Excellence Gap a National and State Priority. This would require the federal government to become involved in gifted education and remove it from the discretion of individual school districts.

2. Acknowledge That Both Minimum Competency and Excellence Can be Addressed at the Same Time. Although "28 of 41 SEAs [State Educational Agencies] claimed that federal policy – in the form of NCLB – had had a detrimental effect on gifted education" (p. 24), the authors argue that both goals are important in their own right.

3. Set a Realistic Goal to Shrink Gaps. Given the long time to eradicate "excellence gaps" at present progress rates, more realistic near-term goals should be set.

4. Determine the Appropriate Mix of Federal, State, and Local Policies and Interventions. The authors "suggest that the highly chaotic nature of the current context provides us with a nearly blank slate" to do this.

5. Include the Performance of Advanced Students in Discussions of Common Standards.

6. Address the "Low-hanging Policy Fruit" Immediately.

7. Conduct More Research – *Much* More Research – on Advanced Learning and Talent Development.

And in every educational innovation, address the following two questions: "How will this affect our brightest students? How will this help other students begin to achieve at high levels?" (pp. 30, 32-33)

The authors of *Mind the (Other) Gap!* close with a 1950 quotation by Martin Jenkins:

> [T]he conservation of intellectual capital is one of the major obligations of education . . . this responsibility is particularly incumbent upon schools serving [African American] youth. . . . We can ill-afford to squander our intellectual capital buy neglecting the development of those highly endowed individuals who are best fitted to assume positions of leadership. . . . To identify exceptional individuals, to provide opportunity for their development, to stimulate them to their highest achievement, to assure that their potentialities become actualities, are both an obligation of and an opportunity for teachers of [African American] youth.

They then note that "in the sentences above, 'African American' can be replaced with 'Hispanic,' 'poor,' or 'ELL' and be similarly relevant." (p. 34)

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Mind the (Other) Gap!: The Growing Excellence Gap in K-12 Education can be accessed online at <http://ceep.indiana.edu/mindthegap/>.

(*Editor's Note*: The preceding two items were excerpted from the *Triangle Coalition Electronic Bulletin* for 18 February 2010 and reprinted with permission. See additional separate story in this issue.)

Freshmen Show Gains in Aspirations for Science Degrees, But Not All Arrive at Finish Line

While entering college freshmen of all racial and ethnic groups display an equal interest in attaining degrees in science or technology, disparities exist among these groups in degree-completion rates, according to new research by the Higher Education Research Institute (HERI) at UCLA. Trends from the Cooperative Institutional Research Program's annual Freshman Survey show that students entering college over the last five years have expressed a much stronger interest in pursuing majors in science, technology, engineering, or mathematics (STEM) than students who entered college in the late 1980's and early 1990's. More than a third (34 percent) of entering freshmen now aspire to a major in these areas. Additionally, underrepresented racial minority students have reached parity with their white and Asian American counterparts in their initial interest as freshmen in majoring in a STEM discipline. The HERI report, "Degrees of Success," also indicates that underrepresented minority students who aspire to a STEM major as entering freshmen have a substantially lower likelihood of completing such a degree within five years than their white and Asian American peers. Among students who aspired toward a STEM degree as entering freshmen, 33 percent of white students and 42 percent of Asian Americans completed a bachelor's degree in a STEM discipline within five years of entering college, compared with 22 percent of Latinos and 18 percent of African Americans. Such findings underscore efforts by the federal government and individual institutions to improve STEM degree-completion rates for underrepresented racial minorities.

"We are losing an alarming proportion of our nation's future science talent during their undergraduate studies," said Mitchell Chang, a UCLA professor of education and co-principal investigator of the study. "If an important national goal is to produce more scientists, it seems that our colleges and universities can aim to improve science-student retention at rates comparable to those for students in other majors." The research is based on a sample of 201,588 students who entered college in 2004 at one of 326 four-year, nonprofit higher education institutions. Within this sample are 62,115 students who initially reported plans to major in a STEM field. The full report is available at <http://heri.ucla.edu/nih/HERI_ResearchBrief_OL_2010_STEM.pdf> .

Parental Influence on Child's Science-Career Decision

Parental influence and access to mathematics courses are likely to guide students to careers in science, technology, engineering, mathematics, or medicine (STEMM), according to research from Michigan State University. The findings of Jon Miller, MSU Hannah Professor of Integrative Studies, and colleagues were presented at a symposium titled "Tomorrow's Scientists and Engineers," at this year's meeting of the American Association for the Advancement of Science. The education of more researchers, engineers, and others in the field of science is critical, said Miller. "Failure to build and maintain a competitive scientific workforce in the decades ahead," Miller said, "will inevitably lead to a decline in the American standard of living." Miller used data from the Longitudinal Study of American Youth, which kept track of nearly 6,000 students from middle school through college, attempting to determine what led them to or guided them away from STEMM careers. According to Miller, "The pathway to a STEMM career begins at home." He said this is especially true in families in which children were strongly encouraged to go to college. "Only four percent of students who experienced low parent encouragement to attend college planned to enter a post-secondary program and major in a STEMM field," he said. "This compares to 41 percent of students whose parents strongly encouraged college attendance."

The research also found that sons were slightly more encouraged than daughters to do well in science and math. Also influential, although not on the same level as parental encouragement, is the parents' education level. The research found that approximately 27 percent of the children of college graduates planned to major in a STEMM field, compared to 18 percent of parents with a high school diploma. The research also reinforced the role mathematics plays in the pursuit of a STEMM career. "Mathematics is a primary gateway to a STEMM career," Miller said, "beginning with algebra track placement in grades seven and eight, and continuing through high school and college calculus courses." The researchers said high school and college science courses have

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"small, positive effects" on a student's decision to pursue a STEMM career, but is not at the level of mathematics.

(*Editor's Note*: The preceding two items were excerpted from the *Triangle Coalition Electronic Bulletin* for 4 March 2010 and reprinted with permission.)

ITEA Officially Becomes ITEEA

Triangle Coalition member, the International Technology Education Association (ITEA), has officially become the International Technology and Engineering Educators Association (ITEEA) as a result of a February balloting of the association's voting membership. This was the association's second attempt to change the name. The first balloting resulted in a 65% favorable vote (66% was needed). This close vote prompted the Board of Directors to request a second ballot, which resulted in over two-thirds of those who voted to approve the name change. This change causes the association to immediately address curriculum and professional development that includes both technology and engineering education at the K-12 level. The association's membership has been comprised of teachers who have been working in both areas and with many of its affiliates already having "engineering" in their association's title. The term engineering is not new to the technology teaching profession; it has been used for over a century in various course titles, discussions, and curriculum efforts. The engineering community played a key role in the creation of this subject area as it has gone through various name changes as industry and technology have changed.

"The name change properly positions the association to deal with the 'T' & 'E' of a strong STEM education. The association has recently produced "The Overlooked STEM Imperatives" (ITEA, 2009), a publication that brings attention to technology and engineering as missing components of a solid STEM education. ITEEA's continuing initiatives with the "Engineering by Design" curriculum work further adds to the promotion of technology and engineering at the K-12 school level. ITEEA's publication titles and electronic communications have started the transition to new names and addresses to be in line with the association's new name. The association's new primary email address is <iteea@iteea.org> and new web address is <www.iteea.org>.

(*Editor's Note*: The preceding item was excerpted from the *Triangle Coalition Electronic Bulletin* for 11 March 2010 and reprinted with permission.)

ESEA Blueprint Released by White House

The Obama Administration has released its blueprint for revising the Elementary and Secondary Education Act (ESEA). The blueprint builds on the reforms already made in response to the American Recovery and Reinvestment Act of 2009 around four areas: (1) Improving teacher and principal effectiveness to ensure that every classroom has a great teacher and every school has a great leader; (2) Providing information to families to help them evaluate and improve their children's schools, and to educators to help them improve their students' learning; (3) Implementing college- and career-ready standards and developing improved assessments aligned with those standards; and (4) Improving student learning and achievement in America's lowest-performing schools by providing intensive support and effective interventions.

Specifically regarding STEM, the blueprint states it "will provide competitive grants to support the transition to higher standards by assisting states in strengthening their STEM programs and by providing substantial support to high-need districts in implementing high-quality instruction in at least mathematics or science and may also include technology or engineering. States will be required to develop comprehensive, evidence-based plans and to align federal, state, and local funds to provide high-quality STEM instruction. States may carry out strategies to improve STEM instruction statewide, such as partnering with statewide Race to the Top partnerships, supporting districts in identifying effective instructional materials, and improving teachers' knowledge and skills in effective STEM instruction for all students, including English Learners and students with disabilities." The 45-page blueprint can be accessed online at <www.ed.gov>.

Draft K-12 Common Core State Standards Available for Comment

The National Governors Association Center for Best Practices (NGA Center) and Triangle Coalition member, the Council of Chief State School Officers (CCSSO), have released the first official public draft of the K-12 standards as part of the Common Core State Standards Initiative, a process being led by governors and chief state school officers in 51 states, territories, and the District of Columbia. The draft standards define the knowledge and skills students should have within their K-12 education careers so that they will graduate high school able to succeed in entry-level, credit-bearing academic college courses and in workforce training programs.

With specific regard to mathematics, the draft standards surface discussions regarding mathematical under-

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standing. According to the draft standards, "asking a student to understand something means asking a teacher to assess whether the student has understood it. But what does mathematical understanding look like? One hallmark of mathematical understanding is the ability to justify, in a way appropriate to the student's mathematical maturity, why a particular mathematical statement is true or where a mathematical rule comes from. There is a world of difference between the student who can summon a mnemonic device such as "FOIL" (first, outside, inside, last) to expand a product such as (a + b)(x + y) and a student who can explain where that mnemonic comes from. Teachers often observe this difference firsthand, even if large-scale assessments in the year 2010 often do not. The student who can explain the rule understands the mathematics, and may have a better chance to succeed at a less familiar task such as expanding (a + b + c)(x + y). Mathematical understanding and procedural skill are equally important, and both are assessable using mathematical tasks of sufficient richness." The NGA Center and CCSSO have already received feedback from national organizations representing, but not limited to teachers, postsecondary education, civil rights groups, English language learners, and students with disabilities. Anyone interested in the standards may provide further feedback by April 2, and review the Draft Core Standards online at <www.corestandards.org/Standards/K12/>.

(*Editor's Note*: The preceding two items were excerpted from the *Triangle Coalition Electronic Bulletin* for 18 March 2010 and reprinted with permission.)

Survey Says Career Changers Who Become Teachers Have Gaps in Preparation, Mentoring

A new national survey points to some significant shortfalls in preparation and support for people who change careers to teach, and also debunks some common assumptions about their paths to teaching. "Career Changers in the Classroom: A National Portrait" was recently released by the Woodrow Wilson National Fellowship Foundation. Funded by MetLife Foundation, the survey finds that the vast majority of career changers (92 percent) pursued teacher education through a university program, and nearly nine in ten considered their programs to have been excellent overall. However, when rating their programs' attention to specific classroom needs, preparation for real-world challenges came up short. On a composite index of ratings, more than one-quarter of those surveyed (28 percent) gave their teacher preparation a "C" or better for addressing such classroom issues as dealing with behavioral issues, incorporating standards into the curriculum, and teaching English language learners.

"Career Changers in the Classroom" also counters stereotypes about career changers as midcareer or second-career executives who take large pay cuts to teach. The survey finds that nearly three in five career changers (57 percent) worked in other jobs for less than ten years before entering the classroom. Two out of three (67 percent) reported that their teaching salaries were the same as or better than their salaries in their previous jobs. The survey does suggest that teacher preparation has become more responsive to contemporary realities in the schools, with newer career changers (those in the classroom for six years or less) assigning their programs significantly higher marks on preparation for current classroom challenges. On the other hand, with fewer than half of recent career changers rating their programs above average in such areas as working with classroom technology and use of assessment data, the findings hint that teacher preparation needs to adapt more fully and quickly to today's classrooms and schools. A previous Woodrow Wilson survey, released in 2008 and also funded by MetLife Foundation, indicated that career changers could be one of the nation's best hopes to fill an anticipated 1.5 million teaching vacancies during the next decade. That study, "Teaching as a Second Career," found that 42 percent of college-educated Americans aged 24 to 60 would consider teaching if the right compensation and preparation were offered. More details on both surveys are at <www.woodrow.org>.

(*Editor's Note*: The preceding item was excerpted from the *Triangle Coalition Electronic Bulletin* for 25 March 2010 and reprinted with permission.)

HOW TO FIND THE
NEWSLETTER
ON THE WEB

The AAPT website has been revamped. To find the Teachers Clearinghouse for Science and Society Education *Newsletter* on the web, go to that site, <www.aapt.org>, and click on "Resources." Then among those resources select "Physics and Society Education."

RECOMMENDED SCIENCE AND SOCIETY EDUCATIONAL RESOURCES

1. Sara Wilmes and John Howarth, "Using Issues-Based Science in the Classroom" *Sci. Teach.*, **76**(7), 24-29 (Oct 09).

The Teachers Clearinghouse for Science and Society Education was established as a response to an emerging trend to infuse societal topics into science courses, a trend which went under the rubric of "Science, Technology, and Society," or "STS." Early issues of this *Newsletter* carried coverage of efforts in STS education such as those developed by Bob Yager at the University of Iowa (he structured the Iowa program following NSTA's "Scope, Sequence, and Coordination" around STS), Jon Harkness in Wausau, WI, the Department of Defense Dependence Schools, and the New York Science, Technology, and Society Education Project. The last was the basis for an article, "The Emerging Generics of an STS Module" in our Fall 1992 issue. Those of you who missed the earlier days of STS education can make up for lost time by reading this article. It contrasts issue-oriented science education with "traditional" science education and shows how issue-oriented science education fosters inquiry and presents science within a meaningful context for students. Included is an "Evidence and trade-offs scoring guide" from the Science Education for Public Understanding Program (SEPUP), which is presently the premier producer of issues-based science curricula. "The inclusion of issues might take time away from studying some science content," the authors write, "but there are powerful payoffs."

2. David A. Vaccari, "Phosphorus: A Looming Crisis," *Sci. Am.*, **300**(6), 54-59 (Jun 09).

Phosphorus, nitrogen, and potassium are the three elements by which fertilizers are characterized. Economically recoverable deposits of phosphorus will last only about 90 years at current use rates worldwide, with U.S. resources lasing only 40 years. One solution is better recycling of phosphorus in agricultural practice, including that excreted in urine. This could also capture excreted nitrogen, presently extracted from air at great energy cost.

3. Gerald G. Marten and Catherine E. Matthews, "EcoTipping Points," *Sci. Teach.*, **76**(7), 43-48 (Oct 09).

The focus of this article is turning a negative ecological tipping point into a positive one, and this article and its accompanying website, <www.ecotippingpoints.org>, offer over 100 examples, searchable by region (Africa, East Asia, Europe, Latin America, Oceania, South Asia, Southeast Asia, and USA-Canada) and by topic (agriculture, business, education, energy, fisheries, forests, public health, urban ecosystems, water and watersheds), also less on plans and curricula, by grade and subject.

4. Grant Gardner, M. Gail Jones, and Mike Falvo, "'New Science' and Societal Issues," *Sci. Teach.*, **76**(7), 49-53 (Oct 09).

". . . the next generation of scientifically literate citizens . . . need not only knowledge of science and technology, but also the ability and motivation to participate in public discourse. By providing students with scenarios that describe complex social problems associated with new science applications, they are better able to bridge science content with common social dilemmas. In addition, complex social issues provide opportunities for teachers to make science meaningful and relevant to students' lives." In these words the authors of this article make the case for STS education and proceed to promote as an appropriate STS education topic, illustrated by three nanotechnolgical applications: 1) tracking people by their scent; 2) detection of disease-causing agents; 3) detection of explosives.

5. <www.eia.doe.gov/energyexplained>.

This new website launched by the Energy Information Administration provides up-to-date graphical and text information for high school students to learn about various sources of energy and how much energy the U.S. produces from each source.

6. Teri Rowland, Lin Chambers, Missy Holzer, and Susan Moore, "Solar Radiation: Harnessing the Power," *Sci. Teach.*, **76**(9), 31-35 (Dec 09).

This article presents a lesson in which students choose where to live on the basis of insolation data from <http://mynasadata.larc.nasa.gov/las/servelets/>.

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7. David Brock, "Working Model Hearts," *Sci. Teach.*, **76**(9), 36-40 (Dec 09).

This article describes how students can learn the physiology of the circulatory system by building a physical model of it.

8. Renee Clary and James Wandersee, "Our Polar Past," *Sci. Teach.*, **76**(9), 47-52 (Dec 09).

This article explains how the authors incorporated historical information about polar exploration in their lessons during the recently-completed International Polar Year (2007-2009).

9. Andreas Schäfer, Henry D. Jacoby, John B. Heywood, and Ian A. Waitz, "The Other Climate Threat: Transportation," *Am. Sci.*, **97**(6), 476-483 (Nov-Dec 09).

With motorized transportation accounting for 23% of energy-related carbon dioxide emissions, 60% of which is due to passenger travel, these authors are justified in concluding that "there will be no solution to the climate threat without changes in transportation." In their analysis of travel around the world, they have found that "regardless of income or geography, people on average spend a roughly constant amount of time on travel." The difference is the mode(s) of transportation used. Those whose annual travel amounts to less than 1000 km use mostly low-speed urban public transportation, while those whose annual travel ranges between 1000 km and 10,000 km use less public transport and mostly vehicles they drive themselves. People with annual travel exceeding 10,000 km "require a substantial share of air traffic or high-speed rail-based ground transportation." This is shown by graphs of the share of transportation provided, respectively, by urban public transport, self-driven vehicles, and high-speed transportation vs. annual travel.

A projected 44% increase in world population by 2050 coupled with increasing travel demand due to rising income "could triple or quadruple world travel by midcentury." The authors project that "automobiles could account for more than 40 percent [of world travel in 2050], high-speed transport for almost 40 percent and low-speed public transport for about 20 percent." Add to this greater emphasis on comfort and safety and the energy bill for transportation, with corresponding increase in carbon dioxide emissions, increases even more, despite the fact that "the decline in fuel use per kilometer and per ton of vehicle . . . has been as much as 80 percent" compared to the Model T. "If consumer preferences for increasingly large and powerful automobiles alone could be moderated, we project there would be a roughly 30 percent reduction in fuel consumption in new cars by the mid 2020s, compared to new cars sold in the United States in the early 2000s," the authors write.

In addition to the reduction of fuel consumption, the expanded use of alternative fuels can also reduce carbon dioxide emissions from transportation. The authors caution that "nearly all biofuel blends deliver only a few percent reduction in greenhouse gas emissions over the course of the fuel's life cycle compared to petroleum fuels" and caution that synthetic fuels from coal, natural gas, or oil shale "can result in fuels with even higher life-cycle greenhouse gas emissions than petroleum, unless CO_2 released during their production is captured and sequestered." But they are "hopeful that the next generation of biofuels, expected to be derived from cellulose rather than from today's feedstocks, will emit substantially less CO_2 over their life cycle." They also look to "the electric vehicle with advanced batteries, perhaps in hybrid mode" and "efforts to develop synthetic oil products" that they feel "hold promise," but feel that hydrogen fuel will not play a meaningful role before 2050.

These authors are able to project future demands for transportation quantitatively in terms of data on past transportation use that they have gathered. But when it comes to how to get the public to accept the changes in transportation needed to reduce their carbon dioxide emissions, they can do no more than speak qualitatively. They point out that "historically, nearly all environmental legislation has been based on regulatory measures" but note increasing interest in "market-based measures." After examining pros and cons of each, they conclude that "neither a pure market-based nor a pure regulatory strategy is likely to succeed." But the need for some kind of strategy is made clear in the author's final statement that "there will be no changes in transportation without coherent government policies requiring them."

10. Chris Wood, "Can China Turn Cotton Green?" *Miller-McCune*, **3**(1), 18-21 (Jan-Feb 10).

Citing the high environmental cost (in terms of water and fertilizer) of growing cotton in both the U.S. and China, this article quotes the conclusion of a research team headed by Pan Jiahua, director of the Research Centre for Sustainable Development and Environment at the Chinese Academy of Social Sciences in Beijing: "A market shift from irrigated, chemical input-intensive growing

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areas such as the U.S. and China toward rain-fed and less -intensive areas in sub-Saharan Africa and parts of Brazil and India would bring significant net environmental gains."

11. Peter Friederici, "The Dirt on Climate Change," *Miller-McCune*, **3**(1), 42-47 (Jan-Feb 10).

This article promotes dirt as a carbon sequestering agent, containing carbon variously in organic molecules and calcium carbonate. The former can be promoted by converting carbon in agricultural wastes into charcoal to make "biochar."

12. National Institute of General Medical Sciences, *The Chemistry of Health*, available on-line at <http:// publications.nigms.nih.gov/chemhealth/>.

This is a 20-page booklet from one of the National Institutes of Health about the chemistry underlying good health, written for high school students.

13. National Institute of General Medical Sciences, *Findings*, available on-line at <http:// publications.nigms.nih.gov/findings//>.

Currently available is the September 2009 issue, which contains articles written for high school students on the following topics: "the discovery and development of the green fluorescent protein" and the role it played in the 2008 Nobel Prize in Chemistry; delivering heart disease medicines directly to blood vessels in the heart without surgery; and the Minority Access to Research Careers program at NIGMS. There are also sidebars on the time-dependent activity of the DNA repair system of the body and why cancer treatment is most effective in the morning; the reason for sleep; algae discovered in Yellowstone hot springs that change arsenic to a less toxic state; and the use of computer techniquess to analyze nucleotide sequences in DNA like words in a text passage.

14. Gilbert N. Plass, "Carbon Dioxide and the Climate," *Am. Sci*., **98**(1), 58-67 (Jan-Feb 10).

This "American Scientist Classic" was originally published in July 1956, 95 years after John Tyndall first proposed that carbon dioxide in Earth's atmosphere produced a warming effect like that of a greenhouse. Plass published his paper at a time that carbon dioxide was being discredited as a determinant of climate change, a year before Keeling would start his well-known atmospheric carbon dioxide measurements at Mauna Loa and decades before the ice core results of the 1980s, according to an accompanying commentary by Gavin Schmidt. Yet Plass was able to match his predicted consequences of adding six gigatons of carbon dioxide to the atmosphere every year from burning fossil fuels to an atmospheric temperature increase of 1.1 degree (C) per century, calculate that a doubling of atmospheric carbon dioxide would mean a 3.6 degree (C) temperature increase (a number since revised downward to 1.2 degrees (C), according to Schmidt), and caution that burning all the known reserves of coal and oil would multiply the present atmospheric concentration of carbon dioxide by seventeen, with a consequent temperature increase of 13.4 degrees (C).

After considering competing theories of climate change, Plass writes that "carbon dioxide theory is the only one that predicts a continually rising average temperature for the remainder of this century because of the accumulation of carbon dioxide in the atmosphere as a result of industrial activity . . . . If at the end of the century the average temperature has continued to rise and in addition measurement also shows that the atmospheric carbon dioxide amount has also increased, then it will be firmly established that carbon dioxide is a determining factor in causing climate change."

15. Alan Dove, "Science Education Crisis Intervention," *The New York Academy of Sciences Magazine*, 16-20 (Winter 2010).

Dove writes that "While Sputnik did spark widespread public fear and inspire a strong political response in the form of the National Defense Education Act of 1958, the actual number of science and engineering enrollments at colleges remained virtually flat throughout the 1960s. Instead of a home-grown talent pool, the Mercury, Gemini, and Apollo programs relied heavily on engineers educated in Europe. The Apollo landing was a thoroughly impressive engineering feat, but it produced little new science."

He then muses that "despite decades of documenting its own weaknesses in science education at the K-12 level, the nation has remained a world leader in scientific and technological achievement. If the U.S. is so awful at teaching science, why are Americans still so good at practicing it?"

While the connection between American science education and American scientific and technological achievement might be considered paradoxical (but see the

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item on Science and Engineering Indicators 2010 in the Triangle Coalition News section of this issue), Dove also states that "it's hard to disagree with those who argue that the country needs to improve the scientific literacy of its lay public" and quotes Physics Professor Jim Gates of the University of Maryland: "Having a scientifically literate public is going to be critical as our nation wrestles with problems whose solutions seem inherently to involve science and technology." Dove continues that Gates "cites climate change, where scientists have had considerable difficulty explaining a well-established phenomenon to politicians and citizens who have little understanding of basic math and physics." Gates also advocates a national science curriculum, which Dove agrees "could help nip some antiscientific trends, such as creationist school boards that attempt to undermine the central organizing principle of biology."

Other suggestions to improve American science education include financial incentives to students and improved classroom technology. Then, at the end, Dove points up another paradox by recalling the Systemic Initiatives of the Clinton years, designed "to help whole school systems make large-scale changes in science education," which "achieved some notable successes in boosting science achievement, particularly in poor rural and urban districts." "Then, in 2002," Dove continues, "Congress passed a mammoth set of reforms called No Child Left Behind. To fund NCLB projects, the NSF had to drain $160 million from Systemic Initiatives budget, effectively sidelining the program less than 10 years after it had begun."

16. Younglin Song, Donna Ahlswede, Christina Clausen, Laura Herbig, and J. Steve Oliver, "Community-Based Inquiry Lessons" *Sci. Teach.*, **77**(3), 61-65 (Mar 10).

The developers of Community-Based Inquiry Lessons (CBIL) describe how they have employed whole-class inquiry (WCI) to determine solutions to societally-related problems ranging from distributing the maximum amount of iron in a spinach vending machine to filtering the Guinea worm from a Nigerian water supply.

17. Fred Guterl, "Where does climate science go from here?" *Discover*, 56-62 (Apr 10).

Interviews with Judith Curry and Michael Mann after the Copenhagen conference on world climate and the "Climategate" hacking of the Climate Research Unit of the University of East Anglia provide two different perspectives in response to the question posed in the title.

18. James J. McCarthy, "Reflections On: Our Planet and Its Life, Origins, and Futures," *Science*, **326**, 1646-1655 (18 Dec 09).

At a Town Hall at the Joint Meeting of the American Association of Physics Teachers and the American Physical Society in Washington, DC, on 13 February 2010, Margaret Leinen of the Climate Response Fund said that carbon dioxide emissions have exceeded the worst case scenarios envisioned by the IPCC (Intergovernmental Panel on Climate Change). This address by the President of the AAAS (American Association for the Advancement of Science) spells out all the details underlying Leinen's assertion. Fig. 7 presents the data that Judith Lean presented at the same meeting, with a distinction made between these CRU data and the data set from the National Oceanic and Atmospheric Administration, as noted in the editor's note following the separate story on Lean's talk in this issue. Fig. 6 shows a ranking of the 50 warmest years on record (based on the CRU data). Fig. 5 shows that only one of eight IPCC scenarios predict fossil fuel emissions exceeding the actual amount. Fig. 8 shows that sea level rise for the past quarter century have followed the high end of climate model projections.

McCarthy says that "as the past decade of new findings has shown, a warming climate does reveal surprises," most of which have been unpleasant. He criticizes the projections of the IPCC as being too conservative, noting that their 2001 inability to "identify any body of science that pointed to a likelihood of a large reduction in Greenland ice during the present century" has been followed by significant thinning and retreat of the Greenland ice cap. Likewise, he finds the 2007 IPCC projected sea-level rise for the 21st century to be conservative relative to other projections, which have prompted the presidents of the island nations of Kiribati and the Maldives to exhort their people to prepare to move. Yet he does find hope to mitigate against climate change in the "wedges" proposed by Socolow and Pacala.

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REVIEWS OF SCIENCE AND SOCIETY EDUCATIONAL RESOURCES

Mark Bauerlein, *The Dumbest Generation: How the Digital Age Stupefies Young Americans and Jeopardizes Our Future or, Don't Trust Anyone Under 30* (Penguin, New York, 2009). 235 pp. $15.95.

I was fortunate to come across this book in the William and Mary College bookstore while vacationing in Williamsburg, Virginia. The title and subtitle immediately attracted my attention. The author, Mark Bauerlein, is a professor of English at Emory University and worked as a Director of Research and Analysis at the National Endowment for the Arts.

In the chapter titled "Screen Time" Bauerlein writes "The 10-year olds' bedroom has become … a multimedia center. Children leave the dinner table…and head off to their rooms to turn on their own shows or crank up iTunes while poring over some homework. Bored with that, they can check a MySpace Forum, or play mortal Combat, or look at school pictures. The long division exercises await while the computer dings a new email coming through, the cell phone buzzes with a new message, and Toonami comes on in a half hour." As a classroom teacher, I began to see evidence of that scenario in 2002.

The book is divided into just six chapters , each with interesting titles; "Knowledge Deficits," "The New Bibliophobes," "Online Learning and Non-Learning," "The Betrayal of the Mentors," and "No More Culture Warriors," in addition to "Screen Time." On page fourteen and fifteen, Bauerlein lists five projects whose goal is to evaluate student's intellectual rankings, including the National Assessment of Educational Progress and the National Survey of Student Engagement. He writes "There are many more important ongoing investigations of the young American intellect…." "One after another, though, they display the same dismal results and troubling implications. Most young Americans possess little of the knowledge that makes for an informed citizen, and too few of them master the skills they need to negotiate an information-heavy, communication- based society and economy." The author goes on to identify student deficiencies in history, math/science/technology, and fine arts. He lists very distressing statistics regarding students' career choices in STEM areas.

Reported in the book are the results of the 2003 National Assessment of Adult Literacy, an evaluation of the literacy of college graduates. "While 40 percent of the grads reached proficiency in 1992, only 31 percent did so in 2003." He also indicates that 27 percent of twelfth grade students who completed the National Assessment of Educational Progress in 2005 were evaluated below basic, up from 20 percent in1992. These results are despite the fact that there were 300 more public libraries in the U S in 2005 than in 1997.

Bauerlein indicates that the cause of these deficiencies is a lack of use of print materials by our youth. On page forty-one he writes "In answer to the question "How often do you go to a library, and what do you do there?" one panelist replied "My dad is still into the whole book thing. He has not realized that the internet kind of took the place of that. So we go to the library almost every Sunday. I actually have a library card, but I have not rented a book for a long time…."

In the chapter titled "The New Bibliophobes" numerous examples of student access to information are cited. The author then concludes the chapter by indicating that "Digital habits have mushroomed, but reading scores for teens remain flat, and measures of scientific, cultural, and civic knowledge linger at abysmal levels." And he asks "Why?"

The difference between the learning environment in school, as opposed to outside of school, is examined, as well as how student use of libraries has changed. Bauerlein writes ""At every university I've entered in recent years, a cheery or intent sophomore sits at each computer station …" "Upstairs, the stacks are deserted and silent."

The author also expresses concern about students' self -perception of their knowledge base, and reality. "Michael Petrilli of the Fordham Foundation terms it "the reality gap between students' expectations and their skills…and the illusion gets punctured all too readily not long after high school graduation." Bauerlein implicates teachers as part of the cause of this situation, as well as the digital environment students are immersed in. He concludes the Chapter titled "The Betrayal of the Mentors" by stating "…the current domestic and geopolitical situation demands that we generate not only more engineers, biochemists, nanophysicists, and entrepreneurs, but also men and women experienced in the ways of culture…."

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The final chapter, "No More Culture Warriors" opens with an interesting analogy to the Rip Van Winkle story. If there is a weakness in this book, it may not be Bauerlein's fault. The weakness lies in identifying solutions to the problems presented. That may be the result of the enormous challenge presented by the problems identified. Not solving those problems presents a great jeopardy to our culture!

- Frank Lock

(*Editor's Note*: Frank Lock has just retired from teaching physics at Lemon Bay H.S., Englewood, FL, and is a frequent contributor of book reviews to this *Newsletter*. His most recent review, of Hans Ohanian's *Einstein's Mistakes*, appeared in our Fall 2009 issue.)

Sheila Tobias and Anne Baffert, *Science Teaching as a Profession: Why it Isn't, How it Could Be* (NSTA Press, 2010), xi + 128 pp. $15.96 (NSTA members); $19.95 (nonmembers). ISBN 0-9633504-8-0.

Sheila Tobias is no stranger to this *Newsletter*. She spoke about her earlier book, *They're Not Dumb, They're Different*, at the NASTS meeting of 1992, and our Spring 1992 issue both covered her talk and reviewed her book. In that earlier book, Tobias surveyed nonscience majors about their experience in taking college courses for science majors. In this book she is joined by science teacher Anne Baffert to survey present and former teachers, administrators, state legislators, and program and policy experts about the state of science teaching in America.

The impetus for writing this book was *Rising Above the Gathering Storm*, the report headlining our Fall 2005 issue which called for 10,000 new science and mathematics teachers per year to educate 10 million minds. Richard Ingersoll of the Center for the Study of Teaching and Policy at the University of Pennsylvania reasoned that persuading the half of new teachers leaving in the first five years *not* to leave would reduce this need for new STEM teachers to 5000 per year. Tobias and Baffert found that improving teachers' work life, including their empowerment outside the classroom, can reduce teacher turnover more than higher pay, mentoring, or professional development. In other words, Tobias and Baffert found that what matters to teachers is treating them as professionals; and, by not doing so, school districts are having to pay the cost of replacing them.

NSTA Executive Director Emeritus Gerry Wheeler points out in his Foreword that professionalism of science teaching has been the missing ingredient of every report calling for reformed science education beginning with *A Nation at Risk* in 1983 and that "lack of professional support of science teachers and the erosion of the public perception of science teaching as a profession" are fundamental reasons that the post-*Sputnik* summer institutes for science teachers didn't have a lasting effect. "Professionalism encompasses reliability and accountability," Wheeler writes, but science teachers have been given no responsibility for developing the standardized tests by which they are being held accountable. And when states developed their science education standards, they ignored all the chapters of the *National Science Education Standards* except those containing content standards. In particular, this eliminated science teachers from the process of implementing assessment standards. Wheeler calls this book a "must-read for anybody seriously interesting in supporting a reform movement that will stick."

In their third chapter, Tobias and Baffert found a connection between the lack of professionalism and gender issues. Higher education has traditionally held a place of honor and it traditionally was a province of men, they write, while lower education was regarded as the province of women – and single women at that. But these female teachers in turn were beholden to the men who provided or raised funds for the schools, and their only training requirement – one more year of schooling than their pupils – made them "cheap and easy to *control*." (p. 32)

Paralleling the evolution of teacher training into what would expected for a profession was institution of the offices of superintendent and principal, men who treated women teachers as "industrial workers." (p. 33) Tobias and Baffert note that neither the National Education Association (NEA, whose membership includes supervisors/managers as well as teachers) nor the American Federation of Teachers (AFT, teachers only, but more concerned with working conditions and salaries) has questioned the power relations between managers and teachers.

In addition, a 1969 book edited by Amitai Etzioni, *The Semi-Professions and their Organization: Teachers, Nurses, and Social Workers*, denigrated these three categories of work dominated by women. This book characterized "semi-professions" (chosen to be less offensive than "sub-professions" or "pseudo-professions") as having shorter training, less legitimate status, less established right of "privileged communication," control over a less specialized body of knowledge, and less autonomy from

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supervision and societal control than professions. It also characterized "semi-professionals" as aspiring to be "professionals" because they view themselves on a higher level than "staff," but it counseled "semi-professionals" to content themselves with being what they are. Tobias and Baffert report that the teachers they interviewed felt that they *are* professionals or could be with the proper reforms – *e.g.*, more community respect and time for self-improvement and collaboration.

Also in the 1960s the NEA developed "The Yardstick of a Profession," listing the following characteristics:

1) Involvement in essentially intellectual activities
2) Command of a body of specified knowledge
3) Requirement of extended professional preparation
4) Demand for continues in-service growth
5) Offering a life career and permanent membership
6) Establishing own standards
7) Placing service above personal gain
8) Provisions of a strong, closely-knit professional organization.

From this Tobias and Baffert have developed their own list of characteristics of a profession applied to secondary science teaching:

1) Knowledge-based expertise that derives from academic training
2) Code of ethical behavior (on and off the job)
3) A moral commitment embodied in a public service (beyond the desire for profit)
4) Higher than average standard of living
5) Autonomy – standards designed and policed by the profession
6) Mobility (including portable benefits) that made it possible for the professional to be independent of a particular employee
7) High status in the minds of ordinary citizens; respect of parents, supervisors and society
8) Career advancement/job security
9) Time set aside for collaboration and research, professional development, self-improvement
10) Input regarding federal/state/local policy
11) Support staff
12) Professional leave time.

One current educational practice that acts counter to the professionalism of teaching is "VAM" (Value-added Assessment Methodology), which seeks to measure teacher *productivity* by their students' performance on standardized tests. As directed toward schools and measured by math and reading scores, this was the intent of No Child Left Behind (NCLB). Forty-five hundred schools serving two million students (8% of federally-funded schools) have failed under NCLB standards, some for four years in a row. Six years of consecutive failure positions a school for "restructuring." To avoid this, many states have lowered the standards of their standardized tests (as they are allowed to do). Tobias and Baffert report that *US News & World Report* describes this as a "race to the bottom." Although science testing is not yet "folded into" NCLB, Tobias and Baffert caution their readers that NCLB has cast its "long shadow" over science education by spawning a "testing culture that has spilled over into annual yearly progress (AYP) requirements." (p. 47) They add that, although NSTA opposes evaluations based on a *single* test, it went along with NCLB lest not doing so would endanger science's place in the curriculum. ("Play ball or risk losing science altogether." (p. 53)) The question then becomes the following: How can science teachers balance their responsibilities to NCLB and the need to train the next generation of scientists and science teachers?

Continuing in their development of "the thesis of this book – the absence of classroom teachers in crafting educational policy overall" (p. 82), Tobias and Baffert report that, twenty years after the publication of *A Nation at Risk*, *A Nation Reformed* found little change in classroom instruction and stated that "*Educators have been treated as part of the problem, not part of the solution.*" Pam Grossman is quoted as saying that "we have gone from . . . a nation at risk to a profession at risk."

Yet, Tobias and Baffert observe that in contrast with high-stakes testing, some education reforms were "designed to elevate teachers' status." (p. 83) One of these has been National Board Certification. Tobias and Baffert recount that in 1858 the American Medical Association (AMA) was formed to eliminate the inequities in the medical profession that resulted from the simultaneous practice of medicine by both medical school graduates and self-proclaimed "doctors." Perhaps because *A Nation at Risk* portrayed similar inequities among teacher credentials, the Carnegie Forum on Education and the Economy, in *A Nation Prepared: teachers for the 21st Century*, called for a board to define standards for teachers, leading to the National Board for Professional Teaching Standards (NBPTS). The Board expressed its standards in terms of "Five Core Propositions":

1) Teachers are committed to students and their learning.

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2) Teachers know the subjects they teach and how to teach those subjects to students.
3) Teachers are responsible for managing and monitoring student learning.
4) Teachers think systematically about their practice and learn from experience.
5) Teachers are members of learning communities.

When studies showed that students of Board Certified teachers performed better on average on achievement tests, all 50 states were encouraging Board Certification. But a year later, in 2005, scores on NCLB high-states tests were *not* higher for students of Board Certified teachers, and improved NCLB scores replaced Board Certification as a measure of "teacher quality." Tobias and Baffert report that the 2007 National Action Plan of the National Science Board (*not* the NBPTS) calls for "national STEM teacher certification guidelines, but explicitly *not* National Board Certification." (p. 88)

In addressing the question of whether Board Certification will "survive the new single focus on pupil's incremental progress as the only measure of teacher effectiveness," Tobias and Baffert suggest that "a key player will be those responsible for teacher education, because high-stakes testing devalues not only teachers' independence but also their certification." (p. 93) Here the authors return to their analogy with the medical profession: when the AMA standards failed to drive out the charlatans, it was realized that medical education had to change. Abraham Flexner's study of medical education at the time led to the replacing of undergraduate medical schools by today's post-graduate medical schools. This, Tobias and Baffert note, would be where the National Science Board's call for "national STEM teacher certification guidelines" comes in.

Lest their readers sense that all is gloom and doom in the world of science teaching, Tobias and Baffert conclude their book by citing some programs that have demonstrated success. They report that the Kenan Foundation, mindful of "the twin issues that we have been tracking in this book: the critical role that STEM . . . teachers play in readying the next generation to compete in the global economy, and the importance of not losing the most skilled of these teachers to attrition" (p. 103), sought to retain teachers by empowering them with leadership training in a two-year part-time program that pairs them with university faculty to work on current research and develop innovative curricula based on it.

They also report on the state of teaching in Finland, where teaching is so respected that there are 10 applicants for every teaching job, with each candidate required to complete a major research project and earn a master's degree. The equivalent of NCLB is achieved by a support staff working with the teacher or in special schools. According to Tobias and Baffert, the goals of the "Teacher Researcher Net" at one of Finland's teacher education universities have a lot in common with the characteristics of professionalism they have been trying to espouse in their book.

It is in this spirit that Tobias and Baffert begin their final chapter with the admonition that "Science teachers need to see themselves as key to the success of the educational enterprise" (p. 113) and make three final recommendations:

1) Attract science teachers to school and district governance.
2) Establish science teacher councils – to participate in decisions such as a) hiring, b) teacher assessment, promotion, retention, and evaluation, and c) standards, curriculum, and student assessments.
3) Establish (additional) alliances between scientists and science teachers (such as that of the Kenan Fellows Program).

\- John L. Roeder

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:

Coverage of MacKay's *Sustainable Energy* and Resource #5 in our Fall 2009 issue indicate the enormous present cost of removing carbon dioxide emissions from the air. It was reported on National Public Radio's "Weekend Edition" on 27 September 2009 that this high cost of "carbon capture" is the main reason that Congressional representatives from coal states are reluctant to support reduction of carbon dioxide emissions. Because mandated reduction of carbon dioxide emissions would be an incentive to advance "carbon capture" technology to the point of making it affordable, David Hawkins of the Natural Resources Defense Council calls it a "policy catch-22."

If we wait for a sufficiently reduced cost of "carbon capture" before we institute it, how much cost reduction would be needed? Would it be achieved soon enough to keep global temperatures from passing a "tipping point"?

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Augustine speaks out on the future of space flight

Norman Augustine is the retired Chairman and CEO of Lockheed Martin Corporation, probably best known in the science education community as the chair of the committee which produced the report advocating massive investment in science education, *Rising Above the Gathering Storm*. But he spoke to the Joint Meeting of the American Association of Physics Teachers (AAPT) and the American Physical Society (APS) in Washington, DC, on 15 February 2010 on a subject dearer to his heart: "A Space Program Worthy of a Great Nation." He spoke of his service on a 10-member committee convened to chart options for future human space flight and his personal concerns about the future of human space flight.

Augustine felt that NASA (the National Aeronautics and Space Administration) is the greatest space agency in the world: it has survived possibly preventable tragedies as well as successes, he said; but, as President John F. Kennedy said, we did it because it was hard. But Augustine also felt that NASA was in the precarious condition of being at a tipping point – becoming too bureaucratic, and with no human extraterrestrial flight in more than 40 years and dependent on Russians to transport astronauts to the International Space Station.

This dependence on Russia signals that Russia is now our partner rather than our competitor in space. In fact, Augustine noted that some have called for the internationalization of space flight, though there is conflicting opinion on what the future of human space flight should be.

Augustine reported that the committee on which he served concluded that human space flight had no financial justification but cited that it could chart a path for the survival of human civilization. They found that NASA's funding did not match its objectives, though, with a resultant slippage of seven years in developing the Aries-1 rocket, delaying its intended use. To have a strong program, Augustine said, we need to add $3 billion per year to NASA's budget. But President Obama canceled the Aries-1 and the entire Constellation program and was able to allocate $1.25 billion per year to human space flight, with the result that program goals will shift to developing new technology to achieve desired missions more efficiently. Augustine seemed resigned to the realization that this is probably the most affordable space program the U.S. can afford, given current economic conditions.