TEACHERS CLEARINGHOUSE FOR SCIENCE AND SOCIETY EDUCATION NEWSLETTER

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The Lessons of Finnish Education

"Educational systems are facing a twin challenge: how to change school so that students may learn new types of knowledge and skills required in an unpredictably changing knowledge world, and how to make that new learning possible for all young people regardless of their socioeconomic conditions. To be successful with these challenges is both a moral and economic imperative for our societies and their leaders." So writes Pasi Sahlberg, Director General of the Centre for International Mobility and Cooperation at the Finnish Ministry of Education and Culture, at the beginning of *Finnish Lessons: What can the world learn from educational change in Finland?* (Teachers College, New York, 2011).

Finland's answer to the challenges faced by educational systems is a twofold result of educational reform that began in the 1970s: a nine-year *peruskoulu* begun at age seven, divided into six years of primary plus three years of lower secondary, followed by three years of vocational or general upper secondary school. The general upper secondary school is ungraded and organized around five or six terms of six to seven weeks, with graduation requiring 75 courses, each consisting of 38 lessons.

Finland's high standing in the PISA results from 2000, 2003, 2006, and 2009 left the world taking notice of Finland's educational system, all the more so because "Finns seemed to learn all the knowledge and skills they demonstrated on these tests without private tutoring, after-school classes, or large amounts of homework." (p. 37) Moreover, Finnish educational costs are lower than those of other countries (5.6% of GDP, *vs.* 5.7% for OECD, 7.6% for U.S.), one reason being early intervention to address special educational needs, thus avoiding the stigma and expense of requiring students to repeat a grade (at their time of graduation up to half of *peruskoulu* students will have had some special education, so "it is nothing special anymore." (p. 47)).

The real secret behind this success is how Finland has structured its teaching profession. "It was assumed very early in Finland's reform process that instruction is the key element that makes a difference in what students learn in school, not standards, assessment, or alternative instructional programs." (p. 39) Every year 20,000 upper-secondary graduates apply to teacher education programs at the eight Finnish universities (where education for all is free), but only 2000 are chosen. Sahlberg calls the ability to select teachers from the top quintile of secondary graduates the "Finnish advantage." Future Finnish teachers are taught at the university – through the level of attaining a master's degree – as they are expected to teach – with "cooperative learning, problem-based learning, reflective practices, and computer-supported education," all pedagogical ideas borrowed from other countries such as the U.S., U.K., Canada, Sweden, and Germany, but styled in a uniquely Finnish way.

Once they are placed in schools, Finnish teachers – now regarded as well-educated professionals – are trusted as professionals to be effective practitioners. Professor of Education Hannele Niemi at the University of Helsinki is quoted as saying that "Parents trust teachers the way that they trust their dentists." They are expected to collaborate with other teachers to design their school's curriculum and assessment of student progress. But the only external standardized assessment is the National Matriculation Examination given at the end of upper-secondary education. What Sahlberg calls "The Finnish Way" is in contrast to what he calls the Global Education Reform Movement (acronymed GERM).

Rather late in his book, Sahlberg acknowledges that the development of Finland's present educational system was not without criticism from elements of the business community, who argued that insistence on social equality educated to the lowest common denominator and pre-

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AN EDITORIAL: This issue is a collaborative effort

Ever since I began editing this *Newsletter* I have sought to receive contributions from as many people as possible. At the beginning I could count on my Clearinghouse cofounders, Irma Jarcho and Nancy Van Vranken, and we have also obtained contributions through the years from Mike Passow on the earth sciences, Bernice Hauser on primary education, John White on technology, and Betty Chan on biology. From time to time other readers would send us contributions as well. But there have been times, especially since Irma Jarcho became an Editor Emerita in 2002, that I seemed to be writing most of the contributions myself. Unless my identity as the writer in the first person was needed, I have rarely given my contributions a byline.

But in this issue I am happy to show what seem to be more bylines than ever before. Along with articles by Mike Passow (on pp. 3-4) and Bernice Hauser (on pp. 12-16), Einstein Distinguished Fellow DaNel Hogan has contributed two lists of resources (on pp. 7-11), and former NSTA and NASTS President Bob Yager has started a column of "Musings." And *all* the book reviews in this issue are contributed: *two* by Frank Lock (who has contributed several book reviews in the past) and one by Art Hobson (who I would like to see write *more* for the *Newsletter*).

So thanks to Bernice, Mike, DaNel, Bob, Frank, and Art for making this issue a truly collaborative effort. And, for those whose contributions were not in this issue, perhaps you'd like to contribute something for the next.

- 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:

The U.S. Department of Justice filed an amicus brief that "'genomic DNA that has merely been isolated from the body without further alteration or manipulation' should not be eligible for patenting," according to a report in the 5 November 2010 issue of *Science*, in support of a decision by Federal Court Judge Robert Sweet, according to a report in the 9 April 2010 issue of *Science*. The biotech industry argues that not allowing companies to patent genes thwarts their research efforts. Do you agree with Judge Sweet's decision? Or do you agree with the argument of the biotech industry?

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.

There's Always Time to Learn — Online and Blended Course Programs in Earth Science Education

by Michael J. Passow, Earth Science Correspondent

"I'd like to enhance my knowledge, but don't have time to drive to and from a campus after school." This familiar complaint has led to new approaches to enhance professional understanding and academic achievement of earth science teachers — distance learning programs. Many universities, institutions, and organizations now offer web-based courses to increase subject area knowledge, and, in some cases, earn course credits. This report will focus on four representative programs.

Mississippi State University offers one of the most extensive and respected suite of programs and courses through their Center for Distance Education, <http://www.distance.msstate.edu/>. The Teachers in Geoscience Program is a 12-course, 36-credit hour program of study. Coursework covers meteorology, geology, astronomy, oceanography, hydrology and environmental geoscience. All are taken online, with the exception of a final capstone field course offered at a variety of locations around the country, including Yellowstone & the Grand Tetons; Central Arizona, including the Grand Canyon; Eastern New York; the Outer Banks of North Carolina; San Salvador Island, Bahamas; Western Washington State, including Mount St. Helens and Mt. Rainier; the Eastern Sierra, including Yosemite; Western Lake Superior; and the Great Plains Storm Chase.

Teachers located throughout the country have had high praise for the quality of these courses, and their applicability to curriculum development to meet local State Standards. The Mississippi State Geoscience Distance Learning Programs also include degree-granting programs in applied, operational, and broadcasting meteorology. Altogether, the Center for Distance Education offers study in 28 academic science, engineering, and business administration fields.

Montana State University, physically located in Bozeman, also provides one of the most respected online programs, <http://eu.montana.edu/online/>. In the earth sciences through the master of science in science education program, Montana State offers 15 graduate courses, ranging from "Fundamentals of Oceanography" and "Historical Geology" to "Dinosaur Paleontology" and 'Geology of the Moon." Teachers can study "K-14 Earth System Science" and "Weather and Climate for Teachers."

Courses and degree programs are also available for biology, chemistry, physics, elementary education, and many other fields <http://www.montana.edu/msse/course%20catalog%20info.htm>. Coursework leading to a masters degree can begin in the fall, spring, or summer, and a full 30-credit program usually takes $2^1/_2$ to 4 years, depending on how many courses one takes each term.

Informal Science Education institutions also provide excellent online professional development opportunities. One of the most remarkable are the Seminars on Science at the American Museum of Natural History (AMNH), <http://www.amnh.org/learn/>. These six-week programs are developed and taught by teams of world-class AMNH scientists and classroom teachers from the life, earth, and physical sciences. Learners wherever they are located connect with to the Museum's scientists, laboratories, expeditions and specimens through online images, videos, interactive simulations, essays, and vibrant discussions between participants and mentors. Eight colleges and universities partner with the AMNH to provide graduate credit.

The themes of courses vary from term to term. Examples of current offerings include: Climate Change; The Solar System; The Ocean System; Space, Time, and Motion; and The Link Between Dinosaurs and Birds. Leading each course are one or more museum scientists and experienced educators. Each week, participants must read the online essays, case studies, and other assignments. They utilize data visualizations, interactive simulations, images, and videos. Where appropriate, they follow links to materials developed by such renowned organizations as the Goddard Institute for Space Studies and the National Oceanic and Atmospheric Administration. Online discussions engage learners in reflection on course content, support and model the inquiry process, and foster interaction with scientists, seminar instructors, and fellow students. Each course culminates in a final project that can either take the form of a proposal that explains how they would research a particularly interesting seminar topic, or creation of an inquiry-based lesson plan focusing on a key course concept to be incorporated into their own teaching.

The AMNH recently began a 15-month program leading to a masters of arts in teaching degree, with a focus on earth and space science, <http://www.amnh.org/education/mat/>. This is the first urban residency pro-

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Online Earth Science Ed

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gram offered by a museum. It offers a blend of "live" and "online" coursework, teaching experiences at the museum and in mentored programs at partnering schools in New York City and Yonkers, and ongoing professional support following graduation. Selection for this program is highly competitive, and the first cohort began in June 2012. (Your earth science correspondent is co-teaching one of the first courses these candidates are taking, "Applied Research and Methods in Informal Science Settings.")

The final example of online programs is the American Meteorological Society's "DataStreme" courses. Currently, these include "DataStreme Atmosphere" <http://www.ametsoc.org/amsedu/dstreme/DSindex.html>; "DataStreme Ocean" <http://www.ametsoc.org/amsedu/DS-Ocean/index.html>; and "DataStreme Earth's Climate System" <http://www.ametsoc.org/amsedu/ECS/index.html>. Each 12-week course involves a blend of readings from textbooks specifically created for these courses and web-provided instructional activities, many using real- and near-real-time data. Since 1994, more than 17 thousand teachers have participated in the DataStreme courses. The information they gained has been shared with more than 300,000 colleagues, and, in turn, has had a role in the education of many millions of students, making this one of the longest-lasting and most effective programs in earth science education ever.

Grants and other funding support have allowed DataStreme participants to earn free graduate credits through the State University of New York at Brockport. The AMS Education program also offers undergraduate versions of these courses: AMS Weather Studies <http://www.ametsoc.org/amsedu/online/info/>; AMS Ocean Studies <http://www.ametsoc.org/amsedu/online/oceaninfo/>; and AMS Climate Studies <http://www.ametsoc.org/amsedu/online/climateinfo/>. More than 200 institutions contract with the AMS to provide these courses and expand their science offerings. Many are minority-serving institutions. Some engage with secondary schools to provide credit-granting opportunities for high school students.

There are many other online programs available for earth science and other educators interested in lifelong learning opportunities. What has become more clear than ever in 21st century professional development is that no teacher need be geographically isolated from quality courses.

Finnish Education

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ferred a standards-based system with assessments. He notes, though, that these critical voices were stilled when the 2000 PISA results were published. Yet being the leader is the hardest position to maintain, and Sahlberg expresses concern that the current world financial crisis is forcing consolidation of Finland's schools, decreasing support services, and producing layoffs, plus increasing national control. Moreover, increased social unrest resulting from increased income inequality poses difficulties for education.

At the same time, Sahlberg keeps his eye on the future by envisioning emerging features in Finnish education, resulting from increased learning of factual knowledge outside the classroom, chiefly from the Internet. Sahlberg sees this leading to a personal roadmap for learning for each student. And with less classroom time spent on traditional learning, he sees the classroom as a place for more group projects and activities, real-world group problem solving, and development of interpersonal skills. "Conventional knowledge tests as we know them now will gradually give space to new forms of assessment," which will require increased engagement of students in learning, with greater emphasis on the importance of creativity, he adds. (p. 142) Manifestation of these features will require renewed dedication to what has already enabled Finland to reach its present achievements – what Seymour Sarason has likened to the educational philosophy of John Dewey – "creative curricula, autonomous teachers, courageous leadership," rather than "competition, choice, test-based accountability, and performance-based pay." (pp. 144-145)

Ways in which the "Finnish Way" contrasts with the GERM (Global Education Reform Movement), according to Sahlberg.

GERM	The Finnish Way
Standardized teaching and learning	Customized teaching and learning
Focus on literacy and numeracy	Focus on deep, broad learning
Prescribed curriculum	School-based/teacher-owned curriculum
Using market reform ideas	Honoring teacher professionalism
Test-based accountability and control	Shared responsibility and trust

Blue Ribbon Commission issues Nuclear Waste Report

Pulling the financial plug on Yucca Mountain, mandated by Congress 25 years ago to be the repository for America's high-level commercial nuclear waste, has left America's nuclear waste management program at an impasse. To address this impasse, President Obama directed Secretary of Energy Steven Chu to form the Blue Ribbon Commission on America's Nuclear Future, which issued its final report in January 2012.

The Executive Summary of the Commission's report collects the contents of the report into eight key recommendations:

1. "A new consent-based approach to sighting." A top-down federally-mandated approach will not work. Instead, the commission recommends a transparent process which enlists the acceptance, if not the support, of all levels of government, even though it takes longer, holding up the siting of the Waste Isolation Pilot Plant (WIPP) as a repository for transuranic radioactive waste as an example. They suggest 15-20 years as a reasonable siting time for a geologic repository, 8-10 years for a storage facility.

2. "A new organization to implement the waste management program." Because the US Department of Energy has not inspired trust in its ability to manage nuclear waste, the commission recommends that a presidentially-appointed board confirmed by the Senate run a new organization "to site, license, build, and operate facilities for the safe consolidated storage and final disposal of spent fuel and high-level nuclear waste at a reasonable cost and within a reasonable timeframe," also the safe transport of this waste. (Still to be resolved is whether defense and civilian waste continue comingled or whether Department of Defense waste continue as the responsibility of the Department of Energy.)

3. "Access to utility waste disposal fees for their intended purpose." The Nuclear Waste Fund, which receives a fee for every nuclear-generated kilowatt hour, has been comingled with other US funds, leaving only $27 million unspent, which is inadequate to meet the federal government's contractual obligation to receive and dispose of spent reactor fuel. The unspent $27 million should be made available to the new nuclear waste management organization, and future utility contributions to the Nuclear Waste Fund in excess of amounts currently needed should be placed in escrow, so that they can be drawn when needed.

4. "Prompt efforts to develop a new geologic disposal facility." "Deep geologic disposal capacity is an essential component of a comprehensive nuclear waste management system for the simple reason that very long-term isolation from the environment is the *only* responsible way to manage nuclear materials with a low probability of re-use. . . ." This conclusion is shared by all who have considered this question, and there will be nuclear waste which meets this criterion regardless of the amount of reprocessing in the nuclear fuel cycle. Because the commission was not a siting commission, it did not evaluate the suitability of Yucca Mountain. But the commission observes that since the inventory of spent U.S. reactor fuel will soon exceed the intended capacity of Yucca Mountain, the search for a new nuclear waste disposal site would be needed anyway.

5. "Prompt efforts to develop one or more consolidated storage facilities." Storage prior to disposal gives spent fuel additional time to cool, and consolidated storage frees shut-down reactor sites from maintenance just to store spent fuel, and this will be needed until a geologic repository is available. Yet storage cannot be allowed to become a dead end for spent fuel, and new storage facilities must take into account lessons learned from the Fukushima earthquake and tsunami.

6. "Early preparation for the eventual large-scale transport of spent nuclear fuel and high-level waste to consolidated storage and disposal facilities." The past record of transporting radioactive materials has been excellent, but transporting spent fuel to a geological repository will involve much more traffic and many more communities along many routes. The Department of Energy should educate those communities, and thus gain their acceptance, well in advance of when the actual transport will occur, beginning with communities closest to sites of reactors which have been shut down.

7. "Support for advances in nuclear energy, technology and for workforce development." Any technological benefit can be improved, and that goes for nuclear energy technology. Also important is preparing and maintaining a workforce to use new technology, particularly that relating to the storage, transport, and disposal of spent reactor fuel.

8. "Active U.S. leadership in international efforts to address safety, non-proliferation and security concerns." "With so many players in the international nuclear technology and policy arena, the United States will increasingly have to lead by engagement and by example," and "the United States cannot exercise effective leadership on issues related to the back end of the nuclear fuel cycle so long as its own program is in disarray." The commission

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Clearinghouse Update

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

More Wedges

Our Fall 2004 issue reported on the paper by Pacala and Socolow in the 13 August 2004 issue of *Science* laying out a strategy to stabilize atmospheric carbon dioxide by seven "wedges," each representing 25 gigatons of carbon *not* emitted into the atmosphere. This was followed by coverage in our Spring 2005 issue of a talk by Socolow on the same topic. Our Spring 2008 issue covered another talk by Socolow, this one increasing the number of wedges required to eight; and our Winter 2012 issue reported on an online paper in which Socolow increased the number of wedges further to nine. But in his own article in the 10 September 2010 issue of *Science*, Martin Hoffert, whose concern about carbon dioxide has been reported in our Winter 2004 and Winter 2005 issues, argues that increasing numbers of coal-burning power plants in India and China will increase carbon emissions to the point of requiring *eighteen* wedges. He also notes the scenario of Davis, *et al.*, in the 3 September 2010 issue of *Science*, which calls for yet another seven wedges for a total of *twenty-five*.

Update on Taxol

The first reference to the ovarian cancer drug taxol in this *Newsletter* came in an Infusion Tip in our Fall 1991 issue, where students were asked to decide the justification to fell six 100-year-old Pacific yew trees to treat one patient. Subsequent updates in our Fall 1993 and Fall 1994 issues reported on alternate ways to produce taxol. Tiangang Lui and Cheitan Khosla in the 1 October 2010 issue of *Science* report that taxodiene, the precursor terpine to taxol, can now be synthesized from isopentyl pyrophosphate and dimethylethyl pyrophosphate in *E. coli* that have had three Pacific yew enzymes genetically transplanted, with suitable biochemical adjustments (in effect, biochemical engineering). From taxodiene, Ajikumar, *et al.*, have also made the next product *en route* to taxol, taxodiene-5α-ol. After this, "several additional enzyme-catalyzed reactions" are needed to make taxol, "although at least some of these transformations may be chemically feasible."

Update on Driverless Cars

Our Fall 2008 issue reported on Alain Kornhauser's talk to the Princeton Sigma Xi chapter about Princeton's entry in the DARPA (Defense Advanced Research Project Agency) competition for driverless cars. A news item in the 22 October 2010 issue of *Science* describes a modified Piaggio electric van equipped with cameras, lasers, and a navigation system but no active driver which tracked a similar vehicle from Parma (Italy) to Shanghai (China). More recently, in October 2012 California Governor Gerry Brown signed legislation making provision for driverless cars on California roads.

Kepler Exonerated

In our Winter 2005 issue we reported that Joshua and Anne-Lee Gilder cited the presence of mercury in the moustache and hair from the head of the exhumed body of Tycho Brahe as evidence of the cause of the great Danish astronomer's death, which they sought to pin on Brahe's assistant, Johannes Kepler. According to BBC News, re-exhumation of Brahe's body led to further tests, which revealed that "the levels of mercury were not high enough to have killed him."

Nuclear Waste Report

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advocates working the with International Atomic Energy Agency (IAEA) in developing multinational fuel-cycle facilities and praises "U.S. sponsorship of the recently-created IAEA global nuclear fuel bank" as a way to give nations access to nuclear fuel without having to engage in uranium enrichment.

In addition to not evaluating Yucca Mountain as a geological radioactive waste repository, the commission did not propose any other specific repository sites, nor did it evaluate nuclear energy as a source for U.S. electrical energy, because it was not chartered to do so. But in the penultimate paragraph of its Executive Summary, it writes the following:

> The problem of nuclear waste may be unique in the sense that there is wide agreement about the outlines of the solution. Simply put, we know what we have to do, we know we have to do it, and we even know how to do it. . . . the core difficulty remains what it has always been: finding a way to site these inherently controversial facilities and to conduct the waste management program in a manner that allows all stakeholders, but most especially host states, tribes and communities, to conclude that their interests have been adequately protected and their well-being enhanced — not merely sacrificed or overridden by the interests of the country as a whole. (p. xv)

The Commission was chaired by former Congressman Lee Hamilton (D-IN) and former National Security Advisor Brent Scowcroft. Its report is available online at <www.brc.gov>.

An Einstein Fellow Responds

Albert Einstein Distinguished Fellow DaNel Hogan responded to our preceding issue as follows: "I was happy to see the energy Literacy Framework detailed in the Teachers Clearinghouse *Newsletter*. The most current website for the framework is <http://www1.eere.energy.gov/education/energy_literacy.html>, where you can find PDF versions of the document and you can order up to five hard copies." DaNel has also sent us two annotated lists which should be of interest to *Newsletter* readers – one of Teacher Fellowships and Opportunities, the other of Energy Education Resources and Opportunities. We are grateful to DaNel for her kind words and for the lists she has contributed to this issue.

(*Editor's Note*: Although some of the current deadlines for some of the Teacher Fellowships and Opportunities may have passed, please note that these programs seek applicants every year. Those interested can use the current deadline to gauge the deadline for the following year's applications.)

Teacher Fellowships and Opportunities

Albert Einstein Distinguished Educator Fellowship
Eligibility: K-12 STEM Teachers with at least 5 years teaching experience
Website: www.einsteinfellows.org

Please consider applying if you are eligible and/or pass on to dynamic K-12 STEM teachers you know who may be interested in applying. (NOTE: All elementary teachers are considered STEM teachers and we need the elementary voice represented!)

The Albert Einstein Distinguished Educator Fellowship Program is a paid fellowship for K-12 science, technology, engineering, and mathematics (STEM) teachers. Einstein Fellows spend a school year in Washington, D.C., serving in a federal agency or on Capitol Hill. To learn more about the program – including how to apply – visit <www.einsteinfellows.org>.

Applications are due 6 December 2012.

Knowles Science Teaching Foundation Teaching Fellowships
Eligibility: High school science or math teacher who is working on subject specific degree or is within the first two years of teaching in the classroom (not a hard and fast rule but meant for early career teachers)
Website: http://kstf.org/programs/teaching/apply.html

Each year, KSTF awards Teaching Fellowships to exceptional young men and women committed to teaching science and mathematics in United States high schools. The foundation believes the commitment to teaching merits the deepest respect and support. Their Teaching Fellowship is designed explicitly to meet the needs of teachers from the time they begin working on a teaching credential through the early years of their career.

Teaching high school science and mathematics is a complex endeavor. Throughout the five-year program, Fellows are introduced to a variety of teaching resources, curriculum materials, research and experts in the field that help them study and reflect on their work as teachers. Every KSTF Fellow receives ongoing feedback and support from teacher developers, all of whom have extensive experience in science and mathematics education. Summer and academic year professional development, collaborative lesson study and yearly portfolios that document each Fellow's progress as a teacher are just a few of the Fellowship aspects that help inform and enhance Fellows' professional growth.

Applications are due 9 January 2013.

The Kavli Institute for Theoretical Physics Teachers' Conference
Eligibility: High School Science Teacher
Website: http://www.kitp.ucsb.edu/outreach/teachers/conferences

Go to website and click on "Join the Mailing List" to get updates on when the application opens. Request hotel and travel support when applying to get airfare and one night hotel stay covered. The conference usually takes place during second semester of the school year.

The KITP is dedicated to a series of one-day conferences designed to bring secondary school science teachers in the U.S. into close contact with some of the world's leading experts in the most exciting current areas of forefront physics research. This is done in conjunction with KITP programs and conferences, which bring to Santa Barbara many of the world's leaders in a given research area to advance the scientific frontiers in that area through discussion and research collaboration. The organizers of the

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Teacher Fellowships

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teachers' conference select speakers from this group known for their talents as expositors to general audiences, as well as for their stature as scientists. The conferences are scheduled to give ample time for questions and discussions from the audience, with talks typically about 40 minutes followed by an interaction period of 15-20 minutes. At lunch teachers gather with the speakers and other scientists for informal discussion along with great food.

NOAA (National Oceanic and Atmospheric Administration) Teacher at Sea Program
Eligibility: K-12 teacher or administrator, college or university teacher, museum or aquarium educator, adult education teacher
Website: http://teacheratsea.noaa.gov/

Participants are assigned a cruise aboard one of NOAA's ships or a partner charter ship. NOAA conducts three main types of cruises:

- Fisheries research cruises that perform biological and physical surveys to ensure sustainable fisheries and healthy marine habitats.
- Oceanographic research cruises that perform physical science studies to increase our understanding of the world's oceans and climate.
- Hydrographic survey cruises that scan the coastal sea floor to locate submerged obstructions and navigational hazards for the creation and update of the nation's nautical charts.

Participants can expect to be at sea anywhere from one week to one month, with the average cruise lasting 12-14 days. Most participants try to sail on cruises offered during the summer vacation, but cruises take place throughout most of the year on a space-available basis.

The program pays for all necessary travel costs, including transportation to and from the ship, lodging, and per diem allowance. Participant's airfare is paid for up front by the program and all other costs are reimbursed.

Applications are due 31 October 2012 at 5 pm EST.

Energy Education Resources and Opportunities

1. The Department of Energy Office of Energy Efficiency and Renewable Energy has a searchable library of K-12 Lesson Plans & Activities <http://www1.eere.energy.gov/education/lessonplans/default.aspx>. You will also find the Energy Literacy framework highlighted on this page. The Energy Literacy framework is a standards-like document for educators which identifies the concepts from both the natural and social sciences that people would know and understand if they were energy literate. There are links to ScienceEducation.gov and to an Energy Basics site that are very useful as well.

2. The Department of Energy's Energy Saver site includes energy saving content as well as how-to articles and videos, calculators, and a blog. Beyond providing information about low-cost ways to lower household energy bills, the site also provides information about local tax credits, rebates, and energy efficiency financing that may be available in different communities.
<http://energy.gov/energysaver/energy-saver>

3. Green Ribbon Schools is a national program recognizing schools making concerted energy efficiency, conservation, and sustainability efforts. See if your state is involved and learn about what it takes to become a Green Ribbon School. <http://greenribbonschools.org/>

4. The Green Schools National Network (GSNN), which is a non-profit organization, advances the national Green & Healthy Schools Movement by connecting like-minded and passionate education, non-profit, corporate and public sector individuals and programs. GSNN is the national umbrella organization that works collaboratively with others to improve education in the United States. Education for sustainability helps young people gain the knowledge, skills, motivation, and hands-on experiences to make the world a better place for everyone and everything.
<http://www.greenschoolsnationalnetwork.org/>

5. The NEED (National Energy Education Development) Project <www.need.org> has a large library of energy curricula on a wide range of energy topics, differentiated among primary, elementary, intermediate, and secondary levels. Specific curricula you will find useful can be found at the following site, which sorts the curricula according to subject: <http://www.need.org/Curriculum-Guides-by-Subject>

6. Energy4me is another organization that has resources and activities for students and also has free kits teachers can order to teach about energy topics. <http://www.energy4me.org/>

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Energy Education Resources

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7. The U.S. Energy Information Administration (EIA) has an Energy Kids site <http://www.eia.gov/kids/> where you can find a wide range of activities for students and information about how teachers can put this site to use. They also have a lot of very useful data and analysis concerning energy on their main site <http://www.eia.gov/>.

8. Energy 101 videos from the U.S. Department of Energy are short videos on a variety of energy-related topics at <http://www.youtube.com/playlist?list=PLACD8E92715335CB2&feature=plcp>. The US-DOE also has a general video site that can be searched for other topics and energy related talks at <http://energy.gov/videos/>.

9. The Switch Energy Project is a film, web, and education program to build energy awareness and efficiency, and help us move forward to a smarter energy future. They have a lot of short video clips on a wide range of energy topics that teachers may find useful and students may find interesting. <http://www.switchenergyproject.com/index.php>.

10. Climate Literacy & Energy Awareness Network (CLEAN) houses a reviewed collection of K-20 educational resources meant to help students' understand the core ideas in climate and energy science. These resources have been linked to the essential climate and energy literacy principles and are searchable in a variety of ways. <http://cleanet.org/>

11a. PBS America Revealed – Episode 1: Food Machine: Over the past century, an American industrial revolution has given rise to the biggest, most productive food machine the world has ever known. Host Yul Kwon explores how this machine feeds nearly 300 million Americans every day. He discovers engineering marvels we've created by putting nature to work and takes a look at the cost of our insatiable appetite on our health and environment. <http://www.pbs.org/america-revealed/episode/1/>

11b. PBS America Revealed – Episode 2: Nation on the Move: America is a nation of vast distances and dense urban clusters, woven together by 200,000 miles of railroads, 5,000 airports, and 4 million miles of roads. These massive, complex transportation systems combine to make Americans the most mobile people on earth. <http://www.pbs.org/america-revealed/episode/2/>

11c. PBS America Revealed – Episode 3: Electric Nation: Our modern electric power grid has been called the biggest and most complex machine in the world, delivering electricity over 200,000 miles of high tension transmission lines. But even though the grid touches almost every aspect of our lives, it's a system we know very little about. <http://www.pbs.org/america-revealed/episode/3/>

11d. PBS America Revealed – Episode 4: Made in the USA: American manufacturing has undergone a massive revolution over the past 20 years. Despite all the gloom and doom, America is actually the number one manufacturing nation on earth. Yul Kwon crosses the nation looking at traditional and not-so traditional types of manufacturing. <http://www.pbs.org/america-revealed/episode/4/>

12. The National Academy of Sciences – What You Need To Know About Energy: As debates about energy grow more intense, Americans need dependable, objective, and authoritative energy information. The National Academies, advisers to the nation on science, engineering, and medicine, provide the facts about energy – a complex issue that affects us as individuals and as a nation. <http://needtoknow.nas.edu/energy/>

13. Our Children's Trust has videos of youth from around the country talking about how climate change is affecting them and their families. It also details the actions they are taking to make a difference. <http://ourchildrenstrust.org/trust-films> They are partnered with iMatterMarch at <www.imattermarch.org>.

14. Alliance for Climate Education (ACE) provides free high school assemblies with a conservation message that challenges students to DOT – do one thing – and to join student action teams. Visit their website to learn how to schedule an assembly at your high school today. ACE is the national leader in high school climate science education. They are dedicated to educating America's high school students about the science behind climate change and inspiring them to do something about it – while having fun along the way. ACE delivers two core offerings: the ACE Assembly and the Student Action Program. <http://www.acespace.org/>

15. Envirolution is dedicated to developing and scaling dynamic K-12 education, job training, leadership academy, and community outreach programs centered around green industries and green energy. With a focus on service learning, their programs not only provide career de-

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velopment for students, but also enable their participants to give back to their communities. Envirolution™ seeks to promote global change by championing local efforts that empower citizens to do positive, meaningful work and to make a good living while giving back to their own social and environmental communities. <http://envirolution.org/>

16. The Green Education Foundation is a non-profit organization that provides curriculum and resources to K-12 students and teachers worldwide with the goal of challenging youth to think holistically and critically about global environmental, social, and economic concerns and solutions. They have a K-12 Lesson Clearinghouse as well as a variety of challenges which students can participate in related to environmental education. <http://www.greeneducationfoundation.org/>

17. Foster an appreciation of the environment and an interest in the green space in your community with classroom resources designed for students in grades K-5, recently updated with new lesson plans and activities for K-2. With TurfMutt as your guide, your class will get outside, investigate the benefits of landscaping and recycling, plus understand the importance of the lawns, flowers, bushes, and trees that surround us every day. <http://turfmutt.discoveryeducation.com/educators.cfm>

18. The National Science Teachers Association has Science Objects which are energy focused. Science Objects are two hour on-line interactive inquiry-based content modules that help teachers better understand the science content they teach. These Science Objects are currently available for free!
Energy: Different Kinds of Energy
<http://learningcenter.nsta.org/product_detail.aspx?id=10.2505/7/SCB-EN.1.1>
Energy: Energy Transformations
<http://learningcenter.nsta.org/product_detail.aspx?id=10.2505/7/SCB-EN.2.1>
Energy: Thermal Energy, Heat, and Temperature
<http://learningcenter.nsta.org/product_detail.aspx?id=10.2505/7/SCB-EN.3.1>
Energy: Useful and Not So Useful Energy
<http://learningcenter.nsta.org/product_detail.aspx?id=10.2505/7/SCB-EN.3.1>

19. GOOD is a collaboration of individuals, businesses, and nonprofits pushing the world forward. They publish a magazine and GOOD Issue 022: The Energy Issue covers a variety of energy related topics.
<http://www.good.is/the-energy-issue/>

20. The PhET site has lots of great simulations for physics, chemistry, biology, earth science and more.
<http://phet.colorado.edu/>
There are simulations of a generator, transformer, electromagnet, pickup coil, and bar magnet. They present an easy way to show how energy is generated by changing the magnetic field and how moving electrons create magnetic fields.
<http://phet.colorado.edu/en/simulation/generator>
Faraday's Electromagnetic Lab presents the same simulation with a different focus.
<http://phet.colorado.edu/en/simulation/faraday>

Competitions and Awards Programs:

1. The **Siemens We Can Change the World Challenge** is the premier national environmental sustainability competition for grades K-12. Through project-based learning, students learn about science and conservation while creating solutions that impact their planet. Opens in August. Deadline is mid-March.
<http://www.wecanchange.com/>

2. The **President's Environmental Youth Awards** (PEYA) are projects developed by young individuals, school classes (K-12), summer camps, and youth organizations to promote environmental stewardship. Winning projects in the past have covered a wide range of subject areas, including:

- environmental science projects
- recycling programs in schools and communities
- construction of nature preserves
- major tree planting programs
- videos, skits, and newsletters that focused on environmental issues

Evaluation results consistently demonstrate that the experience is frequently a life-changing event for many of the young people and sponsors who attend. Deadline is December 31 of each year.
<http://www.epa.gov/peya/>

3. The **NEED (National Energy Education Development) Project's Youth Awards for Energy Achievement** recognizes outstanding achievement and rewards student leadership for excellence in energy education in students' schools and communities. This is a K-12 pro-

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gram with scrapbooks detailing projects and applications due to state coordinators in April each school year. For more information about this program see the following website: <http://www.need.org/Youth-Awards>.

4. National Environmental Education Foundation (NEEF) Sustainable Energy Award is a $10,000 award presented to each of the top three high schools that can demonstrate how they have engaged students and teachers in school-wide energy savings through the creative and innovative use of technology. Deadline is early February.
<http://www.neefusa.org/energyaward>

5. The **Ten80 Student Racing Challenge**: NASCAR STEM initiative is a project-based learning system and optional competition league created by educators, engineers, and industry partners over the last decade. Its mission is to help youth, especially underrepresented minorities and women, to develop confidence and interest in STEM areas that will give them skills in these subjects and as critical thinkers, ultimately helping prepare them for higher education, careers and citizenship. The curriculum is aligned with national standards, and Ten80's team of engineer-educators provides professional development and training for teachers and coaches who support students. <http://www.studentracingchallenge.com/>

6. The **Green Cup Challenge™** starts with dedicated green teachers and students. The GCC invites all schools -- public and private, day and boarding schools -- to measure and reduce campus electricity use and GHG emissions and supports campus greening efforts including recycling and water conservation.
<http://www.greencupchallenge.net/>

District/School Wide Programs:

1. ENERGY STAR for K-12 School Districts: Partnering with ENERGY STAR is a commitment to your students as well as to the environment. <http://www.energystar.gov/index.cfm?c=k12_schools.bus_schoolsk12>

2. Wind For Schools Program: details about how to apply for this grant program. <http://www.windpoweringamerica.gov/schools_wfs_project.asp>

3. Fuels for Schools program will help assess if biomass can be used to heat schools and other buildings within the school district. Your facility may be eligible for a program-sponsored Pre-Feasibility Assessment if located in Nevada, Idaho, Utah, Montana, Wyoming, or North Dakota. <http://www.fuelsforschools.info/aboutFFS.html>

4. TerraCycle's purpose is to eliminate the idea of waste. They do this by creating national recycling systems for previously non-recyclable or hard-to-recycle waste. Anyone can sign up for these programs, called the Brigades, and start sending them waste. <http://www.terracycle.net/en-US/>

5. The Trash Redux initiative focuses on reducing the amount of trash produced by schools. It promotes conservation practices, awareness efforts, and thoughtful decision making in order to obtain a "zero waste" platform in schools. <http://www.gradesofgreen.org/initiatives/trash-redux>

6. Growing public concern over greenhouse effects, concerns over safe disposal of e-waste, and local K-12 school district needs to conserve funding are forcing schools to address green IT issues as a matter of conscience, budget, and political value. The Consortium for School Networking (CoSN) Green Computing Leadership Initiative provides tools, tips, and resources for school technology leaders to help reduce their school district carbon footprint. <http://www.cosn.org/Default.aspx?TabId=4110>

7. Recycle Bowl - Keep America Beautiful's recycling competition is back. Compete against other schools in your state and nationwide to see who recycles the most. There are lots of ways to get involved, tools and resources to get you started, and great prizes for top performers. <http://recycle-bowl.org/>

Teacher Awards:

The **National Environmental Education Foundation (NEEF) Richard C. Bartlett Environmental Education Award** is given annually to an outstanding middle or high school teacher who successfully integrates environmental education into their curriculum and engages students in interdisciplinary solutions to environmental challenges. The award alternates between middle and high school teachers each year (2012 is for high school teachers) and recognizes an educator who can serve as an inspiration and model for others. Winner will receive $5,000 and two merit winners will receive $750 each. Nominations due 8 June. <http://www.neefusa.org/bartlettaward.htm>

Why Pumpkin Seeds?

by Bernice Hauser
Primary Education Correspondent

The study of seeds is intertwined with the study of humankind; like bread and butter, they go together. Educators have to assess their students' abilities to understand the basic concepts and content involved in the study of seeds before they tackle more complex issues and questions with their young charges. Educators have to make choices, but they should ponder that the sustainability of our environment is a global issue that affects every individual on our planet. I recently interviewed Margo, a first grade teacher whom I had been mentoring over this past summer in preparation for her fall science unit centered on the study of pumpkins.

Q: Why pumpkin seeds?

A: Pumpkins are plentiful this time of the year — there is a special farm on Long Island called "Organics Today" that offers pumpkin picking experiences for young children; it does not charge any admission. My students will be able to pick/clip pumpkins directly from the vine. They need this hands-on experience – many of them are inner-city students who have limited exposure to gardens, farms and/or hands-on experiences with growing actual plants, vegetables and/or fruits. I can integrate the study with other academic disciplines, utilize everyday life skills, and perhaps stimulate a richer food future. It also satisfies the earth science requirement, the seeds are nutritious, and this unit of study offers myriad opportunities for language and vocabulary growth/practice that is one of my goals for my students. Besides, studying pumpkins can be just so much fun for everyone!

Q: Share with us some of your initial activities in undertaking this unit of study.

A: Well, Bernice, you have frequently commented that a teacher should really immerse herself/himself in the subject that she/he will be teaching to her/his students. Over this past summer I used the resources listed at the end of this article to learn as much as I could about pumpkins. It was quite fascinating to discover the many facts about pumpkins that I was unaware of. The list is endless—but here is a partial listing of new facts that I have learned:

- Pumpkins are fruit — called the All American Fruit — dating back to before 1600; it is a fruit because it grows on a vine and contains seeds. Common varieties are Dills Atlantic Giant, Jack Be Little, Baby Bear, Connecticut Field, Lumina, Big Max, Red October, Small Sugar Pie, Trick or Treat.
- Pumpkins and pumpkin seeds belong to the gourd or *Cucurbitaceae* family that also includes cantaloupe, cucumber, and squash. Some have smooth skin and some have lots of bumps. They come in different colors and need about 130-180 growing days.
- Pumpkin seeds, also known as pepitas, are flat, dark green seeds. Some are encased in a yellow-white husk, although some varieties of pumpkins produce seeds without shells.
- Pumpkins and their seeds were a celebrated food of Native Americans who treasured them both for their dietary and medicinal properties — the seeds and occasionally the dried pulp are the medicinal parts. Pumpkin seeds are used as a mild laxative against cadmium toxicity, to treat prostate cancer and also used as a mild diuretic.
- The word pumpkin originates from the word *pepon,* which is Greek for "large melon." The French adapted this word to *pompon*, which the British changed to *pumpion* and later American Colonists changed that to the word we use today.
- The common name for pumpkin in Spanish is *semillas de calabaza.*
- Pumpkins are monoecious, having both female and male flowers on the same plant. The female flower is distinguished by the small ovary at the base of the petals. The bright and colorful flowers have extremely short life span and may only open for as short a time as one day – pumpkin flowers are edible — honeybees play a significant role in fertilization — historically pumpkins have been pollinated by the native squash bee which appears to be pretty much wiped out as a species.
- Pumpkins that are small and green may be eaten in the same way as squash and zucchini. In the Middle East the dish is called *halawa yaqtin*; in South Asia it is called *kadu ka ahalwa*; and in Kenya it is called *seveve*. In China pumpkin leaves are eaten as a cooked vegetable or in soup. In the United States, the carved pumpkin was first associated with the harvest season before it became an emblem of Halloween — 80 percent of the pumpkin supply in the United States is available in October.
- According to pumpkin lore, witches turn people into pumpkins and jack-o-lanterns to ward off demons and ghosts. In the myth of *Stingy Jack* who fooled the Devil but was not allowed into Heaven or Hell,

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the devil sent Jack off into the dark night with only a burning coal to light his way, so Jack placed the coal into a carved out turnip and has been roaming the earth ever since. The Irish began to refer to this ghostly figure as "Jack of the Lantern" and then simply as "Jack O'Lantern." In Ireland and Scotland people began to make their own versions of Jack's lanterns and placed them in windows to ward off evil spirits – eventually people discovered that pumpkins made perfect Jack O'Lanterns.

- Native Americans called pumpkins "isquoutum squash" – they flattened strips of pumpkins, dried them and made mats.
- Pumpkins play major roles in fiction: the pumpkin/carriage switch in *Cinderella*; Linus's belief in the Great Pumpkin in Charles M. Schulz's comic strip *Peanuts*; the Harry Potter novels in which pumpkin juice is a favorite drink of students of Hogwart's School of Witchcraft and Wizardry is a recurring element; the pumpkin hurled by the "Headless Horseman" in Washington Irving's "The Legend of Sleepy Hollow"; Jack Pumpkinhead, a character in the *OZ* books of L. Frank Baum, with a pumpkin for a head on a wooden body, brought to life in the second book; in Tim Burton's *The Nightmare Before Christmas*, the main character Jack Skellington, is the "Pumpkin King"; Precious Ramotswe, the fictional detective from Botswana in the *No. 1 Ladies' Detective Agency* series of novels by Scottish author Alexander McCall Smith, often cooks and eats pumpkin; in a short fiction by Nathaniel Hawthorne, "Feathertop from 1852," a witch turns a scarecrow with a "pumpkin head" into a man.

Q: Then what did you do?

A: I needed to clarify for myself and document what I had hoped to accomplish with my students from this particular unit of study — whether it was learning basic skills, specific science content, or appropriate vocabulary (see box). Of course, one of my first steps was to secure permission from my administration to hire a school bus to take my students to the Long Island pumpkin farm on 20 September so that they could actually see a real pumpkin patch with pumpkins growing from actual twisting vines and be able to each pick a pumpkin to take back to our classroom. I felt it was important for each student to select his/her own pumpkin to observe, examine, experiment with – a personal investment in his/her own possession. This visit was also quite illuminating and vital to my clarifying several of my goals — for instance, so many of the children commented how surprised they were to see the pumpkins coming out of the leaves (meaning vines) on the stick, that they expected to find the pumpkins growing in the dirt (meaning soil) like the flowers in St. Mary's Park, a local park in the Bronx near our school. Luckily, one of the farm workers was available to speak with the children. He described the planting process – they planted the pumpkin seeds during the spring season – how they needed to make sure that the

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Skills

Students make use of their five senses to discover content and concepts.
Students experiment and discover concepts through hands on activities.
Students take suitable risks.
Students learn to collaborate and share materials.
Students learn to listen respectfully to the ideas of one another.
Students share meaningful experiences with each other.
Students learn to accurately record and document their results.
Students become more confident public speakers.

Science Content

The natural environment provides foods that are healthy and nutritious.
The pumpkin is a fruit that grows in certain kinds of soil.
The pumpkin grows on vines.
The pumpkin contains seeds that can be eaten for snacks.
The pumpkin can be made into lots of different foods.
The pumpkin is harvested in the fall.
The pumpkin is related to other fruits and vegetables like the cucumber and the squash.
Pumpkins come in different sizes and in different colors.
A seed needs water, warmth, food, and air to sprout.
A seed contains a baby plant.
Seeds are different from each other in size, shape, color, and texture.
A seed contains food for the baby plant.
Plants change in size as they grow.

Vocabulary: soil, climate, temperature, fruit, seed, gourd, sow, harvest, mash, weight, scales, pulp, vines, tendrils, insects, sprout, gardening tools (rake, hoe, spade, tractor, plows, cherry picker)

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pumpkin seed had food and water to grow just like the food and water plants needed to have in order to grow and develop, and how pumpkins eventually grew upwards on vines. He told them in that in this pumpkin patch several shallow holes were poked in small circular hills of soil. One pumpkin seed is dropped into each hole and then covered up with soil. Each hill is about three feet to six feet apart to give the pumpkins lots of room to grow. He distributed a pumpkin seed to each student present and patiently explained that the seed has a coat to keep it safe and warm and that inside this seed is the beginning of a pumpkin with enough food to help feed it while it grows. As the seed lies under the soil, the soil acting like a warm blanket, the seed gets soft from the damp soil and rain that then helps the seed coat break open. A root then begins to grow down into the soil. (My students were partially correct in assuming that it did have its start in the soil on the ground.) The seed uses the stored food, water and soil minerals for additional food. After a short time, green seed leaves appear, then vine leaves appear which he asked the children to feel. Jimmy shouted, "Yipes, they are rough. They scratched my hand." The farm worker then pointed out the stems on the ground that had twisted and turned and crawled along the ground to form vines and tendrils which now were all dried up and withered but which had supported each of the pumpkins that they had picked. The students could not believe that all their pumpkins were once green! When the farm worker asked them how many of them had eaten pumpkin pie, quite a few of them raised their hands, but they weren't sure how the pumpkins in their possession could change into a pumpkin pie, and I wondered whether they had ever experienced making a pumpkin pie.

Q: So now you had 16 pumpkins in your classroom — what next?

A: We had everyone take turns at the sink to wash their pumpkins clean, but only after we had had a discussion of how their pumpkins initially smelled, and why they were covered with flecks of soil, or a leaf from the vine. Some students even spotted dead insects on their pumpkins. After they patted them dry, each student initialed his/her name on the bottom side of the pumpkin. We then had a discussion about what scientists do in order to make their discoveries that they then share with the rest of us. I charged each of my young students to become a pumpkin scientist/expert. Sitting in a semi-circle on the floor with each pumpkin situated on newspapers in front of them, my students began to carefully examine each individual pumpkin. As my classroom is not yet fitted with the newest technological equipment such as a smart board, I made use of a huge pad to record their personal observations. Brendon commented that the pumpkin skin (grooves/ridges) had little hills that went in and out and that each part reminded him of a banana peel. Corrine noticed that the pumpkin changed its shape as you turned it over — sometimes it was round like the moon, and it became a different shape as you turned it over. Suzie said that most of the pumpkins were a yellowish-orange in color.

The children extracted the pulp with their hands to get the feel of the material, but we had spoons or cups or scoops available for children who were squeamish. I encouraged their comments as to how the "pulp" smells, feels, looks – even "yucky" was an acceptable reply. I had the children sort and separate the seeds and place the seeds on paper toweling, count the seeds they had in their individual pumpkins, and encouraged them to figure out ways of counting – perhaps by fives. I had them note the color of the seeds, and the texture, odors, and size. I had them compare the quantity found in the individual pumpkins with each other and keep a record of number of seeds found for additional activities. I inquired if the seed left a spot on the toweling or how it felt to their touch to see if they could discern that oil that is present, though this is a hard concept for young children.

It is important for the students to repeat this activity with medium size pumpkins and larger sized pumpkins and to have them guess or estimate how many seeds they will discover in the pumpkins of different size, then have them count the actual number of seeds, following the same procedure as with the small pumpkins – repeating an activity changing one variable at a time is important in scientific investigations. A great book to share with the class after this activity is to Margaret McNamara's *How Many Seeds in a Pumpkin?*— a most appealing story that teaches math and science concepts while modeling kind behavior, plus a lot to learn about pumpkins in it too.

Q: What other activities should be considered?

A: Definitely the roasting of pumpkin seeds was a must for a classroom activity, in which I introduced my students to the concept of *a healthy snack* — I also advocated as a follow-up that students with their parents make pumpkin pudding for the class or a puree or pumpkin soup so that students can see the variety of uses that this fruit has— we compiled a pumpkin recipe book to share with parents and donated one to the school library (A rec-

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Pumpkin Seeds

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ipe for pumpkin soup can be found in Helen Cooper's *Pumpkin Soup*.).

A lot of scientific concepts are difficult to embrace and discuss with young children – seed dispersal and pollination and fertilization are complex concepts, but I did try to bring these concepts into the unit/topic with the reading of Gail Gibbons's *From Seed to Plant* – a simple introduction to how plants reproduce which discusses pollination and seed dispersal and growing plants.

With the aid of parent volunteers (one for every student group of six), we baked pumpkin pies, measuring ingredients, following directions in a recipe, conversing about sequencing, learning about safety precautions (handles on stoves, turning burners off and on, use of pot holders, why we use wooden spoons to stir) and health procedures (washing of hands).

I distributed drawing sheets to my students – they made drawings of their pumpkins which then become the covers for their individual *Pumpkin Science Record Book.* Every time we have an activity or discussion about our pumpkin — changes in its appearance, what happens if you place it in a freezer, what happens if you place it in sunlight, the cooking of the pumpkin and the changes that occur — the students recorded their observations/ comments about what they experienced during that activity.

Q: What kinds of other interdisciplinary explorations could students do with their pumpkins?

A: Perhaps I can list some samples in easy-to-follow categories:

Math Explorations

- Baking a pumpkin pie is an activity that applies sequencing, ordering, fractions, weights, measures, dimensions, temperatures, adding, subtracting, dividing, and multiplying.
- Weighing their pumpkins and pumpkin pies enables students to compile statistics from comparing the weights they measured with the weights of other students' pumpkins and pies.
- The cost of buying ingredients to bake one's own pie can be compared with the cost of buying a commercial pumpkin pie from a supermarket or bakery.
- The cost of paying the workers who plant the pumpkins, pick them, box them, and transport them can be compared with the cost that people pay for the pumpkins.

Dramatic Play

- The students can act out the sowing of seeds, the picking of the pumpkins, the boxing of them, transporting them, baking of pumpkin pie or the carving of a Jack O'Lantern or the making of pumpkin soup (I utilized the model of *This is the House that Jack Built*). Each child draws from a basket a card that stated his/her role (pumpkin picker, planter, baker, cook, truck-driver, store-manager, customer). This activity reinforces collaboration, listening skills, physical movement, cause and effect, sequencing practices plus opportunities to act out in dramatic fashion steps to make a pie, how a seed moves and finally settles down in another locale in order to flourish and grow. Art, dance, singing and movement can be used to reinforce new concepts.

Language Activities

- Students can record their new discoveries daily in their pumpkin journals. They can make up stories, songs, and poems about their individual pumpkins. They can practice good speech patterns when sharing thoughts with their peers –"My pumpkin feels like a bumpy sidewalk… my pumpkin feels like a rocky garden" – and become a more self-confident public speaker. They can share pumpkin recipes with each other and listen to stories about pumpkins.

Mapping Activities

- Students can create a mock pumpkin patch. They can learn and practice the fundamentals of geography and mapping and place directional signs and use art materials to create the classroom's own mock pumpkin farm.

Additional Science Activities

- Students can discuss how pumpkins were planted and harvested long ago and the new technology and use of robots that may do the job quicker and more efficiently.
- Students can visit a community garden and apply to secure a plot for their class.
- Students can initiate plans for a school garden and write letters to the school principal asking if it was possible to use part of the playground or the school's roof to start a vegetable garden.
- Students can grow a plant from a seed by sprouting alfalfa, cress, or mung bean seeds on moist paper towels in shallow trays in a dark environment, checking them daily.

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- Students can collect seeds they encounter during a walk in a local park.

I saved all the pumpkin seeds that were not used for the roasting seeds activity to use for art projects. Students washed the seeds, allowed them to dry, and then made necklaces, bracelets, collages, and simple musical instruments (placed seeds into paper cups, fastened together with tape and used as a rhythmic instrument).

The following are samples of children's original poems emanating from past and present science units on seeds (with permission of the students and their parents). Kirsten Yager is now a fourth grader and Gabe William is a student in my class.

My Seed Adventure
by Kirsten Yager

I am a sunflower seed. I came from a beautiful sunflower on a farm with lots of animals.
One day while relaxing at the farm, the wind was so strong it blew me right off my sunflower. First I landed in a backyard full of children. It was very noisy and loud. Then the wind came along and blew me away to another farm. This place was very quiet. I liked it here. Soon a storm came and picked me up again and carried me to a pretty schoolyard. This was where I finally stayed put. I liked this spot and my colorful neighbors around me. Over time I grew as tall as the sunflower I came from. I turned out to be a beautiful sunflower just like the one I came from.

Carried by the Wind
by Gabe Williams

Blowing seeds
of a milkweed pod
into the breeze
is like a butterfly
fluttering into the air

Resources:

Henry Cole, *Jack's Garden* (Greenwillow, New York, 1997)

Helen Cooper, *Pumpkin Soup* (Doubleday, NY, 1998). ISBN 0 -374-36164-9.

Helen Cooper, *A Pipkin of Pepper* (Random House, China, 2005). ISBN 13-978-0-374-35953-9.

DyAnne diSalvo-Ryan, *City Green* (HarperCollins, New York, 1994). ISBN 068812786X.

A. H. Ensminger, *Foods & Nutrition Encyclopedia* (Pegus Press, California, 1983).

Jill Esbaum, *Seed Spout, Pumpkin, Pie* (National Geographic, Washington (DC), 2009).

Paul Fleishman, *Seedfolks* (New York, Harper Trophy, 2002). ISBN 0-06-447207-8.

Isabelle Gaines, *Pooh's Pumpkin* (Disney Press, New York, 1998). ISBN 0-7868-4256-3.

Gail Gibbons, *The Pumpkin Book* (Holiday House, New York, 1999). ISBN 0-8234-1465-5.

Thich Nhat Hanh, *Planting Seeds-Practicing Mindfulness with Children* (Parallax Press, 2011). ISBN 9781935209805.

Bernice Hauser, *"You're the Apple of My Eye*: An Interdisciplinary Science Exploration for Young Children*," Bulletin of Science, Technology & Society,* **18**(4)*,* 285-288 (1998).

Kathy Henderson, *And the Good Brown Earth* (Candlewick Press, 2003). ISBN 9780763638412.

Will Hubbell, *Pumpkin Jack* (Whitman, Morton Grove (IL), 2000).

Helene J. Jordan, *How a Seed Grows* (HarperCollins, New York, 1992).

Ruth Kraus, *The Carrot Seed* (HarperCollins, New York, 1945) ISBN 9780060233501.

George Levenson, *Pumpkin Circle: The Story of a Garden* (Tricycle Press, CA, 1999). ISBN 978-0-329-55362-3. (This is a wonderful resource on how to grow pumpkins.).

Margaret McNamara and G. Brian Karas, *How Many Seeds in a Pumpkin*? (Schwartz and Wade, New York, 2007) (This book is useful in conjunction with the activity to count the number of seeds in a pumpkin.).

Wendy Pfeffer, *From Seed to Pumpkin* (HarperCollins, New York, 2004).

Sonia Lynn Sadler, *Seeds of Change: Planting the Path to Peace* (Lee and Low, 2010) (biography of Nobel Prize winner, Wangari Maathai) .

Janice Van Cleave, *Biology for Every Kid-101: Easy Experiments that Really Work* (John Wiley & Sons, Inc. NYC, 1990). ISBN 0-471-50381-9.

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News from Triangle Coalition

Collaboration and Support Key to Improving STEM Teaching Crisis

A paper recently published by Demos and the New York Hall of Science sheds new light upon the current crisis of teacher turnover and highlights the importance of support and collaboration in improving retention rates, especially among STEM teachers.

Support. Collaborate. Retain: Strategies for Improving the STEM Teaching Crisis discusses the large role that school culture, which includes autonomy levels, professional respect, and administration support, plays in whether or not teachers remain in the profession. The authors illustrate the importance of these and other factors and suggest ways in which schools and other stakeholders can begin to improve them.

The report emphasizes that school support is especially crucial for new teachers as a third leave the profession within the first three years, and one-half leave after five years. Math and science teachers, the authors note, are most likely to leave the teaching profession all together due to job dissatisfaction. In one national estimate, the cost of teacher turnover in the U.S. totals nearly $3 billion annually. In addition to the monetary costs, student achievement also suffers as a result of high teacher turnover.

Opportunities for creative collaboration and interaction, whether it be peer-to-peer, formal or informal, on-site or virtual, can have a powerful impact on teacher retention. According to the report, teachers who work in supportive, collaborative school environments are more likely to remain in their jobs and perform better than teachers who are isolated and do not feel supported.

One of the authors, Julia Rankin, coordinated a project in California connecting secondary science teachers with scientists, professors, and undergraduates students in professional learning communities (PLC) to provide them with additional support outside of the school. A three-year longitudinal study of the program determined that the relevance of professional development, perceived classroom effectiveness, and identifying as part of the PLC had a positive effect on the retention of classroom teachers.

Rankin says, "As important as administrative support is within schools, it does not always happen. Some would say it rarely happens. Teachers can still find support outside of the school in a collaborative community that enriches their teaching experience. PLCs, if properly established and maintained, can have tremendous impact on teacher effectiveness, teacher retention and student learning."

So what can we do? In the report's conclusion, authors Meghan Groome, Julia Rankin, and Jennifer Wheary include the following actionable policy recommendations for stakeholders, including teachers, teacher educators, school leaders, policy makers, and external partners and advocates, in impacting teacher retention and school culture. Together, the creative cooperation of individuals and institutions can achieve impressive results in developing formal and informal opportunities for teachers to gain support and professional development within and outside of their schools.

Teachers

- Can include school culture as an important factor when deciding to teach at a certain school.
- Can also take steps to build a network of peers who can provide the support that is lacking in their schools.
- Can look for opportunities to refresh and update their own understanding of STEM subjects, both within and outside of their area of expertise. These opportunities might include engaging in summer internships, participating in workshops, and pursuing links or collaborative projects with the scientific community.

Teacher Educators

- Can make teacher networking and networks part of their teacher education programming.
- Can build virtual platforms using existing technology (*i.e.*, LinkedIn, Facebook) that will link current students to alumni and endure through time and as teachers move geographically.
- Can create structural changes that allow for teacher collaboration and incorporate elements of shared planning time, interdisciplinary study teams, and interdisciplinary project-based learning environments.

Government, Scientific and Cultural institutions

- Can encourage their scientists and staff to get involved in outreach with local teachers and to provide training and programs to help facilitate this.

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To see the complete list of recommendations and read more about the authors' observations, see the full report, available online at <http://www.demos.org/sites/default/files/publications/STEM_Report_Demos-NYAS.pdf>.

Recent STEM Education Releases from the National Academies

A Strong STEM Workforce for DoD

An Interim Report on Assuring DoD a Strong STEM Workforce, available online at <http://www.nap.edu/catalog.php?record_id=13433>, is part of an 18-month study to assess the science, technology, engineering, and mathematics (STEM) capabilities that the Department of Defense (DoD) will need in order to meet its goals, objectives, and priorities. This study also assesses whether DoD's current workforce and strategy will meet these needs and identifies strategies to help it to do so.

This interim report was issued for the purpose of assisting DoD with its FY2012 planning process and with laying the groundwork for future years. Earlier in the project, the DoD Committee on STEM Workforce Needs and the U.S. Defense Industrial Base convened a workshop in August 2011 to gather a broad range of views from the public and private sectors, all of which are stakeholders in the future STEM workforce. At the conclusion of this study, undertaken by the National Academy of Engineering and the National Research Council, a final report will be released.

Rising Above the Gathering Storm Innovation Workshop

In September 2011, a major workshop was convened in Madison, Wisconsin, to examine the ability of the states to drive innovation. Titled "Rising Above the Gathering Storm: Developing Regional Innovation Environments," the workshop brought together leaders in education, government, economic development, and industrial innovation to discuss state and regional initiatives to boost competitiveness through science, technology, and innovation. The conference was organized around four major themes:

- Revitalizing K-12 Science and Mathematics Education
- Strengthening Undergraduate Education in Science and Engineering
- Building Effective Partnerships Among Governments, Universities, Companies, and Other Stakeholders
- Fostering Regional Technology Development and Entrepreneurship

Rising Above the Gathering Storm: Developing Regional Innovation Environments: A Workshop Summary, available online at <http://www.nap.edu/catalog.php?record_id=13391&utm_medium=etmail&utm_source=The%20National%20Academies%20Press&utm_campaign=NAP+mail+new+7.03.12&utm_content=Customer&utm_term=>, gives an overview of the presentations, observations, and recommendations made during the workshop.

STEMConnector Seeks Results Information from STEM Programs

The STEMConnector announces a new project measuring results-driven STEM success. While assessment tools, "evaluation" metrics, and other analytical methods are widely available for STEM organizations, a national inventory of this information does not exist. Moreover, the STEMConnector says results-based STEM program information for many organizations is lacking or inconsistent across a broad range of activities. This leads to difficulty in measuring success within STEM organizations, inability to locate STEM models that work, and missed opportunities to share "best practices."

The STEMConnector and ASTRA have partnered in applying SMART* metrics across a continuum of STEM efforts in a project funded by Cisco. The goal is to establish a national resource of measurable results and outputs of STEM programs, including degrees earned, return on investment, jobs and career choices, learning accomplished, money awarded, and more. The STEMConnector is asking STEM programs and organizations to help by submitting information on their results. To learn more about this study and how to participate, visit the STEMConnector online at <http://blog.stemconnector.org/stemconnector-announces-new-project-measuring-results-driven-stem-success>.

(*Editor's Note*: The preceding three items were excerpted from the Triangle Coalition STEM Education Bulletin for 16 July 2012, reprinted with permission.)

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White House Announces New Details on STEM Master Teacher Corps

The Administration has officially announced its plans for the creation of the STEM Master Teacher Corps that was proposed by President Obama last February. Senior officials, including Secretary of Education Arne Duncan, Domestic Policy Council Director Cecilia Muñoz, OSTP Director Dr. John Holdren, and PCAST Co-Chair Dr. Eric Lander met with a group of K-12 math and science teachers on 18 July at the White House to discuss the details of the plan.

The STEM Master Teacher Corps will start by selecting 2,500 accomplished STEM educators to serve at 50 different sites throughout the country. Over the next four years, the corps will expand to 10,000 teachers who will commit to serve for multiple years to improve STEM teaching in both their schools and their communities.

Teachers will be selected through a highly competitive process, based on demonstrated effectiveness in teaching one or more STEM subjects, content knowledge, and contributions to teaching and learning. A set of national benchmarks will guide this rigorous selection process which will be administered at the local or regional level.

In an effort to raise the prestige of the teaching profession and attract and retain the best talent in our nation's STEM classrooms, corps members will be compensated in such a way that is more competitive with alternative professions. Corps members will receive an additional $20,000 annual stipend in exchange for their service, leadership, and commitment.

Corps members will take on leadership and mentorship roles, leading teacher professional development activities, evaluating and providing feedback to other teachers, and disseminating effective practices to improve STEM instruction. They will also have opportunities to improve their own instructional leadership and pedagogical content skills, and to deepen their subject matter expertise.

According to the White House announcement, the STEM Master Teacher Corps would be supported by the U.S. Department of Education as part of the RESPECT project, and established in collaboration with local public-private partnerships between STEM-related non-profits, businesses, and school districts.

The current proposal is contingent upon Congress's approval of the $1 billion price tag, which was included in President Obama's FY2013 budget request. Effective immediately, the Administration has allocated $100 million from the existing Teachers Incentive Fund to help school districts establish career pathways and development plans for excellent STEM teachers. In this program, these highly effective teachers will model STEM instruction for their peers and take on additional leadership responsibilities in their school districts.

President Obama emphasized that supporting teachers is an investment in the economy and the future workforce. "If America is going to compete for the jobs and industries of tomorrow," the President said, "we need to make sure our children are getting the best education possible. Teachers matter, and great teachers deserve our support."

The proposal for the STEM Master Teacher Corps builds on recommendations from the President's Council of Advisors on Science and Technology (PCAST) *Prepare and Inspire* report to recognize STEM educators, retain talented individuals by incentivizing STEM teaching, and encourage teacher cooperation to improve STEM education across the country.

(*Editor's Note*: The preceding item was excerpted from the Triangle Coalition STEM Education Bulletin for 6 August 2012, reprinted with permission. *Prepare and Inspire* was described in our Fall 2010 issue and is available online at <http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf>,)

100Kin10 Launches Second Fund to Train STEM Teachers

100Kin10, a multi-sector partnership answering the President's call to recruit 100,000 science, technology, engineering and math (STEM) teachers over the next decade, just announced the creation of the Innovation Fund II to continue adding excellent STEM teachers to America's classrooms. With a goal of $20 million, Innovation Fund II launched on 24 October with initial commitments totaling $5 million from The Samueli Foundation, Amgen Foundation, and the MacArthur Foundation. The partnership's first fund closed in February 2012 with 15 funders making commitments totaling $24 million. More than 10 investments have been made to-date.

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The structure of the Fund allows funders to maintain complete control over how their respective commitments are invested in projects proposed by the initiative's more than 100 innovation partners. The organization is currently accepting nominations for new partners seeking project funding.

Nominees are accepted as 100Kin10 innovation partners following a rigorous vetting process conducted by a team at the University of Chicago. Current partners include federal agencies, states, museums, corporations, universities, school districts, non-profits, and individuals. Nominees are accepted as innovation partners based on their ability to strategically apply their unique resources to address the nation's shortage of STEM teachers and to improve STEM learning for all students. To learn more, visit the <www.100kin10.org>.

(*Editor's Note*: The preceding item was excerpted from the Triangle Coalition STEM Education Bulletin for 8 November 2012, reprinted with permission.)

New Research Points Way to Big Improvements in Science, Math Education

Recent research on how people learn to become experts can help to dramatically improve the effectiveness of science, technology, engineering, and mathematics (STEM) education, according to an article in the fall 2012 *Issues in Science and Technology*.

Nobel laureate Carl Wieman argues that despite the widespread recognition of the importance of STEM education and countless efforts aimed at improving it, there continues to be little discernible change in either student achievement or student interest in STEM.

"This is unfortunate," he writes, "because there is an extensive body of recent research on how learning is accomplished, with clear implications for what constitutes effective STEM teaching and how that differs from typical current teaching at the K-12 and college levels. Failure to understand this learning-focused perspective is also a root cause of the failures of many reform efforts."

The fall 2012 *Issues* also includes an article that reports on research that finds that test-based incentives have had only small effects, and in many cases no effect, on student learning. A National Research Council study committee examined evidence on the effectiveness of the full range of incentives programs, including those that sanction schools whose students do not perform well on standardized tests, those that award bonuses to teachers if their students' test scores climb, and those that target the incentives to students themselves by requiring them to pass an exit exam before receiving their diploma.

"Although the study's findings do not necessarily mean that it is impossible to use incentives successfully," writes Stuart Elliott, "the small benefits they have produced so far suggest that they should be used with caution and carefully evaluated for effectiveness when they are used."

The article recommends a path of careful experimentation with new uses of incentives, combined with a more balanced approach to educational interventions. "Evidence does not support staking so much of our hope for educational improvement on this single method," says Elliott. "Rather, it suggests that we should be moving some of our eggs out of the incentives basket and into other complementary efforts to improve education."

Issues in Science and Technology is the award-winning journal of the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and the University of Texas at Dallas.

(*Editor's Note*: The preceding item was excerpted from the Triangle Coalition STEM Education Bulletin for 15 November 2012, reprinted with permission.)

Pumpkin Seeds

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Rebecca Wood, *The Whole Foods Encyclopedia*, (Prentice Hall, New York, 1988).

Baking Resource:
www.homebaking.org (recipe for baking pumpkin pie)

Pumpkin Farm: Available for Class Trips
Organics Today
160 Washington Street
East Islip, Long Island, New York
Pumpkin Picking Season: Until 1 November
Hours: 9:00-6:00pm every day
Admission: Free
Pumpkins: 65-75 cents a pound
Hayrides and photo options available
631-650-4424
631-579-6167

RECOMMENDED SCIENCE AND SOCIETY EDUCATIONAL RESOURCES

1. Daniel M. Levin, Judy F. Kramer, Alla Keselman, and Berneatta Barnes-Whitlock, "Making the Argument," *Sci. Teach.*, **79**(5), 46-50 (Summer 2012).

Maintaining that argumentation is an important part of the scientific process, these authors present an activity simulating a legislative hearing on a bill that would require schools to sell bottled water, based on a similar activity on animal welfare developed by Scott DeGasperis, available online at <www.accessexcellence.org/AE/ATG/data/released/0228-ScottDeGasperis/description.php>.

2. J. J. Bevelacqua, "Fukushima Daiichi Accident and Its Radiological Impact on the Environment," *Phys. Teach.*, **50**, 354-358 (September 2012).

A health physicist, reactor operator, and industry consultant, this author begins with a primer of reactions occurring in nuclear reactors behaving normally, then continues with a discussion of the reactions that occurred in the Fukushima Daiichi reactors once the earthquake and subsequent tsunami hit them, and concludes with a series of worked-out examples based upon Fukushima Daiichi data that teachers can use to teach about this nuclear accident to their classes.

3. Kevin Heng, "The Study of Climate on Alien Worlds," *Am. Sci.*, **100**(4), 334-341 (Jul-Aug 2012).

The radiation emitted by an exoplanet can be found by subtracting the signal from the planet's star when the planet is behind the star (secondary eclipse) from the signal from the star and planet combined just before or after the secondary eclipse. This can be done for individual wavelengths and for individual points on the planet, which enables "mapping" the planet. The time-dependent brightness of an exoplanet should be a sine function peaking at secondary eclipse, but redistribution of heat by the planetary atmosphere will shift the sine curve. Measuring this phase shift enables determining wind speed.

4. Philip T. Pienkos, Lieve Laurens, and Andy Aden, "Making Biofuel from Microalgae," *Am. Sci.*, **99**(6), 474-481 (Nov-Dec 2011).

The U.S. currently uses 200 million gallons of gasoline, diesel, and jet fuel per year. Given the controversy of producing bioalternatives from corn, algae have been proposed as a biofuel source, and this article assesses its prospects. The key to algal biofuels is production and extraction of lipids, though the remaining biomass residue could be used to generate methane or fermented to produce ethanol. The most productive algal strains need to be identified or genetically engineered, and optimum methods must be developed to grow and harvest them with both economic and environmental sustainability. So far the prospects are not encouraging. The two calculations of annual potential algal fuel production presented would replace only between a quarter and a half of the hydrocarbon fuels currently used. The current projected costs at a 10-million-gallon-per-year facility are between $10 and $20 per gallon. And life-cycle assessments have shown "unpromising energy returns [more energy to produce biofuel than it can generate] and weak greenhouse-gas benefits." Yet the authors conclude that "Although the path to commercialization may be long and may require many millions of dollars, the potential for algal biofuels to contribute to national goals of reduced dependence on fossil fuels, reduce CO_2 emissions and greater energy security are worth the investment. We are confident that the barriers will fall."

5. Vince Beiser, "Can You See My Blood Now?" *Miller-McCune*, **4**(6), 18-19 (Nov-Dec 2011).

Three different researchers are pioneering attachments to cell phones to enable photographing microscopic images of blood samples, with the transmitted photos enabling diagnosis of HIV, waterborne parasites, anemia, and, eventually, malaria.

6. Dan Ferber, "A New Kind of Car Payment," *Miller-McCune*, **4**(6), 38-45 (Nov-Dec 2011).

The payment described in this article is electrical energy from electric cars connected to the grid, not for energy backup but for frequency regulation – the electric cars' output can respond to this need in less time than the coal-or gas-burning power plants presently used. Plugged-in electric cars can also store intermittent electrical energy generated by the Sun and wind.

7. Jim Morrison, "Fallback Position,´ *Miller-McCune*, **4** (6), 46-53 (Nov-Dec 2011).

One reason for the difficulty recovering from shoreline damage from Hurricane Sandy has been a higher sea

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REVIEWS OF SCIENCE AND SOCIETY EDUCATIONAL RESOURCES

Phillip Taubman, *The Partnership: Five Cold Warriors and Their Quest to Ban the Bomb* (HarperCollins, New York, 2012). xviii + 478 pp. $29.99. ISBN 978-0-06-174400-6.

This book is about four men who held positions of power in American government, and a fifth man, an accomplished physicist who consulted as a government advisor, who have come to see the jeopardy in which their decisions regarding nuclear weapons have placed our world. In his preface to *The Partnership,* Philip Taubman writes of the power they helped to administer and of the philosophical change they underwent; "Then, late in life, they looked at the world they had helped make and realized it was too dangerous, too near a new kind of nuclear conflagration, to hand off unaltered to their grandchildren." People who read this well-written book hopefully will be encouraged to consider carefully the long term implications of decisions they make.

In January 2007, four of the five men involved in the partnership wrote an op-ed published in *The Wall Street Journal* calling for the elimination of nuclear arms. Taubman writes of how, after the destruction at Hiroshima and Nagasaki, efforts to prevent a nuclear arms race were started by the Federation of Atomic Scientists. He employs a sports analogy to describe what the op-ed was like; "It was roughly equivalent to Bill Walsh, Jerry Rice, Peyton Manning, and Tom Brady saying the time had come to rid football of the forward pass."

Using a quotation from a speech by President Obama, Taubman illustrates where the nuclear threat stands today; "In a strange turn of history, the threat of global nuclear war has gone down, but the risk of a nuclear attack has gone up." Taubman goes on to describe the existing threats from al Qaeda, Iran, North Korea, and Pakistan. He describes the early attitude of Sidney Drell, who was an undergraduate at Princeton when the head of the math department informed him of the destruction at Hiroshima. Drell replied, "I hope they build two (nuclear bombs) and they take all the people who built the first one, put them on an island, and drop the second one on them." Drell joined Henry Kissinger, George Shultz, William Perry, and Sam Nunn to form the Partnership.

Section two of the book, "Pathways to Power," contains interesting and informative information about the careers of the five men. Part three, titled "Manning America's Nuclear Arsenal," describes many of the experiences the men had while in power. One section describes how Richard Nixon's staff made a decision to initiate a nuclear alert over a Mideast confrontation with the Soviet Union without consulting Nixon. Another describes then Senator Sam Nunn's defense of the proposal to begin work on the neutron bomb. Included is interesting information about Ronald Reagan's Star Wars initiative. Taubman writes, "Reagan's admirers like to say that he engineered the end of the cold war and that his military buildup led to the collapse of the Soviet Union. Both assertions greatly overstate the case. American pressure may have speeded its demise, but it was not the primary factor." Taubman then presents information defending this position.

Part five is titled "Going to Zero," described as shorthand for total nuclear disarmament. Included is information describing how George W. Bush ignored nuclear issues. Taubman includes information about a meeting with Bush in 2008. An observer at the meeting is quoted as saying, "(Bush) couldn't have shown less interest. He jotted a few notes, looked up over his glasses – and then he asked a question about something else." Taubman includes a quotation from Sam Nunn about the meeting: "I didn't think he brushed us off. I thought he was interested in it, but it was pretty apparent he hadn't thought very deeply about it." The men were encouraged by the attitude of President Obama. In his maiden speech on foreign policy Obama said, "I state clearly and with conviction America's commitment to seek the peace and security of a world without nuclear weapons."

Taubman writes of the advanced age of many of the people pursuing nuclear disarmament. He indicates that Sam Nunn opened a meeting in Germany with a story about a Georgian who was heavy drinker, "who was told that he would go deaf if he didn't stop drinking. The man stopped for a month, then resumed. When his wife asked why, the man replied, 'Well I like what I've been drinking better than what I've been hearing.'" In the same section I was appalled to read that the U.S. conducted its last nuclear weapons test as late as 1992. And a quotation from Colin Powell, who served in four presidential administrations, is significant in terms of the financial burden American tax payers have borne: "The thing I convinced myself of after all these years of exposure to the use of nuclear weapons is that they were useless. They could not be used."

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Taubman provides information about "Nuclear Tipping Point," a documentary film about nuclear disarmament featuring Shultz, Kissinger, Perry, and Young. The film was screened at the Library of Congress in the spring of 2011. Members of Congress were invited and Shultz, Perry, and Young attended to respond to questions. Just two House members showed up.

The book ends with a quotation from Henry Kissinger: "Once nuclear weapons are used we will be driven to take global measures to prevent it. So some of us have said, let's ask ourselves, 'If we have to do it afterwards, why don't we do it now?'"

This is an excellent book that is well worth reading. I recommend it to everyone with an interest in nuclear disarmament. It is a valuable resource for educators.

- Frank Lock

(*Editor's Note*: Frank Lock is a frequent contributor to this column. He recently retired from teaching physics at Lemon Bay High School (FL).)

Taras Grescoe, *Straphanger: Saving our cities and ourselves from the automobile* (Henry Holt and Company, New York, 2012). $25. ISBN 978-9-8050-9173-1.

After a century of car-oriented planning and of rising oil prices that portend the end of cheap energy, Taras Grescoe chronicles a global revolution in transportation. Journeying to many cities, Grescoe gets the story on the world's transit systems and presents an extended argument for expanding such systems.

He focuses on rail, whether subways, light rail, or streetcars, devoting occasional attention to bicycles, sidewalks, and buses, and mindful of the omnipresent automobile. His twelve chapters, one city per chapter, provide a panorama of worldwide transit and its human impacts.

The lessons are many. At an auto show in Shanghai, China, consumers' lust for cars is palpable. The country has overtaken the United States as the world's largest automobile market. Yet on Shanghai's double-decked Inner Ring Road, congestion turns the highway into a six-lane parking lot. China's air pollution, fed by gasoline engines and coal-burning power plants, is the worst in the world and kills 656,000 citizens prematurely every year. The air is a health hazard. Drivers in Beijing were stuck for ten days in a jam that stretched 60 miles. But Shanghai citizens now have a choice: brave the traffic, or ride the Metro. China is investing in new subway systems with thousands of miles of track, and in fast rail that already connects cities with 5,000 miles of track. Only 15 years after opening, Shanghai's Metro counts eleven lines and 261 miles of track, making it the world's largest subway system. It's the fastest way to get around town.

Grescoe, in his mid-forties, has never owned a car. His preface notes, "This book is, in part, the story of a bad idea: the notion that our metropolises should be shaped by the needs of cars, rather than people. . . . By diminishing public space, the automobile has made once great cities terrible places to live." However, "This book also tells the story of some very good ideas. . . . The movement goes under a variety of names: transit-oriented development, smart growth, new urbanism. . . . By investing in development that includes well-conceived transit, we can create more sustainable and, crucially, more *civil* communities."

Grescoe asks whether New York City really needs so much subway. His answer: Definitely. The lines are always full, and standing-room-only at rush hour. Thanks to transit, the city was on its way a century ago to becoming a remarkably good place to live. But then, "like a slow-motion tsunami," the coming of masses of automobiles reshaped the city. By 1932, New York was choking on traffic. But the worst was yet to come: It was architect and "master builder" Robert Moses who made the metropolis safe for the car and, in the process, nearly destroyed the city's quality of life. Today, the promise of North American cities as good places to live is finally being revived, because many people have the courage to oppose what Robert Moses and others tried to impose: Cities built for cars, rather than people. Today in New York even Mayor Bloomberg, to his immense credit, takes the subway to work daily.

Los Angeles is "one city that even the most visionary planners and politicians might not be able to redeem." The trouble is, Angelenos have never really wanted it to be a city. Today it's a random distribution of car-oriented suburbs. Los Angeles was a battlefront during the 1920-1950 destruction of America's streetcars by the automobile industry. Because General Motors, Firestone Tires, Standard Oil, and Mack Truck bought up and eventually scrapped streetcar systems in 45 cities in order to make way for buses built by GM and Mack Truck – buses that were later sold to make way for the automobile – America's cities have for decades been car-dominated. In L.A., the outcome is that the city is built along a thousand

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miles of urban freeways that function as ersatz city streets.

The Phoenix chapter is sub-titled "The Highway to Hell." Phoenix is "a nightmare, the antithesis of any city I could imagine living in. . . . A centerless city." In every city, Grescoe dialogues with leaders and planners. His dialogue with Phoenix planner Joel Kotkin, "probably America's best-known apologist for sprawl," points up the differences between conventional fossil-fueled optimism regarding the future of freeways and far-flung suburbs, versus the new urbanism that thrives on higher densities, walking communities, and transit. Grescoe notes Phoenix's new light-rail system, running on 20 miles of track to the suburb of Mesa. But the city is so sprawled that 20 miles of rail cannot begin to reach the people, so the system is little used. Away from the freeways, one discovers how the subprime crisis has wracked Phoenix. The Metrocenter, for example, was once Arizona's biggest mall but is now a crime-ridden shell of vacant big-box stores. Entire outer subdivisions seem empty. Everything is for sale. Phoenix "could well be the West's next ghost town."

Moving to foreign shores, Grescoe glowingly describes the Paris Metro that, by preserving the city's historic integrity, saved the city. The hero of Copenhagen is the bicycle, "the most decentralized, affordable, and efficient mode of mass transit ever invented." 55 percent of the central city's residents get to work or school by bicycle, and the number is rising. In greater Copenhagen, population 1.8 million, there are more bike-to-work commuters than there are in the entire United States. Copenhagen has waged "a quiet war on cars." As a result, "When sociologists undertake international surveys of life satisfaction, the Danes consistently come out on top."

Moscow is crushed by its congested highways, but partly redeemed by fast, cheap, comfortable subways. Tokyo's trains, whose organizational efficiency is a wonder to behold, keep the city working smoothly. Bogota, Colombia, was declining and headed for tough crime-ridden city streets until a succession of two forward-looking mayors tamed the violence and introduced regulated, modern, "bus rapid transit." BRT, with passenger loading that's similar to subway stations, originated in Curitiba, Brazil, in 1972, and is copied worldwide.

Back in North America, Grescoe studies Portland, Vancouver, Philadelphia, and Montreal – cities that offer hopeful examples for this urbanizing world. The Philadelphia story is the most surprising and most hopeful of the four. Grescoe subtitles this chapter "The next great city." Philadelphia is "one city whose center has held," thanks to its well-frequented transit and its rail connections to the east coast Amtrak system. Philly was slowly declining for decades but has lately been on the upswing, partly due to its long history of rail-centered growth. The city already has the basic requirement for sustainable growth, namely lots of transit. Transit-proximate households in the United States devote only 9 percent of their income to transportation, compared to 25 percent for car-dependent households. This translates to an enormous economic advantage for people living near transit, an advantage that is maximized in Philadelphia's extensive and dense low-rise residential areas close to the central city. It's worth noting that 35 percent of Americans don't have automobile access, because they are too young, old, infirm, or poor to drive. Thus, Philly is in an excellent position to profit from the urban renaissance that Grescoe foresees. "It bodes well for the future that the public in Philadelphia never lost the habit of using public transport." Grescoe waxes philosophical about transportation's future. "As the era of cheap fossil fuels that kicked the North American metropolis into a manic state of overdrive comes to an end, the ideology of growth for growth's sake has also reached its limits. When it comes to houses and cities, bigger is not better. Bigger is more McMansions; bigger is subdivisions so sprawled people never get to know their neighbors; bigger is ever longer, ever more soul-sucking commutes. Bigger is stupider."

Grescoe has provided a reasoned, beautifully written, entertaining, and instructive read.

\- Art Hobson

(*Editor's Note*: Art Hobson is Professor Emeritus of Physics, University of Arkansas, Fayetteville, ahobson@uark.edu. He is author of *Physics: Concepts & Connections* (Pearson Education, Inc., 2010), a conceptual physics textbook for non-science students that includes societal issues and lots of modern physics. His review will also appear in *Physics & Society*, newsletter of the American Physical Society's Forum on Physics and Society, and in Northwest Arkansas newspapers.)

Jeffery Bennett, *Beyond UFOS: The Search for Extraterrestrial Life and its Astonishing Implications for Our Future* (Princeton University Press, Princeton, 2008). $26.95, ISBN #978-0691-13549-6.

The more I read this book, the more I enjoyed it. The author is an astrophysicist and astrobiologist and has also

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written children's books about space. The book is divided into ten chapters which include information about what constitutes life, life in the solar system and among the stars, and the search for extraterrestrial life. Throughout the book, Bennett stresses the importance of the scientific process. Early on he addresses the issue of Intelligent Design, indicating that it does not qualify as a science, stating "Rather than seeking natural causes for life, intelligent design posits that life is the work of a supernatural designer." He then addresses the UFO issue, indicating that personal testimonials about UFO encounters do not count as scientific evidence, as scientific evidence must be verifiable, and testimonials of UFO encounters are not verifiable. Bennett goes on to indicate that "with extremely high confidence" any aliens who are visiting are advanced well beyond our technological level, and that if they wanted us to know they are here, they would tell us.

In a section in chapter four titled "Understanding Evolution" the author presents a brief and succinct review of the development of the Theory of Evolution and presents some of the most significant evidence verifying the theory. The next section is titled "Evolution in the Classroom," and Bennett concludes the first paragraph with an insightful and incriminating conclusion; "After all, if we can't teach our children about the most important and unifying discovery in the history of biology, how can we expect them to learn science at all?" He then presents a great deal of evidence defending the teaching of evolution in our classrooms.

The book includes a well thought out description of the habitable zone a life-bearing planet must occupy. The habitable zone the Earth occupies has a forty-million mile range. The same chapter includes a well written section describing the carbon dioxide cycle. Also included is information about a hypothesis describing the reason for the retrograde rotation of Venus, ascribing it as being a result of the runaway greenhouse effect on the planet, rather than the result of a collision with a minor planet-sized body.

Bennett addresses the issue of robotic space research versus research by humans. He makes a strong statement about the value of sending human crews to explore, and concludes by writing "Robotic science is cool, but no one grows up with the dream of being a robot. Inspiration comes from people."

In a section describing the possibilities of life on the moons of Jupiter, Bennett presents information about Europa, including the fact that there may be two to three times as much liquid water under the icy surface of that moon as there is on Earth. In the same chapter, a section titled "Beyond UFOS" presents the idea that if life is found on a moon of Jupiter, similar conditions should be found on moons of large exoplanets that have already been discovered. In a section in chapter eight, Bennett discusses what he identifies as "center of the universe syndrome," and this is very interesting.

Bennett concludes the book with an analysis of SETI Search for ExtraTerrestrial Intelligence), and the Fermi paradox – "Where is everybody?" He includes a discussion of why building a Moon base is an important step in helping our civilization mature. I cheered as I read.

This is a book written by a visionary. A large majority of students are interested in UFOS and the possibility of extraterrestrial life, and the book is a valuable resource for teachers who engage their students in discussions about the nature of science and space research.

- Frank Lock

RESOURCES

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level. This article discusses measures currently underway at Point Peter in North Carolina's Alligator River National wildlife Refuge to "slow things down and give the coastal ecosystem a chance to adapt." The Nature Conservancy has installed human-made reefs to dissipate wave energy, taken steps to slow the advance of salt water, and planted salt-tolerant young trees. Parts of the coastal ecosystems are the humans that have chosen to build homes there, and a report from the Environmental Protection Administration has had this to say about these systems: "A large rise in sea level . . . rather . . . unexpectedly." One way to accommodate this has been the concept of "rolling easements," which "essentially prohibit . . . as the seas rise."

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by REY

How Professional Development Programs Can Model Science

by Robert E. Yager

No one is against Professional Development (PD) for science teachers. But, how it is typically structured remains a major problem! Not many Professional Development efforts outline how the PD can be structured as an example of science itself. Professional Development efforts, even those funded by NSF and offered by organizations like the National Science Teachers Association (NSTA) and the National Science Education Leadership Association (NSELA), require follow-up (or evidence of success).

PD efforts are too often performed like traditional science teaching, *i.e.*, without reference to current reform efforts and not using science itself to provide evidence for the specific value of the reforms advocated. Seldom do typical PD providers challenge the actual results of their specific PD efforts. They often involve "national" featured speakers and often involve all teachers in a particular school. Teachers are expected to attend! The leaders often attack typical teaching but do not practice the reforms they describe with their own "presentations". They often mimic traditional college science teaching where teachers (scientists) talk about what they know and expect all attendees to understand and to find such descriptions useful. The points made by "presenters" are sometimes personal and at times argue for the reform goals. They push for improvements which are not defined by "seeing it" or "experiencing it" in action!

Although many PD efforts are headed by national leaders and often include specific commercial sponsors, rarely is any real evidence of their successes sought or collected *after* the workshops. Most would need to get such evidence from the teachers *after* the workshop and after the ideas have been tried with their own students. Seldom is anyone expected to report on their successes with various PD features involving their actual work with their students. It is like hearing about success rather than being involved with it or feeling the need for specific evidence of impact. Evaluation must involve teachers and their students in the evaluation of a PD program to use in assessing or claiming success. This would be expected from science teachers since it would also impact what students do. Some are now collecting evidence for enrollees *before* the actual starting of the PD program! Can real success be measured only with smiling faces, complimentary comments, and verbal testimony that the time was well spent?

But, what do teachers do differently later regarding the suggestions of the PD experiences in their own classrooms with their own students? What do they say to their students, administrators, and parents? What actually happens in their classrooms? Do they interact with administrators and other teachers about the ideas recommended and "tried"? "Presentations" are all too typical of NSTA conferences, to school based PDs, or for teachers as they prepare to teach.

One of the most important features of a model PD is the contacts teachers have with the teacher participants *after* the session -- preferably some weeks after the particular PD. Are enrollees expected to report and to share their new ideas with other teachers, with the PD staff, with their own students? Do students help evaluate the new activities and procedures tried?

The Iowa Chautauqua Program is exceptional when one looks at the years it has operated in Iowa: 1982 -2008. Basic to the design is the use of other teachers as the most important staff members. They were called Teacher Leaders. Each Chautauqua effort operates at least for a single whole year. It starts with a two week Leadership Conference involving the most successful teachers from previous PD efforts as they prepare to be important staff colleagues for other teachers. They have been identified by staff and other teachers in accomplishing the reforms the best. They learn how they can become leaders and how they can continue to grow into even more successful teachers. How can they help others in the process?

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Musings

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The Iowa Chautauqua was validated in terms of how it accomplished the goals three times by the National Diffusion Network (1994, 1995, and 1996). The Chautauqua sequence has operated at sites across the whole State for 30 years. After NDN approval, the Iowa Chautauqua was introduced to leaders in other states. This was especially successful with teachers involved with the NSTA's Scope, Sequence, and Coordination (SS&C) project, where all science teachers in the particular schools were involved collectively. In years following SS&C support, there were five sites involved annually across the State where 70 more teachers were introduced to the Chautauqua PD program.

The teachers generally included ten at the elementary, ten at the middle school level, and ten at the high school levels. The collaborative was set up to be active for at least one whole given year. It has often been longer – sometimes four years! This often involves all teachers from a given school and with three Teacher Leaders at each site. Some Teacher Leaders have served as long as ten years. Many continue to grow and to learn from other Teacher Leaders as new plans are developed and tried during the annual Leadership Conferences.

Science and the Iowa Chautauqua start with student questions, attempts to answer students' own questions, sharing the results with each other, and interacting further with their peers. This is a way for them to experience examples of science itself! At most sites control group teachers from nearby schools are asked to help; only one or two teachers "participate" by allowing comparison of students without any teachers involved with the Iowa PD. It was a way of enlarging the team, including the involvement of other teachers. It was especially prevalent in nearby schools when Scope, Sequence and Coordination (SS&C) was funded for eight continuous years; it was a way of gaining more support from administrators, community leaders, and *all* science teachers in a given district.

When teachers work together in developing and sharing goals, teaching tips, and student successes, they are most successful and treat PD experiences like it is a science! It is apparent that when teachers and students are successful, they seem to want to learn even more. Perhaps if teachers want to learn more, they can really make PD experiences more successful – and provide teachers with the power of working collaboratively! All this indicates again that students must want/need to learn in order to accomplish real learning!!

(*Editor's Note*: Robert E. Yager is Professor of Science Education, University of Iowa. He is a past contributor to this *Newsletter*, past President of the National Science Teachers Association and of the National Association for Science, Technology, and Society.)

FORTHCOMING SCI & SOC EDUCATION MEETINGS

5-9 January 2013, Winter meeting of the American Association of Physics Teachers, New Orleans, LA. Visit <www.aapt.org>.

13 February 2013, Great Energy Efficiency Day, Capitol Hill, Washington, DC., organized by the Alliance to Save Energy. For more information, contact <info@ase.org>.

20-21 May 2013, EE Global Forum, Washington Convention Center, Washington, DC, organized by the Alliance to Save Energy. For more information, contact <info@ase.org>.

environmental modeling

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provements, with the result that the Lower West Side has become an attractive area.

Mugdan told the Physics Club that he was also in charge of Superfund sites, including one at a former Diamond Alkali plant on the Passaic River which had manufactured Agent Orange during the Vietnam War. A by-product of Agent Orange manufacture is dioxin, which is of concern at the concentration of parts per trillion, and this byproduct contaminates Passaic River sediment at tens of thousands parts per trillion. (Dioxin can now be measured at one part in a quintillion, Mugdan said.)

The goal of EPA is to clean the lower eight miles of the 17-mile long Passaic River. Mugdan stated that they are looking at deep dredging (which would entail moving 11 million cubic yards), capping with dredging (4 million cubic yards), and focused capping with dredging, as opposed to no action at all. Costs, to be borne by Diamond Alkali, range from $1 billion to $3.5 billion. Each run of their model requires four weeks, for data since 1995 with projections to 2055. Mugdan reported that capping with dredging was slightly more effective than deep dredging and would cost a billion dollars less.

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Mugdan cites examples of environmental modeling

Walter Mugdan is an Attorney who directs the Emergency and Regional Response Division for Region 2 (New York and New Jersey) of the United States Environmental Protection Administration (USEPA). He took time out from the EPA's response to hurricane Sandy to speak to the Physics Club of New York on 16 November.

His talk was originally titled "You Can Run, But You Can't Hide – From Science," and the thrust of his opening remarks was directed toward this topic. He recounted learning no science at all in elementary school but remembered learning about tectonic plates in a ninth grade earth science course and internal combustion engines and surface tension in the eighth grade, all from the same teacher. She was on the crazy side, he said, but he remembered everything she taught him.

After that, Mugdan said that he took only minimal science, including one course in geology and two in cultural anthropology at the University of Michigan, where he also attended law school and then broke into the new field of environmental law and got a job with the USEPA in 1975 as an air pollution attorney. In this new position he needed to learn what he thought he didn't have to learn about corporations and about air pollution, what caused it, and how it could be controlled.

One of the first controversies he was thrust into was the expressway planned for the west side of Manhattan that New Yorkers dubbed "Westway," which was to be funded by the US Department of Transportation but opposed by the EPA. This led Mugdan to learn about environmental modeling, which accounts for the retitling of his talk as "Modeling in Environmental Decision Making."

Mugdan recalled that it was a time that people were opposing highways in urban areas, and it was proposed to build Westway in a tunnel under a landfill to be created at ground level. The EPA recommended a West Side arterial road, with the funds not used to be applied to deferred maintenance of the city's subway system.

Building Westway required proving that air quality standards would not be violated, with particular focus on carbon monoxide, which is not a serious auto pollutant today. This required modeling the environment, which included vehicle origin and destination surveys, vehicle miles traveled growth projections, a traffic distribution model, a vehicle emissions model, and air quality dispersion models.

Noting that what has been the practical controller of traffic speed in New York City has been its volume (it has stayed at 10-12 mph north-south, 6-8 mph east-west during rush hour, except during World War II, when gasoline was rationed), Mugdan faulted previous projections of traffic volume from the building of Westway for assuming that building Westway would not increase it. Experimental data, he went on, showed speed to be a double-valued function of the traffic volume, showing a maximum permissible volume, but no one could predict this from a model until Dan Gutman, a physics student who had volunteered his services to the Sierra Club in opposition to Westway.

Gutman, Mugdan said, was able to persuade the opponents of Westway that he was right. From his modeling, it was concluded that cars coming out of the tunnel would violate air quality standards, and Mugdan translated this into a 500-page brief. Meanwhile, Mugdan said, New York City and State had decided to abandon Westway in favor of the present West Street and mass transit im-

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