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Election Preview
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Murray to Serve on Investigative Panel

Former APS president Cherry Murray was picked to be a member of the presidentially appointed National Commission tasked with preventing a BP-like oil spill from happening again. The panel will investigate the events leading up to the spill and make safety and environmental protection recommendations.

Murray, who served as President of APS in 2009, is the dean of Harvard's School of Engineering and Applied Sciences. Other members of the panel include the president of the Natural Resources Defense Council Frances Beinecke, the president of the University of Maryland Center for Environmental Science Donald Boesch, executive vice president for Mission Programs for the National Geographic Society Terry Garcia, and chancellor of the University of Alaska Anchorage Frances Ulmer. The commission is chaired by former Florida senator Bob Graham and former head of the Environmental Protection Agency William Reilly.

Fluid Dynamics Tackles the Oil Spill

In a perverse way, fluid dynamics has taken center stage as oil continues to spill into the Gulf of Mexico. Physicists and engineers from across the country who specialize in fluid flows have weighed in on how much oil has been flowing out of the damaged pipe a mile beneath the ocean's surface.

Admiral Thad Allen, the National Incident Commander for the Gulf oil spill, formed the Flow Rate Technical Group (FRTG) on May 20th to determine exactly how much oil is spewing into the Gulf. The team brings together scientists and experts from multiple government agencies and universities to analyze video of the gushing pipe, and the surface slick.

The full official estimate now states that for the first month and a half of the spill roughly 26,500 barrels a day flowed into the Gulf of Mexico with a standard deviation of about 6,250 barrels. This estimate only covers the time up to June 3rd before the top of the leaking pipe was cut, affecting the flow. Group members are continuing to work to estimate how much oil is leaking after the riser pipe was cut. After cutting the pipe, BP placed a capture device on top and is capable of diverting about 15,000 barrels per day of leaked oil. As *APS News* goes to press, the situation is fluid and continues to evolve.

Steven Wereley, an associate professor of mechanical engineering at Purdue University and a member of the team, used a common technique to estimate the flow of oil coming out of the broken pipe. Particle image velocimetry (PIV) records how fast a jet of fluid is shooting into a liquid. Once the liquid's speed is determined, it's a simple algorithm to calculate the pressure and flow rate of a jet of fluid.

"It's basically just feature tracking," Wereley said, "There are thou-

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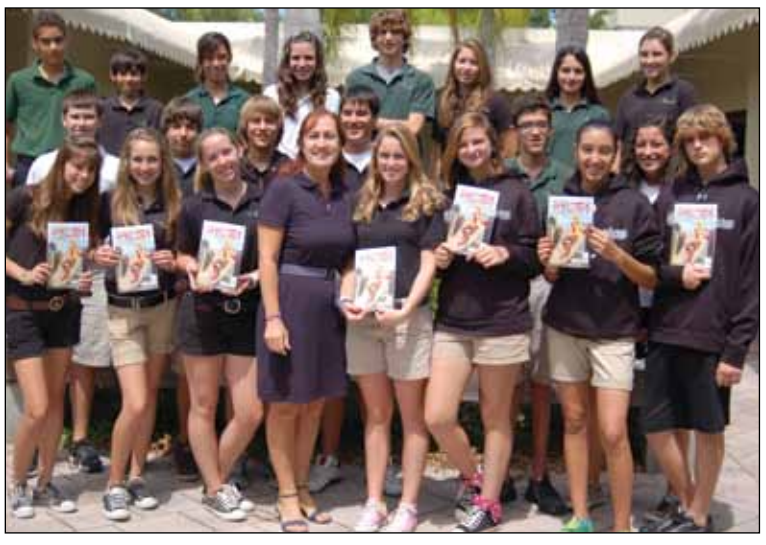
PhysicsQuest, Video Contest Winners Announced

May ended with a flurry of activity around APS's outreach department, as winners were announced for the LaserFest Video Contest and the yearly PhysicsQuest classroom competition.

LaserFest Video Contest

For the last three years, APS has sponsored a video contest aimed at getting the general public excited about and involved with physics. This year, the guidelines, which specified a short video that features lasers in some way, were intentionally simple to allow contestants be as creative with the videos as possible.

For the first time, when deciding the grand prize winner, the judges were split between two videos. They opted to award both videos the grand prize, which includes $1,000 cash, a handmade trophy, a SpectraSound kit, and a book chronicling the history of the laser.



Enmarie De Witt of the Westminster Christian School in Palmetto Bay, Florida poses with her 2010 PhysicsQuest grand prize winning eighth grade Physical Science class

Stephen Boyd is no stranger to entering video competitions. In 2009, he entered his first one for *Bicycling Magazine's* "Win Any Bike" contest and walked away with a Cervélo S4 road bike. Since then he figures he's entered at least 25 other video contests at sites around the internet.

"I make a lot of videos for video contests but this is one of the most fun ones I've done because I got to learn stuff," Boyd said.

Boyd's video, titled "Lasers are Crazy," features him and his friend Derek Tulowitzky dancing and rapping about how lasers work. Boyd is a senior at Ball State University in Muncie Indiana, studying actuarial science. Though not a physics major, Boyd was able to draw on his freshman year class on the physics of optics as well as on friends studying physics to help with the science.

He said that he has been making music all of his life and used to be in a band that went on tour. Now he mostly records electronic music,

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Two APS–Sponsored Fellows Bring Science to Capitol Hill

Each year APS sponsors one or two scientists enrolled in the AAAS Science and Technology Policy Fellowship program. The fellowship places researchers into one-year positions in the government in areas where science and policy overlap. The purpose is twofold. Lawmakers can consult with scientists about technical issues when drafting public policy. At the same time scientists gain experience working with shaping federal policy and conducting policy research. The ultimate aim is to promote positive contact between lawmakers and scientists.

The APS sponsors fellows that work in different congressional offices. This year, APS is sponsoring Virginia Corless at the Senate Energy & Natural Resources Committee and Arti Garg at the House Foreign Affairs Subcommittee on Terrorism, Nonproliferation, and Trade.

Virginia Corless had long had interests that extended beyond the confines of the lab. Her fellowship on the Energy Committee has given her a chance to combine some of her interests with her technical background.

Corless received her undergraduate degree in physics at MIT, and then went on to earn her PhD in astrophysics at Cambridge in 2009. She spent the next year doing postdoctoral work in Munich at Ludwig-Maximilians-Universität, researching the gravitational lensing effects of irregularly shaped intergalactic objects.

At the same time, she stayed active in areas outside of physics research as well. At MIT she minored in applied international studies, taking several political science and theater classes as well. Theater especially has always been a passion of hers, having both acted in and directed plays. While at Cambridge she directed a reinterpreted production of the 10th century miracle play *Dulcitius*. In it she infused ancient creation myths with modern cosmology, and she incorporated into the play's epilogue an excerpt from Nobel laureate Steven Weinberg's book *The First Three Minutes* about the Big Bang.

Drawing on her theatrical experience, Corless wrote a Back Page for the January 2010 issue of *APS News* entitled "Theater Deepens the Vision of Physics."

In her career she has always sought to combine her background in physics with other fields and travel. Over the summer of 2002, Corless taught biology to students in China through MIT's China Educational Technology Initiative. In the summer of 2004 she won a fellowship from the MIT International Science & Technology Initiatives program to study globular clusters at the Osservatorio Astronomico di Roma in Italy.

While she was working on her PhD, she spent a month in Washington DC doing an internship at the Science and Technology Policy Institute under the Institute for Defense Analyses. The Institute is one of the major suppliers of research information to the White House's Office of Science and Technology Policy.

"I've never been a pure-hearted scientist. I've always been really torn," Corless said, "Science policy is a place where so many things intersect."

At the Energy and Natural Resource Committee, Corless works on a range of energy policy issues. She's been able to combine her background in physics with the applied international studies minor she received as an undergraduate by focusing on helping to spread energy technology internationally. She has helped to oversee many of the agencies in the government that deal with international development, including the Department of Energy, USAID, and the Commerce Department.

"I was very lucky to end up on the Energy Committee," she said, "There's been a lot of very interesting stuff I've worked on."

Though she has contributed to

FELLOWS continued on page 3

APS Commemorates Shelter Island Conference

Photo courtesy of Gene Sprouse

On June 4, as part of the APS historic sites initiative, Editor-in-Chief Gene Sprouse presented a plaque to the owners of the Ram's Head Inn on Shelter Island, to commemorate the celebrated conference that took place there 63 years earlier. The plaque reads: "At this site a small meeting of theoretical physicists took place June 2-4, 1947. In a burst of pent up creativity after the war, they attacked several of the most important problems of the time, which led to dramatic breakthroughs in fundamental areas of quantum physics." The conference was attended by many of the post-war luminaries in US physics, and was notable for advances made in the understanding of quantum electrodynamics. It was held on Shelter Island, a secluded spot between the two forks of eastern Long Island. In the picture, Ram's Head Inn proprietor Linda Eklund (left) accepts the plaque from Sprouse (right) while the Chair of the APS Historic Sites Committee, Ben Bederson (center) looks on.

Members in the Media

"If this holds up, the LHC is going to be producing some fantastic results."

Neal Weiner, *New York University, about surprising results about muons at Fermilab that could help to explain matter-antimatter asymmetry,* The New York Times*, May 17, 2010.*

"What I get is 25,000 barrels a day coming out of that tiny hole –that's a 1.2-inch hole,"

Steven Wereley*, Purdue, estimating how much oil is flowing out of the damaged oil pipe in the Gulf of Mexico,* NPR*, May 20, 2010.*

"It'll be written about in physics books a hundred years from now,"

Zoltan Ligeti, *Caltech, about the discovery of the Higgs Boson*, Chicago Tribune*, May 29, 2010.*

"If they wanted to make highly enriched uranium, they could do it,"

David Albright*, Institute for Science and International Security, on Iran's nuclear capabilities,* UPI, *June 1, 2010.*

"Joining the discussion on my Facebook page is no substitute for a PhD in physics. However, it's a lot faster and cheaper,"

Steven Chu*, US Department of Energy,* The Associated Press*, June 1, 2010.*

"It is an unproven field…We are right at the edge now where optimism turns into realism."

Thomas J. Weiler*, Vanderbilt University, on Ice Cube, the neutrino detector array located in Antarctica,* The Wall Street Journal*, June 1, 2010.*

"The world of time travel seems to be a world where the laws of cause and effect get screwed up…But we learned throughout the 20th century that just because things seem crazy doesn't mean they don't happen, it just may mean that we have to think about them slightly differently."

Lawrence Krauss*, Arizona State University,* ABCNews.com*, June 7, 2010.*

"Science is more and more living in a glass house."

Robbert Dijkgraaf*, University of Amsterdam, on how the web makes scientific data easily accessible,* The New York Times*, June 14, 2010.*

"The first astronomer who can prove they found an Earthlike planet around an Earthlike star will win many kudos and prizes."

John Huchra*, Harvard-Smithsonian Center for Astrophysics,* The New York Times*, June 14, 2010.*

Physics Olympiad Team Heads for Croatia

The five high school students that will represent the United States at this year's International Physics Olympiad have been selected. Over ten days in late May, twenty students trained hard in a wide range of physics disciplines at the University of Maryland, each hoping to land one of the coveted spots on the Traveling Team. Though only five will travel to the competition held this year in Zagreb Croatia, all twenty students are considered a part of the United States team.

The students selected to travel this year are David Field, a senior at the Phillips Andover Academy in Andover, Massachusetts; Daniel Li, a senior at Thomas Jefferson High School for Science and Technology in Alexandria, Virginia; Anand Oza, a senior at Montgomery Blair High School in Silver Spring, Maryland; Jenny Lu, a senior at Pomperaug High School in Southbury, Connecticut; and Eric Spieglan, a sophomore at Naperville North High School in Naperville, Illinois.

"All twenty students who participated in the training camp are champions. They have tested themselves with the best of their peers for ten days and have proven to be an exceptional group of young people," said Warren Hein, executive officer of the American Association of Physics Teachers (AAPT). "We are proud of them all and are confident that the five Traveling Team members will continue the tradition of success for the United States as they represent the US Physics Team in

OLYMPIAD continued on page 4

This Month in Physics History

July 1849: Fizeau publishes results of speed of light experiment

The speed of light is one of the most well-established values in physics, measured so accurately that the meter is now defined in terms of it. But before the 17th century, most scientists, including such giants as Johannes Kepler and Rene Descartes, considered the speed of light to be infinite, able to travel any distance instantaneously. Galileo Galilei was among the first to question this assumption and attempt to measure the speed of light experimentally.

By modern standards, Galileo's methods were extremely crude. He stationed himself on one hilltop, and an assistant on a distant hilltop, each armed with a lamp that could be covered and uncovered at will. Galileo would uncover his lamp, and his assistant would do the same as soon as he observed the light from Galileo's lamp. Knowing the distance between the two lamps, Galileo could measure how much time had elapsed between the two flashes to calculate the speed of light. Not surprisingly, his conclusion was rather vague and inconclusive: "If not instantaneous, it is extraordinarily rapid." But he did conclude that light travels at least ten times faster than sound.


Armand Fizeau (1819-1896)

The first serious measurement of the speed of light occurred in 1676, when the Danish astronomer Ole Roemer observed the moons of Jupiter and noticed that their eclipses seemed to occur at different times, depending on the relative positions of Jupiter with respect to Earth, being late when Earth was far away, and early when Earth was closer to Jupiter. He correctly deduced that this effect wasn't due to an actual shift in the moon's orbits, but resulted because the light from those moons traveled a greater distance when Earth was farther away. He knew the accepted value for the diameter of Earth's orbit at that time, and from that, he concluded that the speed of light was 240,000 kilometers per second.

Roemer's measurement was still wide of the actual value, but it provided a useful baseline for future experiments. In 1728, an English physicist named James Bradley added his own findings to the accumulating body of knowledge, using stellar aberration to calculate the speed of light in a vacuum: in his case, 301,000 kilometers per second. The measurements were getting better. However, it would be another 100 years before a French scientist named Armand-Hippolyte-Louis Fizeau figured out how to measure the speed of light by means of a terrestrial experiment.

Born in Paris in 1819, Fizeau was the son of a physicist and professor of medicine, who left Fizeau a considerable fortune when he died. Free to pursue his interests without worrying about making a living, Fizeau focused on scientific research, initially intending to be a physician like his father, but ultimately choosing to study astronomy with Francois Arago at the Paris Observatory, where he no doubt learned of prior attempts to measure the speed of light using astronomical phenomena.

His scientific interests were quite varied, however. For instance, in 1839, he developed a fascination with Daguerrotype photography–then quite new–and teamed up with fellow French scientist Jean-Bernard-Leon Foucault in adapting the process to astronomy. It took 10 years, but the two men eventually took the first detailed photographs of the surface of the sun in 1845.

His work with Foucault inspired Fizeau to attempt his own measurement of the speed of light. He built an apparatus in which a cogwheel and a mirror were placed eight kilometers apart, and then sent pulses of light between them. He would rotate the cogwheel and observe how fast the beam of light traveled between the cogs of the wheel and the distant mirror, observing that if he spun the wheel very fast, the reflection back from the mirror was obscured because the light had struck one of the cogs.

Fizeau suggested that the amount of time it took the wheel to move the width of a single cog was equivalent to how long it took for the light beam to travel to the mirror and back again. Since he knew how fast the cogwheel was rotating, and the width of a single cog, as well as the distance to the mirror, Fizeau was able to calculate the speed of light, obtaining the value 313,300 kilometers per second. This was still roughly 5% too high.

Foucault improved on Fizeau's apparatus slightly, replacing the cogwheel with a rotating mirror–hence it is now known as the Fizeau-Foucault Apparatus. Light was reflected at different angles as the mirror rotated. Since both the speed of rotation and the distance to the mirror were well established, it was possible to measure the difference between the angle of the light as it entered the apparatus and when it exited the setup, and calculate the speed of light from that. Foucault concluded in 1862 that the speed of light was 299,796 kilometers per second.

Fizeau's contributions to science are not limited to this speed-of-light measurement. Subsequent experiments in which he measured how light traveled through flowing liquid resulted in a surprising discovery: the velocity of light doesn't change as expected when the medium it is passing through is in motion. Scientists had already determined that light traveled at varying speeds through different mediums, but until Fizeau's experiments, they believed that if a medium was moving, the speed of light would be obtained by simply adding the velocity of the medium to that of the light. His results implied a different formula, which would later be explained by Albert Einstein as the latter was developing his theory of special relativity.

Subsequent methods to measure the speed of light, of which Albert Michelson was a prominent practitioner, relied on wave interference. These methods became increasingly accurate with the advent of laser technology, and today, over 350 years after Galileo's hilltop experiment, the speed of light's value is defined to be 299,792.458 kilometers per second, according to a 1983 declaration by the 17th General Congress on Weights and Measures, thereby rendering the meter a derived quantity. It only took some 163 separate experiments involving more than 100 scientists–testament to the collaborative nature of the scientific enterprise.

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Editor . . . . . **Alan Chodos**
Staff Science Writer . . . . . **Michael Lucibella**
Art Director and Special Publications Manager. . . . . . **Kerry G. Johnson**
Design and Production. . . . . . **Nancy Bennett-Karasik**
Proofreader. . . . . . **Edward Lee**

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Washington Dispatch

A bimonthly update from the APS Office of Public Affairs

ISSUE: Budget and Authorization Environment

Appropriations Update

Since the last Dispatch in May there has been no movement on the assorted Fiscal Year 2011 Appropriations bills in either chamber of Congress. The difficult political environment in Washington has created a situation where the Democratic Party is reluctant to act on spending measures for fear of appearing to be wasting tax dollars, and the Republican Party, sensing a favorable reception from the public in an election year, is staking out a position to roll back government spending in general. The only FY11 Appropriation bills expected to pass on time are Defense and Homeland Security. All other FY11 Appropriations bills will likely fall under a Continuing Resolution lasting until February 2011 and possibly later, depending on the outcome of the Congressional mid-term elections in November.

America COMPETES Reauthorization

The America COMPETES bill, originally passed in 2007, authorized activities for the DOE Office of Science, National Science Foundation (NSF), and National Institute of Standards and Technology (NIST) for three years.

On May 7th, the House Science and Technology Committee, following a daylong consideration of nearly 60 amendments, passed the reauthorization bill, H.R. 5116. Although the bill garnered five GOP votes, Ranking Member Ralph Hall (R-TX) was not among them, and tepid support from Republicans spelled trouble down the road.

Trouble came on May 13, when the H.R. 5116 reached the House floor. Election-year politics and the toxic partisan environment carried the day. Following all debate and consideration of amendments, Republicans introduced a "Motion to Recommit" (MTR) that stripped out all the increased authorizations for science, freezing spending for the next three years at 2010 levels. Opponents of the bill also included a "poison pill" provision requiring that all NSF personnel who had been found guilty of using office computers to watch pornography be fired. The provision caught the bill's sponsors by surprise, and 121 Democrats opted to support the MTR to avoid being tarred in November as pornography supporters. The motion passed 292 to 126, sending the bill back to committee.

On May 19th, using a new bill number to circumvent the MTR, the sponsors brought the legislation back to the floor under "suspension of the rules." The bill received 261 yea votes but failed to get the requisite two-thirds needed for suspension passage, leaving the legislation's fate uncertain. Nine days later, immediately before the Memorial Day recess, in a surprise move, Democrats returned to H.R. 5116, using a parliamentary maneuver called "a division of the question" that allowed separate votes on each of the nine "instructions" contained in the MTR. Only two of the nine amendments passed: one on pornography and one requiring universities accepting federal funds to permit ROTC and military recruiting on campus. During the final vote on passage of the bill, 17 Republicans joined 245 Democrats voting yea.

The Senate is expected to produce a draft text for its version of COMPETES Reauthorization prior to the July 4th recess. Provided the bill contains no new or extraneous provisions and is simply a reauthorization of the 2007 Act, a bipartisan outcome may be possible.

Be sure to check the APS Washington Office's Blog, Physics Frontline (http://physicsfrontline.aps.org/), for the latest news on the FY11 Budget.

ISSUE: POPA & PPC Activities

The Energy Critical Elements Study Group, which is examining the scarcity of critical elements for new energy technologies, held its first meeting in late April at MIT. The meeting focused on technology issues, reserving all policy considerations for a second workshop that will be held in Washington, DC in the fall.

The Electric Grid Study Group, which is examining the technical challenges and priorities for increasing the amount of renewable electricity on the grid, presented and discussed its draft report with POPA in June. The Study Group will seek approval on a final version of the report from POPA later this summer.

The Direct Air Capture Study Group provided an update at the June POPA meeting. Their draft report is currently going through an external review process.

In consultation with the Constitution and Bylaws Committee, POPA is reviewing the procedures for developing and approving APS Statements to ensure that the APS membership is consulted well in advance of any Council action.

As a sequel to its recent study, *Technical Steps to Support Nuclear Arsenal Downsizing*, the National Security subcommittee is planning a workshop with the goal of catalyzing cooperation among industries in the nuclear supply arena concerning potentially proliferation-related technology.

At the June 7th Physics Policy Committee (PPC) meeting, a charge was approved to form a joint POPA-PPC Working Group. The Working Group, which will include members from both committees as well as outside experts, will examine how basic and applied research can better address the nation's needs, and make recommendations for improving the innovation process and enhancing the manufacturing capabilities of high technology products in the US.

If you have suggestions for a POPA study, please visit http://www.aps.org/policy/reports/popa-reports/suggestions/index.cfm and send in your ideas.

ISSUE: Media Update

The *Buffalo News* and *Salt Lake City Tribune* published letters to the editor on June 1 by two APS members who commended their congressional representatives for supporting the reauthorization of the America COMPETES Act. Ia Iashvili, an assistant professor in the Department of Physics at SUNY Buffalo, thanked U.S. Rep. Chris Lee (R-NY) for his vote on the act, while Eric Sorte, a PhD candidate in the Department of Physics of the University of Utah, lauded U.S. Rep. Jim Matheson (D-UT) for his support.

In other media news, the *Financial Times* published a story on May 18th detailing physicists' caution regarding proliferation risks associated with smaller, more efficient nuclear power technologies. Francis Slakey, APS associate director of public affairs, was quoted in the piece. APS's recent report, *Technical Steps to Support Nuclear Downsizing*, found that smaller technologies could represent proliferation game changers, leading to more efficient methods for production and use of nuclear materials that would be harder to detect.

Log on to the APS Public Affairs web site (http://www.aps.org/public_affairs) for more information.

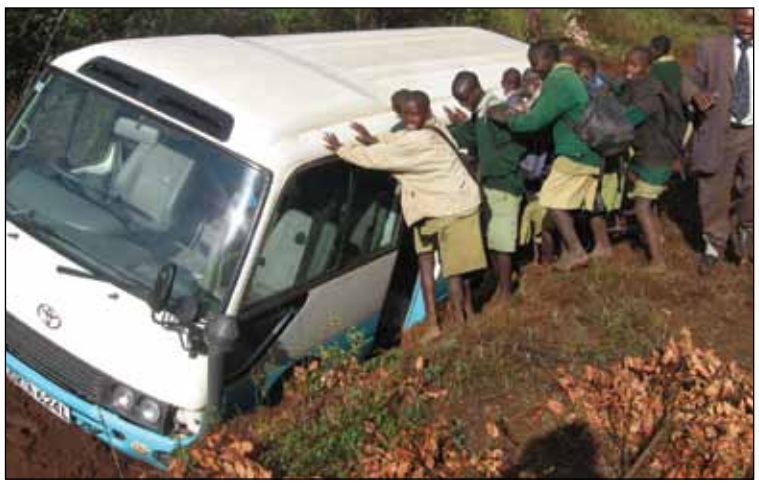
INTERNATIONAL News

...from the APS Office of International Affairs

Physics on the (dirt) road in Kenya

By Chris Discenza

Ed. Note: Chris Discenza is the Public Outreach Specialist at APS. A picture from his trip to Kenya appeared in the Aug./Sept. 2009 issue of *APS News*; what follows is his personal account.



We approached the school cautiously over the thick dirt road. The Ontulili High School is located in the forest that rests in the shadow of Mt. Kenya. Although this wasn't the rainy season, there were scattered afternoon showers that flirted with the current drought. We knew that if it rained we would be stranded in the thick soil that formed the only road back into town. During our presentation to the students, rain started and continued to pour in an ironic response to our weather science demonstrations.

In July I traveled to Kenya with two colleagues: Sherri Heck, a research scientist from the National Center for Atmospheric Research (NCAR), and Cristina Pease from Pima Community College, who traveled with me on a physics bus around the US in previous years. Sherri was the mastermind behind the whole operation. She measures the carbon dioxide levels in rural areas around the world, and Mt. Kenya, on the equator, is an ideal spot for her instrument to collect data valuable for modeling the climate.

The trip to Kenya was funded by NCAR in support of Sherri's research and included a science outreach component. Christina and I led the outreach program. We were also accompanied by Peter Bundi, Associate Director at the Kenyan Meteorological Department. He escorted us to different schools and enlightened us on current political events and cultural subtleties in Kenya.

We gave presentations on physics and weather science to students and teachers at eight schools around Mt. Kenya. The presentations for the students were motivational demonstration shows, while the meetings with the teachers functioned as workshops to demonstrate and explain experiments. Since many of these schools lack a budget for science materials,we brought a kit of sustainable materials to each school. Each kit consisted of reusable experiments, rechargeable batteries, and solar chargers for the batteries. Not only did this promote sustainability and alternative energy, it was a functional requirement for the rural schools. Many of the

KENYA continued on page 5

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many projects at the committee, much of her work has been on the early development stages and she said that it would take a long time to see their final results.

"One thing I learned during the fellowship," she said, "is that 99 percent will come to nothing; but that one percent will have a big impact."

However Corless is not frustrated with the slow process and the long timeframes.

"Ideas tend to live for a long time around here," she said, "You never know which ones come to fruition."

After the fellowship finishes in August, Corless said that she hopes to continue working on international energy issues. She said ultimately she hopes to keep working to spread the next generation of energy technology to the developing world.

Arti Garg sees the importance of having many different perspectives shape public policy. She said that her fellowship on the House Foreign Affairs subcommittee on terrorism nonproliferation and trade has given her the chance to offer more scientific input into internationally focused legislation.

For the fellowship, Garg works as a science legislative assistant on the subcommittee staff. This year is the first time in recent memory that either the subcommittee or the full committee has had a science fellow (there is an AAAS science fellow serving on the full committee this year as well). As a legislative assistant, Garg has already done much with the committee, including preparing background material, setting up hearings, organizing briefings, and working on legislation. It's been a busy nine months at the subcommittee. They have had five hearings on a wide scope of topics including foreign food assistance, labor rights, aerospace export controls, bioterrorism and nuclear cooperation.

"I felt that there were a lot of policy-related issues that have a lot of technological underpinnings," Garg said about why she first applied for the program, "There's a lot of stuff that happens in Washington and a lot of it affects science."

She first heard about the Congressional Science Fellowships while working as a science policy fellow at the National Academies. While at the Academies, she worked on a study about how the NSF can prioritize its funding and on ways for the InterAcademy Council to council to put together a metric to gauge a country's science and technology capabilities.

Garg received her BS in physics along with an AB in English from Stanford University. She continued on there to earn a masters in aeronautical & astronautical engineering before moving on to the University of Washington to earn her masters in physics, and her PhD in physics from Harvard in 2008.

After defending her thesis, Garg did her postdoctoral work at Lawrence Livermore National Laboratory. There she split her time between the Institute for Geophysics and Planetary Physics, which built on her PhD research into gravitational lensing effects of dark matter, and the Center for Global Security Research, where she worked on developing a remote surveillance system.

Before working with the National Academies, Garg didn't have much background in public policy, having only taken a single US political science course as an undergrad. Later, she audited John Holdren's course at Harvard's Kennedy School of Government. However, her research into astrophysics took her to the Cerro Tololo Inter-American Observatory and Las Campanas Observatory in Chile. There she was able to experience firsthand how international policies directly affected people's lives, such as how the observatories are run, who are issued visas to work, and how Chile was able to use the telescopes to build up its own research base.

"I don't feel like it's made my life impossible. But it's important to recognize that I don't have the experience that other people do that I work with." Garg said, adding that while there she's always been able to learn what she needed to know, "It's not bad, it's just different."

Garg is still unsure what she plans to do after the fellowship ends. She is currently on leave from Lawrence Livermore and might return after she finishes in Washington. She is also looking at other avenues as well, especially areas in the government that have been using technology to address climate change or humanitarianism.

"One thing I've learned about myself in the last nine months is that I'm OK now not being a research scientist anymore, but I do enjoy doing a lot of the nitty-gritty technical stuff," Garg said.

Letters

Physicists Vie for Darwin Award

Who is this guy in the picture in the lower right-hand corner of page 1 in the May 2010 issue of *APS News*? I don't see any safety glasses, knee pads, or elbow pads for safety. At least he has a helmet. No safety glasses on the people in the picture on page 6 either. From the pictures and text, I suppose there is a secondary lesson here on the Darwin's Theory of Evolution: survival of the fittest...

Richard W. Kadel
Berkeley, CA

World's Oldest Graduate Student?

In your article "Feynman Drew More than Diagrams," published in the May *APS News*, you stated that "The works were acquired by Princeton, where Feynman had been a graduate student, in the mid-eighties, and were kept …" Feynman was born in 1918, thus in the "mid-eighties" he was over 60 years old, and definitely NOT a graduate student at Princeton, nor anywhere else.

Edgardo Browne
El Cerrito, CA

Ed. Note: *What we MEANT to say was that the pictures were acquired by Princeton in the mid-eighties. Feynman was a graduate student at Princeton between 1939 and 1942.*

OLYMPIAD continued from page 2

Zagreb."

For these students, physics is more than a subject in school, it's a real passion.

"I'm happy to learn more," said Jenny Lu, "I really like problem solving in general… being able to look at a solution and see if it has a lot of applications."

The Olympiad, now in its 41st year, is an international competition for high school students. Each year it brings together teams of the brightest physics and math students from around the world for a week of intense physics problems and labs. Over ninety national teams compete for gold, silver and bronze medals. Last year the United States placed second overall, tied with its best standing historically.

The competing students are given both theoretical exams and physical labs that touch on a wide range of physics subjects. The students are told generally what topics to study ahead of time, but exactly which will be featured on the exams is a closely guarded secret, kept from the students until the exams are passed out. After all the tests and labs are completed, all the coaches review the answers, and assign points to the responses for the final tabulation.

The Olympiad first started in Eastern Europe in 1967, before branching out to other nations in Europe in the 1970s, and later the rest of the world. The United States first participated in 1986, when three team members won bronze medals, the best any team had done at its debut. AAPT and the University of Maryland have organized and trained each US team since its inception. APS and the American Institute of Physics, along with more than a dozen other organizations, also sponsor the team.

Making the team is a major accomplishment. More than 4,000 students from over 350 schools across the country took the preliminary "F=ma Exam." From there, 320 semifinalists were chosen, and had to pass through another round of more difficult testing. From these semifinalists the twenty students for the team were selected.

For the ten days that students are attending the training camp, they are worked hard. Almost every day is full of lectures, labs, and exams, from morning to late into the evening. One of the days was set aside for the students to go on a field trip to Capitol Hill. There the students got to meet Representatives Vernon Ehlers (R-MI), Bill Foster (D-IL), and Rush Holt (D-NJ), all of whom are physicists.

For the students selected to be on the traveling team, the end of camp doesn't mean that their training is over. Each was given a packet of questions from past Olympiads, which they're expected to complete in the 17 days between the end of camp and when the teams arrive in Croatia. The packet gives each student roughly 40 hours of work per week to keep them mentally in shape for the competition.

Though it's an intense training schedule, the students who participate say they enjoy their time at the camp.

"Being with people that are so passionate about the subject is such a thrill," said Christina Brasco, who just graduated from Weston High School in Weston, Connecticut and will be attending Yale in the fall, "I think the fact that everyone is so excited about being here has really brought us together."

This atmosphere is something that the coaches intentionally sought to foster.

"Many of these students are absolutely the best physics and often the best math students, and here they're among peers," said head coach Paul Stanley "It's OK to be a geeky physicist here."

Though there are only limited slots open on the traveling team, the students don't see themselves as competing against one another. The students all have vast amounts of physics knowledge, and part of the aim of the camp is to get the students to work together and teach each other as well as learning from the coaches.

"The peer group is very strong, I learned more from my peer group than my coaches," said Brian Zhang, a junior at Gunn High School in Palo Alto, California.

That Way Lies Madness

A May Letter in *APS News* made much ado about "seminal" and perhaps sexism. "Seminal" and "seminar" derive from a root that appropriately means "seed". Would objectors mind using "germinal" which refers to the earliest stage of an organism or an endeavor, or would it be confused with a daring novel by Zola?

David Markowitz
Storrs, CT

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In the May 2010 issue of *APS News*, Mano Singham suggests to avoid the word "seminal" due to its alleged obscene connotation. Please notice that the chief meaning of the Latin word "semen," from which "seminal" is derived, is "seed." The word "seminarium," which in English became "seminary" and "seminar," originally denoted a plant nursery. Not that obscene, I think! Should these words be banned, as well?

Kai Neergård
Næstved, Denmark

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Mano Singham raises the question "Is 'Seminal' Sexist?" in a letter in the May 2010 issue. Alas there are many English words derived from pre-scientific beliefs or superstitions. "Testify" is another, arising from the early practice of swearing oaths while grasping one's (male) sexual organs–see, e.g, Joseph T. Shipley, *The origins of English words*, Johns Hopkins Univ. Press, 1984, pg. 416. Doubtless a lexicographer could cite many more instances. While there are words and phrases patently derived from truly offensive racial and ethnic slurs, which should indeed be avoided, banishing neutral words that happen to have origins associated with a particular sex would impoverish the language. That way lies madness.

Robert Michaelson
Evanston, IL

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It is doubtful whether "seminal" is a sexist term. There is no reason why the innovative work of a physicist who is a woman cannot be called "seminal". But if "seminal" is sexist, then so are the words "matter" and "material", as they derive from the Latin word mater (mother); and it is high time to start using non-sexist terms such as "condensed substance physics" and "antisubstance".

Daniel Rohrlich
Jerusalem, Israel

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In May, 2010 issue of *APS News*, Mano Singham suggests that the word "seminal" should be retired, "except for use in its narrow, technical sense." I am at a loss to understand why anyone with access to a dictionary (and perhaps a little knowledge of Latin) would consider this a sexist word. Its "narrow, technical sense" (I assume he is referring to the medical term) is completely independent of its meaning as applied to research and writings. The two meanings are related only by having a common Latin root, which means "seed," but also "cause," or "origin." English has many examples of such words with two or more dissimilar and independent meanings. As for replacing it with other words, none of the words that Singham lists have the meaning that my dictionary gives of "containing the seeds for later developments." We should not impoverish the English language by removing words whose only offense is similarity to other words from a different context.

Robert K. Moniot
New York, NY

Comparison to Biological Sciences Can Be Misleading

David Goodstein, in his article on scientific fraud, references a study by Patricia Woolf from the 1980s. Woolf showed that 21 out of 26 fraud cases involved biomedical science, but Goodstein simplifies this to say that they occurred in biology, a very different fish indeed, especially given that the large majority of those involved in biomedical science are physicians, and that the number of research physicists is very small compared to the number of biomedical scientists. This omission, when taken into account, significantly weakens Goodstein's argument, and indeed is mystifying, because he specifically refers to biomedical sciences rather than biology in a 2002 article for Academe Online (http://www.aaup.org/AAUP/pubsres/academe/2002/JF/Feat/good.htm)

It is somewhat glib to claim, as Goodstein does, that biology/biomedical science is characterized by a lack of reproducibility and then go on to generalize this as engendering fraud without considering the relative number of researchers and the diligence with which research fraud is pursued in different fields.

Joshua Halpern
Washington, DC

Student Cheating Can Lead to Fraud

In the June *APS News*, David Goodstein's Back Page article on scientific fraud did not mention the type of misconduct most familiar to physicists: student cheating.

As an undergraduate, I was a below-average physics student, but refused to cheat. In later years I felt justified by such press as the *New York Times* article in 2001 that reported "Louis A. Bloomfield, a physics professor at the University of Virginia, using a computer program, found 60 term papers were nearly identical." [http://www.csie.ntu.edu.tw/~lyuu/virginia.html.]

The same article stated further that "in 1993, 53 percent of students at schools without honor systems admitted to cheating once or more on a test in the previous year, while 29 percent of students at schools with honor codes admitted cheating. Two out of three students surveyed at colleges and universities without an honor code admitted to copying another student's papers, while 42 percent of students on honor codes said they had done so." The malfeasance that had been tolerated at university was gradually becoming exposed and addressed.

It is disheartening when one honors academic rules while privileges are bestowed upon the unprincipled. If dishonesty were confronted more seriously in college, most of the fraudulent actions which David Goodstein referred to might never have occurred.

Loren Booda
Arlington, VA

No Fraud in Cold Fusion

David Goodstein is to be commended for writing a very thoughtful and well-written article ("Scientific Fraud (or scientific misconduct if you dislike using the term fraud)," The Back Page, *APS News*, June 2010) about an extremely important but frequently neglected topic. He mentioned that although he has been frequently asked if scientific fraud occurred during the "Cold Fusion" episode, in fact, he believes that this did not take place, and although most of the scientific community has concluded that cold fusion is not possible, in his view, "the final verdict [about this] is not yet in."

It is worthwhile noting that the failure of mainstream scientific journals to report positive findings about the field has become a topic in the mainstream ethics in science literature. In particular, a special two-issue edition of the Taylor & Francis *Ethics in Science* journal, *Accountability in Research* (http://www.tandf.co.uk/journals/titles/08989621.asp), dealing with questions related to why information about the field had not been widely disseminated, appeared in 2000[1].

Twenty-one years after cold fusion was first announced, a more "normal" dialog about the subject is badly needed.

Scott R. Chubb
Burke, VA

[1]S.R. Chubb, M. Fleischmann, S.E. Jones, D.L. Goodstein, F. Scaramuzzi, G.H. Miley, J.O. Bockris, D.J. Nagel, *Accountability in Research*, 8, 1-162 (2000). All of the papers in this collection are available on-line at www.lenr-canr.org. See: http://www.lenr-canr.org/LibFrame4.html

Letters (continued)

Moderation Urged on Climate Change, Energy

Burton Richter's thoughts on climate change and energy (Richter Takes Readers Beyond Smoke and Mirrors, *APS News*, June 2010) contribute much needed moderation and common sense to this normally contentious arena. Having spent a good part of my career sorting out the economic benefits, costs, and risks of technology policies and specific technologies, I would like to point out that his general approach is consistent with economic analyses of optimum policies for dealing with climate risk.

Richter calls for deployment of available, economically justifiable options for reducing CO_2 emissions, while avoiding costly, government-imposed technology prescriptions. Economic analyses agree. Assuming that the IPCC's central projection of future global warming is correct (3 °C for doubling of CO_2), environmental economist William Nordhaus of Yale University finds that an optimum policy would be based on a slowly increasing carbon tax, not technology prescriptions or wasteful and corruption-prone cap-and-trade schemes (see W. D. Nordhaus, *A Question of Balance: Weighing the Options on Global Warming Policies* (Yale University Press, 2008)). Indeed, a near maximum ratio of avoided climate damage to economic costs of implementation is achieved for a 50-year delay before implementing any mitigation policies. The optimum policy itself calls for a broad-based carbon tax this year of the equivalent of $0.10 per gallon of gasoline, rising to $0.30 per gallon in 2050. Such a "tilting of the playing field" would naturally favor "winners" identified by Richter, such as natural gas and nuclear energy. This is in stark contrast to the draconian, growth-arresting solutions promoted by states such as California and by the Federal government. This is not just theoretical; the Spanish experience with subsidized renewable energy is largely responsible for Spain's current financial difficulty (see <http://www.juandemariana.org/pdf/090327-employment-public-aid-renewable.pdf).

Roger W. Cohen
Durango, CO

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Burton Richter's interview in the June issue of *APS News* offers encouragingly moderate recommendations for mitigation of anthropogenic global warming (AGW), while calling attention to the important issues of technological realism and economic feasibility. However, the current IPCC consensus projections and associated estimate of equilibrium climate sensitivity (ECS) act to discourage attention to Richter's issues of practicality and acceptance of his moderate proposals, by presenting a probability distribution of projected warming having a sharp lower cutoff and an alarmingly long upper tail, and by assigning high confidence to this distribution. Those inclined towards moderation should consider the detailed depiction and derivation of this distribution (Reference 1, Pages 720 and 798-799), wherein visibly divergent model-based probability distribution function (PDF) estimates are treated as a composite, thereby disregarding the negative model validity implications of conflicting projections and creating a picture skewed towards alarm. A careful reading of Reference 1 discloses several caveats that should imply lessened confidence in current climate models, such as this statement on Page 608: "Consequently, for models to predict future climatic conditions reliably, they must simulate the current climatic state with some as yet unknown degree of fidelity." Recently published work suggest the need to modify IPCC projections towards support of greater moderation by reporting low measurement-based ECS values [2], a significant decadal period climate forcing that is not included in current IPCC models[3], and evidence of a celestial origin for many important climate oscillations [4].

Robert E. Levine,
Sierra Vista, AZ

[1] S. Solomon et al. Eds, *Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK (2007).

[2] R. Lindzen and Y. Choi, *Geophysical Research Letters* 36, L16705, doi:10.1029/2009GL039628 (2009).

[3] S. Solomon et al, *Science* 337, 1219 (2010).

[4] N. Scafetta, Empirical evidence for a celestial origin of the climate oscillations and its implications, *Jour. Atmospheric and Solar-Terrestrial Phys* (2010), in press.

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As one who objected to aspects of the 2007 APS "National Policy" climate-change declaration, its recent so-called "Commentary" is welcome.

Your headlined news coverage emphasizes the procedural and rescripting process, but it glosses over substance, particularly POPA's concessions and clarifications. For those who wade through and compare the original APS policy with its "Addendum," please note two notable and critical modifiers, not previously stated, but now exhibited more than once:

The Commentary directly makes note of "uncertainties," "uncertainty in the estimates," "uncertainty in net effect," "probability distributions," and other qualifying terms that physicists experienced in scientific methodology find to be *de rigueur*, yet entirely omitted from the original APS statement.

The addendum stipulates that data found in the (IPCC) climate-change formulation is "relative to its pre-industrial value" and "relative to their pre-industrial values." This is an indirect, albeit belated admission that radiative-forcing data in the 2007 IPCC report were normalized to the year 1750. Lacking definitive measurements prior to the industrial revolution, the IPCC did as well as it could in normalizing data. One problem is that IPCC data adjustment was understated. Another problem is that global temperatures in 1750 were comparatively low, thus rendering subsequent values markedly higher.

While there is considerable and demonstrable statistical confidence that aggregate contemporary global warming has occurred (at least before the 21st century), there is much less proven causative connection with historic human activity and even less demonstration of statistically confident cost-effective remedial action. In light of worldwide economic demands, societal needs should be addressed, in my opinion, on the basis of more substantive science.

It's not a matter of whether climate change is occurring, or whether humans are responsible: It's a matter of providing a scientifically justifiable current assessment couched in probabilistic terms.

Alexander DeVolpi,
Oceanside, CA

Long History of Galactic Magnetic Fields

The quoted remark by Ruth Durrer in "Members in the Media," *APS News*, May 2010, "These magnetic fields could not have formed recently, and would have to have formed in the primordial universe," expresses something long known, at least by Albert Einstein in 1934, and by Russell Kulsrud (Princeton), some British physicists, and myself, since the nineteen fifties or sixties.

A detailed article by me exists in the CD of the *Proceedings of the 22nd Texas Relativistic Astrophysics Symposium* held in December 2004 at Stanford University, which derives the origin of magnetic fields at Recombination Time (about 370,000 years in our Big Bang universe), with its important consequences for galactic astrophysics. My research approach since 1961 uses some thoughts from the pioneering Swedish astrophysicist, Hannes Alfvén, and agrees with an approach urged in 1983 by an outstanding brilliant Russian physicist, Ya. B. Zel'dovich, who was a good friend of Andrei Sakharov.

Howard D. Greyber
San Jose, CA

Happy Birthday, Dear Laser

Photo by Frank Brady

On May 16, 1960 Theodore Maiman and co-workers demonstrated the world's first working laser. LaserFest, spearheaded by APS together with the Optical Society, SPIE and IEEE-Photonics, is a year-long celebration of this anniversary, and on May 16 itself, APS presented a plaque at the very site where the laser was born, Hughes Research Laboratories in Malibu, California. The presentation, part of APS's historic sites initiative, was made by APS President-elect Barry Barish of Caltech, seen on the right side of the photo (in the tan jacket), delivering some remarks, which included reading the text of President Obama's letter that was printed in the June *APS News*.

KENYA continued from page 3

schools did not have electricity or running water.

We also brought Galileoscopes to each school, and many students and teachers saw the details of the moon for the first time. I imagine this might have been similar to the reaction Galileo received when he demonstrated the telescope 400 years ago. In addition, we were able to point to celestial objects with a green laser pointer, to their amazement.

Our school visits were extremely formal, a cultural influence remaining from British rule. It was also unusual for them to have American visitors, and we were treated as ambassadors. The formality followed the same rituals at every school. We were always invited to the principal's office for tea and lunch. Kenyan tea is one of their proudest drinks and it is always steeped in hot milk. The lunch typically consisted of rice with a beef stew–flavorful, but not as exotic as an American might imagine.

The schools lacked computer labs and advanced equipment–the average classroom contained only desks and a blackboard. Often the walls were not even painted. Interestingly enough, the level of education at these schools was extremely high–the students were very focused and the teachers were highly educated. The muted colors of unfinished walls were a beautiful contrast with the students' bright matching uniforms.

At the end of our presentation we always took a moment for questions. An awkward silence would pass and then a student would casually emerge from the crowd and hand me a handful of torn paper slips. Each slip had a question.

- Is the physics here and in the USA the same?
- Do students in the USA do quantum physics?
- What is the function of a Galileoscope?
- Can a photo-electric cell be used to measure the threshold wavelength of the infrared and ultraviolet rays?
- What were you demonstrating when you used the yo-yo?

After reading the last question, I realized that this was the first time these students had seen a yo-yo. In fact they all laughed at the name. I worried that the word "yo-yo" was Swahili or slang for something other than physics. I also had a similar experience when I demonstrated the right hand rule for the Lorentz force. Luckily, my gesture was not perceived as lewd, but they thought I was joking. They learn what is called "Flemming's left hand rule" for the same phenomenon. Many students and teachers also asked what happened to Pluto as if it was destroyed or had disappeared. This made me realize some of the challenges of communicating science internationally and the benefits of having face-to-face discussions about science.

After our presentation to the to students, the rain continued to pour. We decided to try our luck with the bus on the muddy road in hopes that the rain had not yet penetrated the soil. We drove at a walking pace as the bus occasionally drifted in the mud. Our luck lasted for a half of a mile before the bus gently slid into the embankment like a kiss on the cheek. We were stuck. The rain promptly ended but the mud remained. We called for backup. Backup was a Land Rover used to shuttle Sherri and her instrument up the mountain. It would take over an hour to rescue us. Of the many problems that arise from getting stuck in the middle of the forest, making a call was not one of them. Ironically there is cell phone service everywhere in Kenya: the forest, the city, on safari, and even on Mt. Kenya. As we waited for backup, a herd of primary school students were making their way home. Many of them were barefoot (I have to admit I did fantasize squishing my toes into the soft mud). The students gathered around our curious predicament. Since they had not studied English, Christina had difficulty communicating with them. However, I could understand that they were making fun of the mud caked on my nice shoes. They told Peter that they could push the bus out of the mud. At first he was reluctant, but they quickly crowded behind the bus and demonstrated their power. Sure enough, they pushed the bus from the embankment and onto the road. In the meantime many of the girls were inspecting Christina's black dyed hair. I decided to teach the kids how to high five. I'm not sure if a high five will inspire the youth in Kenya, but it is a successful method of communication while stuck in the mud.

2010 GENERAL ELECTION PREVIEW

The 2010 APS Nominating Committee is pleased to present an outstanding slate of candidates for the 2010 APS annual election. Those who are elected will begin their terms on 1 January 2011.

VICE PRESIDENT

Christopher McKee
University of California, Berkeley

Christopher McKee is a professor of Physics and of Astronomy at the University of California, Berkeley. He received his AB in Physics from Harvard in 1963 and his PhD in Physics from Berkeley in 1970. After a year as a postdoctoral fellow in theoretical astrophysics at Caltech, he became an assistant professor of astronomy at Harvard. In 1974 he joined the Physics and Astronomy Departments at Berkeley. He was instrumental in establishing the Theoretical Astrophysics Center at Berkeley and served as its first director in 1985. Shortly thereafter, he relinquished that position to become Director of the Space Sciences Laboratory at Berkeley, a position he held until 1998. He was Chair of the Physics Department from 2000-2004. Subsequently, he served on and chaired the committee that oversees all academic hiring and promotions on the Berkeley campus. For many years he was a consultant at Lawrence Livermore National Laboratory. He has served on numerous advisory committees for NASA and NSF. For the National Academies, he co-chaired the 2000 decadal survey of astronomy and astrophysics with Joseph Taylor. He has also served on other Academy committees, including the Board on Physics and Astronomy. He has served as an Associate Editor of *Reviews of Modern Physics* and is on the editorial board of the *Annual Reviews of Astronomy and Astrophysics*. He is currently the chair of the Rahman Prize Committee for the APS.

McKee is a theoretical astrophysicist with a broad range of interests. Much of his work has focused on the dynamics and thermal physics of astrophysical plasmas, with applications to shock waves in molecular gas, to supernova remnants and to the relativistic blast waves believed to power cosmic gamma ray bursts, among others. In collaboration with J.P. Ostriker, he developed the three-phase model of the interstellar medium, which has been widely used to organize and interpret observational data. More recently, he has used both analytic techniques and large-scale numerical simulation to study the process of star formation, one of the central problems in contemporary astrophysics.

Michael Turner
University of Chicago

Michael S. Turner is the Rauner Distinguished Service Professor and Director of the Kavli Institute for Cosmological Physics at The University of Chicago where he has been a faculty member since 1980. He was born in Los Angeles, CA, received his BS in physics from Caltech, his M.S. and PhD degrees from Stanford University, and an honorary D.Sc. from Michigan State University.

Trained in general relativity and particle physics, Turner came to Chicago in 1978 as an Enrico Fermi Fellow. Working with David Schramm, he began to explore the connections between particle physics and astrophysics and cosmology, and helped pioneer the interdisciplinary field of particle astrophysics and cosmology. In 1983, he and Edward W. (Rocky) Kolb created the Theoretical Astrophysics group at Fermilab. They also wrote the influential monograph, The Early Universe, and mentored many of the researchers in particle cosmology.

Beyond his university activities, from 2003 to 2006 Turner led the Directorate for Mathematical and Physical Sciences at the National Science Foundation where he oversaw a billion-dollar budget, and from 2006 to 2008 he was Chief Scientist of the Argonne National Laboratory.

In addition to serving on many NSF, DOE and NASA Advisory Committees, Turner has participated in more than 10 NRC studies, and he chaired the Quarks to the Cosmos study, which called attention to the field of particle astrophysics and set its priorities. Currently, Turner is the Chairman of the Board of the Aspen Center for Physics, a member of the NRC's Board on Physics and Astronomy and of the Governing Board of the NAS, and a Director of the Fermi Research Alliance, which manages Fermilab for the Department of Energy.

Turner has long been active in the APS, having served on the APS Council and Executive Committee and on the CSWP and PPC. He has also chaired the Publications Committee, Nominations Committee, and is the past chair of the Division of Astrophysics. He was co-chair of this year's April Meeting in Washington, DC and will be the chair of next year's April Meeting in Anaheim, CA.

CHAIR ELECT-NOMINATING COMMITTEE

Ani Aprahamian
University of Notre Dame

Ani Aprahamian is a professor of Physics at the University of Notre Dame. She is an experimental nuclear physicist with research interests in the field of nuclear structure and nuclear astrophysics. She has been the director of the Nuclear Science Laboratory at Notre Dame and the chair of the Physics Department. She is presently the vice-chair of the National Academies decadal review of Nuclear Physics (NP2010) and the co-chair of the standing Nuclear Science Advisory Subcommittee on Isotopes (NSACI). She is a member of the board of directors for the South Dakota Science and Technology Authority (SDSTA). She is also the chair of the scientific council of GANIL in France, and a member of the science advisory committee for FRIB (facility for rare isotope beams) soon to be constructed at Michigan State University.

Presently Ani's research interests are focused on studies of exotic neutron-rich nuclei that are produced in a very short flash in nature leaving an indelible signature on the abundances that are observed in the solar system today. The big bang and stellar evolution are thought to create the elements through iron, but the origin of nearly 50 percent of the elements above iron remain somewhat of an enigma to nuclear physicists and astrophysicists alike. It is thought that a neutron-rich explosive environment in the emerging supernova shock front may be responsible for the enhancement of the heavy elements through a series of rapid neutron capture and beta decay processes. A better understanding of the details of such a process is heavily dependent on the properties of nuclei involved. These nuclei lie far from stability at the very edges of what we are capable of producing in the laboratory, providing one of the strong motivations for the construction of FRIB. Properties such as nuclear masses and evolution of nuclear shapes affect the rate of neutron captures, the ensuring beta decays, and therefore hold the keys to the bottlenecks that may arise and the final abundances that result for the heavy elements into the actinides. Her research group carries out experiments at Notre Dame's Nuclear Science Laboratory, the NSCL at Michigan State University, Argonne National Laboratory, Oak Ridge National Laboratory, and Lawrence Berkeley Laboratory in the US, and Jyvaskyla in Finland, GSI in Germany, CERN in Switzerland, JINR in Russia, and Legnaro National Laboratories in Italy.

Lars Bildsten
Kavli Institute for Theoretical Physics

Lars Bildsten is a Permanent Member of the Kavli Institute for Theoretical Physics and a Professor in the Physics Department at University of California, Santa Barbara. He received his PhD in theoretical physics from Cornell University in 1991, where he held a Fannie and John Hertz Graduate Fellowship. Bildsten was at Caltech for three years as the Lee A. DuBridge Research Fellow in Theoretical Astrophysics and received a Compton Fellowship from NASA in spring 1994. He was an assistant and associate professor in both the Physics and Astronomy departments at University of California, Berkeley from January 1995 through July 1999. During the previous Decadal Survey of Astronomy and Astrophysics, Bildsten served on two Panels: High Energy Astrophysics from Space and Theory, Computation and Data Exploration. He was an elected member of the Executive Committee of the High Energy Astrophysics Division of the American Astronomical Society in 2000 and 2001 and the Executive Committee of the Division of Astrophysics of the American Physical Society from 2003-2005. He has served on many recent NRC panels, including the Committee on Astronomy and Astrophysics from 2001 to 2005 and the Panel to Review the Science Requirements for the Terrestrial Planet Finder and Committee on Review of Progress in Astronomy and Astrophysics toward the Decadal Vision in 2005. He was a member of the NSF's Mathematical and Physical Science Advisory Committee from 2004 until 2007. In 2008, he began his service on Astro2010: The Astronomy and Astrophysics Decadal Survey committee.

Bildsten has placed substantial efforts in education, both at the college and K-12 level. His upper division physics course: "Physics of California" has brought fluid dynamics and continuum mechanics back into the curriculum for physics majors at UC-Santa Barbara. He is also part of a collaborative effort in Santa Barbara to dramatically strengthen and enhance science and engineering education in grades 7-12. As a member of the Board of Directors of the Dos Pueblos Engineering Academy Foundation, he has worked to raise over $2,000,000 in funding for a new facility, and funds that have allowed for nearly 20 math tutors to be placed in 7th-8th grade classrooms throughout the county.

Bildsten's theoretical research spans the fields of stellar astrophysics, gravitational wave phenomena, and stellar explosions. His current efforts are focused on the physics of accreting white dwarfs, with a special focus on the thermonuclear instabilities that lead to explosions, both the remarkably bright Type Ia supernovae and newly discovered faint explosions. This encompasses the theoretical study of many different physical phenomena, including thermonuclear instabilities, nuclear reactions, propagating combustion fronts and stellar oscillations. Bildsten also works closely with observers to gain knowledge on these objects from observation, especially focused now on supernovae of all types. He has maintained a strong interest in the prospects for detection of accreting neutron stars in our Galaxy and merging neutron stars at cosmological distances with the Laser Interferometer Gravitational Wave Observatory and is presently chair of the LIGO Astronomy and Astrophysics Advisory Panel.

GENERAL COUNCILLOR

Haiyan Gao
Duke University

Haiyan Gao is a professor of Physics at Duke University, and a Changjiang Lectureship Chair Professor at Tsinghua University. She received her BS degree in Physics at Tsinghua University in 1988, and PhD degree in Experimental Nuclear Physics in 1994 at Caltech. She was a Postdoc at the University of Illinois, Urbana-Champaign from 1994 to 1996, and a staff Physicist at Argonne National Laboratory from 1996 to 1997 before she joined the faculty at MIT in 1997. She moved to Duke University in 2002.

Haiyan Gao's research focuses on understanding the structure of the nucleon and exclusive nucleon and nuclear processes at high energies in terms of quark and gluon degrees of freedom of Quantum Chromodynamics (QCD). Most of her work uses the novel experimental technique of scattering polarized electrons or photons from polarized gas targets. She and her group are also collaborating on a challenging experiment aiming at a two-order-of-magnitude improvement over the current limit of the neutron electric dipole moment to search for new physics beyond the Standard Model.

She has served on several advisory panels and committees, including the Program

GENERAL COUNCILLOR

Committee and Fellowship Committee of the Division of Nuclear Physics (DNP) of APS, Panel on Public Affairs of APS, and the Advisory Committee of the Institute of Nuclear Theory. Currently, she is a member of the editorial board of *Progress in Physics*, and is an associate editor of the *European Physics Journal A*. She is the Vice President of the Overseas Chinese Physics Association (OCPA), and a fellow of the APS.

Angel E. Garcia
Rensselaer Polytechnic Institute

Angel E. Garcia is a professor of Physics at Rensselaer and holds appointments in the Departments of Biology and Chemical Engineering. He received a BS and MS in Physics from the University of Puerto Rico, and a PhD in Theoretical Physics from Cornell University in 1987. He was a staff member in the Theoretical Biology and Biophysics Group at Los Alamos from 1989-2005. At Los Alamos he was Group Leader of the Theoretical Biology and Biophysics group from 2001-2005.

Angel joined Rensselaer as a Chaired Constellation Professor in Biocomputation and Bioinformatics in 2005. Angel E. Garcia is a theoretical and computational biophysicist interested in protein folding and protein dynamics. His research group aims at understanding basic steps in biological processes from physical principles. Recent work includes the development of models that explain the role of high hydrostatic pressure in the unfolding of proteins, the role of denaturants on protein stability, and the development of an atomic model describing the translocation of cell-penetrating peptides through lipid bilayers.

He has served on the Committee of Visitors of the Division of Physical Sciences of the National Science Foundation. He has been a member of the Executive Committee of the Division of Biological Physics of the APS; Chair of the Theoretical Chemistry Subdivision of the American Chemical Society; member of the Council of the Biophysical Society; and member of the Nominating Committee of the Protein Society. He is an Associate Editor of *Proteins*, has served on the Editorial Board of the *Biophysical Journal*, of Molecular Simulations, and is a Member of the Faculty of 1000 for Structural Biology.

Jeff Harvey
University of Chicago

Jeff Harvey is the Enrico Fermi Distinguished Service Professor and a member of the Physics Department and the Enrico Fermi Institute of the University of Chicago. He received undergraduate degrees in mathematics and physics from the University of Minnesota, a PhD from Caltech in 1981 and was a postdoc and faculty member at Princeton University before moving to the University of Chicago in 1989.

His research interests and accomplishments cover a broad spectrum of topics in particle theory, cosmology, mathematical physics, and string theory. The present focus of his research is the application of the AdS/CFT correspondence to the strong interactions.

He has been a member of the editorial boards of *Physical Review D* and *Classical and Quantum Gravity* and is currently an associate editor of *Reviews of Modern Physics*. He was chair of the University of Chicago physics department from 2001-2004.

Pierre Meystre
University of Arizona

Pierre Meystre obtained his Physics Diploma and PhD from the Swiss Federal Institute of Technology in Lausanne, and the Habilitation in Theoretical Physics from the University of Munich. Following a postdoctoral position at the University of Arizona Optical Sciences Center and nine years as a staff scientist at the Max-Planck Institute for Quantum Optics in Germany he returned to the University of Arizona in 1986. He is currently a Regents Professor of Optical Sciences and Physics, holds the Chair of Quantum Optics, and is Director of the B2 Institute. His research includes theoretical quantum optics, atomic physics, and ultracold science. At the B2 Institute he is also increasingly engaged in renewable energy and smart grid R&D. He has published over 280 refereed papers and is the author of the text *Elements of Quantum Optics*, together with Murray Sargent III, and of the monograph *Atom Optics*.

Dr. Meystre has served on numerous national and international committees. He is past-Chair of the Division of Atomic, Molecular and Optical Physics of the American Physical Society, past-Chair of the National Research Council standing committee on atomic, molecular and optical science (CAMOS), and currently serves on the NRC Board on Physics and Astronomy.

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sands of people in the US that do this technique, you can call almost any university and they'll have someone who could estimate the leak."

Wereley appeared before the Subcommittee on Energy and Environment of the House Energy and Commerce Committee, saying that using PIV on the short videos of the gushing pipe, he first pegged the flow at somewhere between 70,000 to 100,000 barrels per day. After more video and information about the oil to gas ratio became available, he revised his estimate down to a base of 12,000 to 25,000 barrels per day.

The FRTG used PIV together with two other methods to come to their final numbers. NOAA had airplanes fly over the spill with an Airborne Visible/InfraRed Imaging Spectrometer (AVIRIS) which can measure the area and the depth of the oil spill. Researchers combined the volume of oil on the surface with estimates of how much has evaporated, been burned off, or dispersed to get a total amount of oil that leaked.

For their initial estimate, researchers were able to check their numbers against readings from the Riser Insertion Tube Tool. Stuck into the end of the leaking pipe on May 16th, the RITT pumped about 3,000 barrels of oil a day to a tanker on the surface before it was replaced with the current capture device. Researchers took the pressure and flow readings from the RITT and extrapolated how much oil was leaking out the end of the pipe and other holes.

Scientists outside of the technical group have also used PIV and other common fluid physics techniques to estimate the flow of oil. Many of these estimates have been picked up in the media.

"This was a homework problem that was too good to resist," said Eugene Chiang of the University of California, Berkeley who teaches a course on estimating orders of magnitude. His first estimate used PIV and was carried on *PBS NewsHour*. It pegged the flow at somewhere between 25,000 and 100,000 barrels of oil a day, "It's a really simple calculation, almost embarrassingly so."

Pirouz Kavehpour at UCLA came up with a more conservative figure using a slightly different technique. He looked at the shape that the gushing oil made as it flowed into the seawater to estimate its critical Reynolds number, which he then fed into an equation that gave a total volumetric flow rate.

Using this calculation, Kavehpour estimates that at bare minimum at least 5,000 barrels per day is pouring into the Gulf. This base line is closer to BP and NOAA's initial figures; however he didn't put any upper limit on the amount, saying that there wasn't enough available data to say what the upper limit might be. He said also that he was concerned about the accuracy of some of the other estimates seen in the media.

"None of these estimates are peer reviewed," Kavehpour said, "Which is really bad I think."

The wide range of estimates also highlights how far away from an ideal lab setting the situation actually is. Accurate flow rates have been devilishly hard to calculate because of limited available information. Typically in a lab, PIV uses reflective particles that are easily tracked by high speed, high definition cameras.

Nearly a mile under water, uncertainties abound. There are no reflective particles or high definition cameras to track the flow. Researchers using PIV have had to rely on tracking eddies suspended in the water using the grainy video available.

Mirko Gamba, a post-doc at Stanford University, used a method similar to Chiang's and came up with a range of 30,000 to 90,000 barrels per day.

"If we had good quality images and knew what we are looking at and had a sense of scale, seeing it from all sides, we could do a much better job to pinpoint this number," Gamba said.

The biggest uncertainty is that the ratio of oil to methane gas gushing out of the broken pipe is constantly changing. Even within the original 30-second video, it is clear that the proportion of methane gas to oil can change dramatically over just a few seconds. Without a consistent flow, or a way to easily find its average, large error bars surround nearly all estimates.

Other factors, such as the poor quality of the released video, difficulty gauging sizes and proportions, limited viewing angles, and the opaqueness of the oil itself have likewise limited the precision of estimates.

"It's really only meant to give an order of magnitude," Chiang said of his estimate, "I can't even claim to know the first significant figure, but I can claim to know the exponent." He revised his estimate lower later after it was learned that the inner pipe which carried the oil was half the diameter of the outer protective pipe seen in the video.

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though he's been playing drums for nine years, and also dabbles with keyboard and synthesizers. Boyd recorded all of the original music for the video using his own equipment.

With the prize money, Boyd said that he would likely use it over the summer when he and his friends are planning a bicycle tour from Muncie to Bar Harbor Maine.

Cory Stinson's winning video "Interference; A True Story Dance Using HeNe Lasers" had a unique take on the physics video contest. Instead of describing the physics of lasers, the laser spots themselves become the main characters of a love story. In the video, two spots encounter each other and dance together, creating interference patterns while Frank Sinatra croons "Strangers in the Night."

"The inspiration came from one of the demos that we do in the freshman physics classes at the University. We show them interference between the two laser beams," Stinson said, "Its' just something that not a lot of people see or wouldn't expect to see from a laser beam."

Stinson is a physics graduate student specializing in optics and lasers at San Diego State University in California. He and his professor, Dr. Matt Anderson, worked together to come up with the idea for the video. The two filmed the interacting lasers, and spent about ten hours over the next three days editing the film together.

Stinson began editing videos long before LaserFest started. While an undergraduate at the University of North Texas, he helped update the multimedia content of the school's planetarium when it switched to color projectors. He also placed second in San Diego State's "Aztec for Life" video competition. With the prize money, Stinson hopes to invest in a new professional quality camera.

PhysicsQuest Competition

This year's winner of the PhysicsQuest competition is Enmarie Dewitt's eighth grade physical science class of the Westminster Christian School in Palmetto Bay Florida. The class correctly found the answers to all four physics problems included in the kits. Each student won an iPod Nano, and the class as a whole received a 500 dollar gift certificate to Educational Innovations, the manufacturer of the kits.

PhysicsQuest is an interactive kit that APS sends out to over 3,000 teachers across the country each year. The kit contains four physics experiments for students to perform. After the class completes the activities, they submit their answers to the PhysicsCentral website to be entered into the grand prize drawing.

"They learn so much about different physics concepts, and it has been a real positive experience with physics," DeWitt said, "At the end of the four labs, they wanted to know more and do more physics. It really piques their interest and curiosity into physics."

This year's kits featured the physics of lasers and optics to correspond with LaserFest, the celebration of the 50th anniversary of the laser. The experiments included using a laser to measure the width of a human hair, testing the energy levels of a laser with a glow-in-the-dark square, measuring the wavelength of a laser using a diffraction grating, and shining lasers through polarizers. Dewitt said that her favorite was finding the width of a human hair and that her students really enjoyed testing the energy levels of lasers as well.

ANNOUNCEMENTS

Erratum

In the "Members in the Media" column in the June *APS News*, we mistakenly referred to "the NBC show 'The Big Bang Theory'." This show airs on CBS, and *APS News* regrets the error.

The Back Page

Improving K-12 science education

By Judy Franz

The US spends close to a trillion dollars annually on education, of which 90% comes from state and local sources. This means that there are extraordinarily many points of power and decision making, so change at the national level is very difficult. Nevertheless, there are exciting initiatives underway across the country, and I am hopeful that there will be some major improvements.

Three main reasons are usually given for the necessity of improving K-12 science education. The first is workforce and economic development. President Obama has made the strong statement that "If we as a nation do not prepare one of the world's most educated and scientifically and mathematically literate workforces, then we have no chance of continuing to be one of the world's most secure and competitive economies." It's becoming widely accepted that the international economy we live in is changing the nature of work and the kinds of jobs young people will enter. Jobs that once required a high school degree and paid a decent wage are disappearing.

The second reason, the need for improving science literacy, is becoming more evident. The public is called upon to worry about such things as whether the LHC is causing black holes that will destroy the world or whether climate change is real, but most people have no idea how to think about such things themselves or even how scientists approach such issues.

The third reason is the production of the next generation of scientists and engineers. Within the physics community, we can argue about whether the country needs to increase the number of PhDs in physics, but we would all agree that we want the brightest students to consider physics as a career. And there is very little argument about the value of increasing the number of undergraduate majors in physics. The rigorous training in conceptual and analytical thinking makes physics a wonderful background for a wide range of careers. Most students decide to study physics and math while in high school or before, so providing strong science education along the way is critical.

There is general agreement that what is needed most to improve science education is more and better K-12 science teachers. Research has shown that there is no school factor more important to learning than the quality of teachers. For years, national education reports emphasized the need for better science teachers, but it was the 2007 report *Rising above the Gathering Storm* that caught the attention of a wider audience. It was a report not on education but on national competiveness and innovation, yet its first two recommendations were to recruit 10,000 new science and mathematics teachers annually and to strengthen the skills of the 250,000 existing teachers.

Why don't we have sufficient excellent physics teachers? Here's my list:

1. Low priority in physics departments
2. Low salaries and no merit pay
3. Lack of mentoring and professional development
4. Erratic funding for teacher support programs
5. Poor school management
6. Lack of good standards and assessment

This is a rather disheartening list, but I will attempt to show you that many of these issues are being attacked.

Physics teachers are educated by physics departments with the help of schools of education. But most physics departments haven't seen educating teachers as an important part of their roles, and it is not uncommon for physics faculty members to actively dissuade their better students from considering teaching careers. A recent study has found that less than one quarter of physics departments have teacher education programs with recent graduates, and the number of graduates from these programs is about 1/3 of the national need.

There are more than 20,000 physics teachers, but only a third have a degree in either physics or physics education, and most of the rest have had AT MOST a set of introductory courses. Many are teaching without proper certification.

More than a decade ago, physicist staff members at APS, the American Association of Physics Teachers (AAPT) and the American Institute of Physics (AIP) started discussions to determine how we could work together more effectively to improve physics education. The key problem that was not being tackled, we all agreed, was the production of more, well-educated, new teachers.

We found a small group of universities that would work closely with us to develop model programs of teacher education that might be emulated by others. We applied for and received a 5-year grant of about $6M from NSF. The program is called PhysTEC for Physics Teacher Education Coalition. Initially, there were five key elements that each university had to provide:

- Teaching introductory courses with inquiry (active learning)
- Real cooperation with the School of Education
- Master high school teacher resident in department
- Mentoring for new teachers
- Assessment

As the program has developed and models have been tested, each of these elements has remained extremely important, and two others have been added–active recruitment of students, and early teaching experiences, often as undergraduate TAs in introductory courses.

I am very proud of this program and pleased that I could play a role in it from its inception. PhysTEC recently received a second NSF grant for $6.5 M and is now cited as a model program by NSF and others. Participating universities have greatly increased their production of new physics teachers; we think they are better educated as well. More information about this program can be found at http://www.phystec.org/ and http://www.ptec.org/.

There is a tremendous amount of evidence that students learn best when they are actively involved in the learning process, but physicists tend to suffer from the misconception that if they understand something very well and can explain it very clearly, then this understanding will be transferred from their brains to those of the students. If prospective teachers aren't taught with inquiry methods, not only will they learn less, but they will be much less likely to use inquiry methods in their own teaching.

The second item on my list is low salaries and no merit pay. Teachers' pay usually depends only on their education and years of service. Teachers as a whole earn about 90% of the salary of others with comparable education. AIP surveys have shown that physics teachers' salaries are quite low compared to what physics majors can earn in other jobs. Teachers' unions fight merit pay vigorously, so that great teachers usually receive no special financial rewards.

In President Obama's new Race-to-the-Top initiative, states compete for very large federal grants but have to show that they are taking major steps to improve education. These steps include reworking teacher evaluation systems so that they are based, in part, on student achievement.

The third item on my list, lack of mentoring and professional development, results in a high turnover rate. New physics teachers typically get very little on the job mentoring, and many get discouraged and leave. One of the jobs of the Teachers-in-Residence in the PhysTEC program is to stay in touch with the new teachers and help them through initial trouble spots. Teachers also need continuing professional development opportunities, but physics teachers rarely get this.

The fourth item, erratic funding, makes it difficult to sustain good programs. Some years Congress is keen to support education, but then other priorities arise. NSF can only fund excellent programs for a limited period of time since its mandate is to support educational research and innovation and not ongoing programs. The *Gathering Storm* report noted that US education infrastructure suffers from a "recurring pattern of abundant short-term thinking and insufficient long-term investment."

The fifth item, poor school management, is a complicated set of issues, involving difficult decisions on such things as charter schools and teacher reward systems, but particular to science is the need to allow students to do hands-on experiments. School principals need to provide adequate space, equipment and scheduling flexibility. In surveys, teachers most often cite "job dissatisfaction" as their main reason for leaving their jobs. When probed about what this means, it is not salary but the obstacles that prevent them from doing their jobs well that they cite.

Finally, the sixth item is the lack of standards and assessment. The program, "No Child Left Behind," started by President Bush, is up for reauthorization. As is, schools are required to test all children on math and reading competencies, and a school's progress in these areas affects its funding. The result has been more emphasis on math and English which means less on everything else, including science. The science community has lobbied to have science become part of the core competencies, but this is not in the blueprint that was released recently by the Department of Education.

One big problem is that the assessment is supposed to be based on standards, but there are no widely-adopted science standards. The US education system is tremendously decentralized, but there are now forces working toward coordinated efforts among states. How has this come about?

There is a bipartisan, non-profit education organization, called Achieve,which has been working with states to raise academic standards and graduation requirements, improve assessments, and strengthen accountability. Based on some of this work, 48 states (all but Texas and Alaska) have formulated a set of "Common Core State Standards," for what children should learn in math and English. These were released for comment a few months ago. Reviews have been very good. Now we need to do this for science.

Why is it is so difficult to define standards? There currently exist two sets of science standards that were developed back in the '90s; one by AAAS and the other by the National Academy. Each is several hundred pages long and has been criticized as being a mile wide and an inch deep. Of course it was we scientists that wrote and approved those standards, and they are so diffuse because each of us truly believes that if students don't learn about our part of science, they will be damaged for life. But common national standards would allow teacher education to focus on deep understanding of ideas that every student ought to know and would allow textbooks to be reduced to a manageable size.

Can the science community work together to develop standards that are "few, clearer, and higher," as we have been asked to do? My understanding is that the mathematicians had many battles as they developed their standards, but they at least were all mathematicians, while we physicists will have to contend with chemists, biologists, geologists, and all other branches of science. It will be a tough job, but it is extremely important, and there is a committee within the National Academy that is beginning the process. Once standards are in place, teachers can be evaluated on their ability to help students meet the standards, and teachers' professional development can concentrate on these core topics. Good standards are necessary if we are to have good assessment tools, and this is critical to giving science a larger role in the overall school curriculum.

In conclusion, we know quite a bit about what is needed to get and keep more excellent teachers in the classroom. Physics departments have to work harder to convince good physics students to consider teaching as a career, and then these students have to get an excellent education, not just in physics itself, but also in how students learn physics.

We need to make sure when we send teachers out into the schools that they are supported and mentored, particularly through the first few years that can be very tough. We should work to retain good teachers, whether it is through merit pay or better school management. We should work to help develop national standards that will become good assessment tools. And we should press federal agencies to include stable funding for teacher professional development and for science education research so we continue to explore how students learn and how to make good teaching even more effective.

Judy Franz served as Executive Officer of APS from 1994 to 2009.

APS News welcomes and encourages letters and submissions from its members responding to these and other issues. Responses may be sent to: letters@aps.org