InterActions

across physics and education

June/July 2007

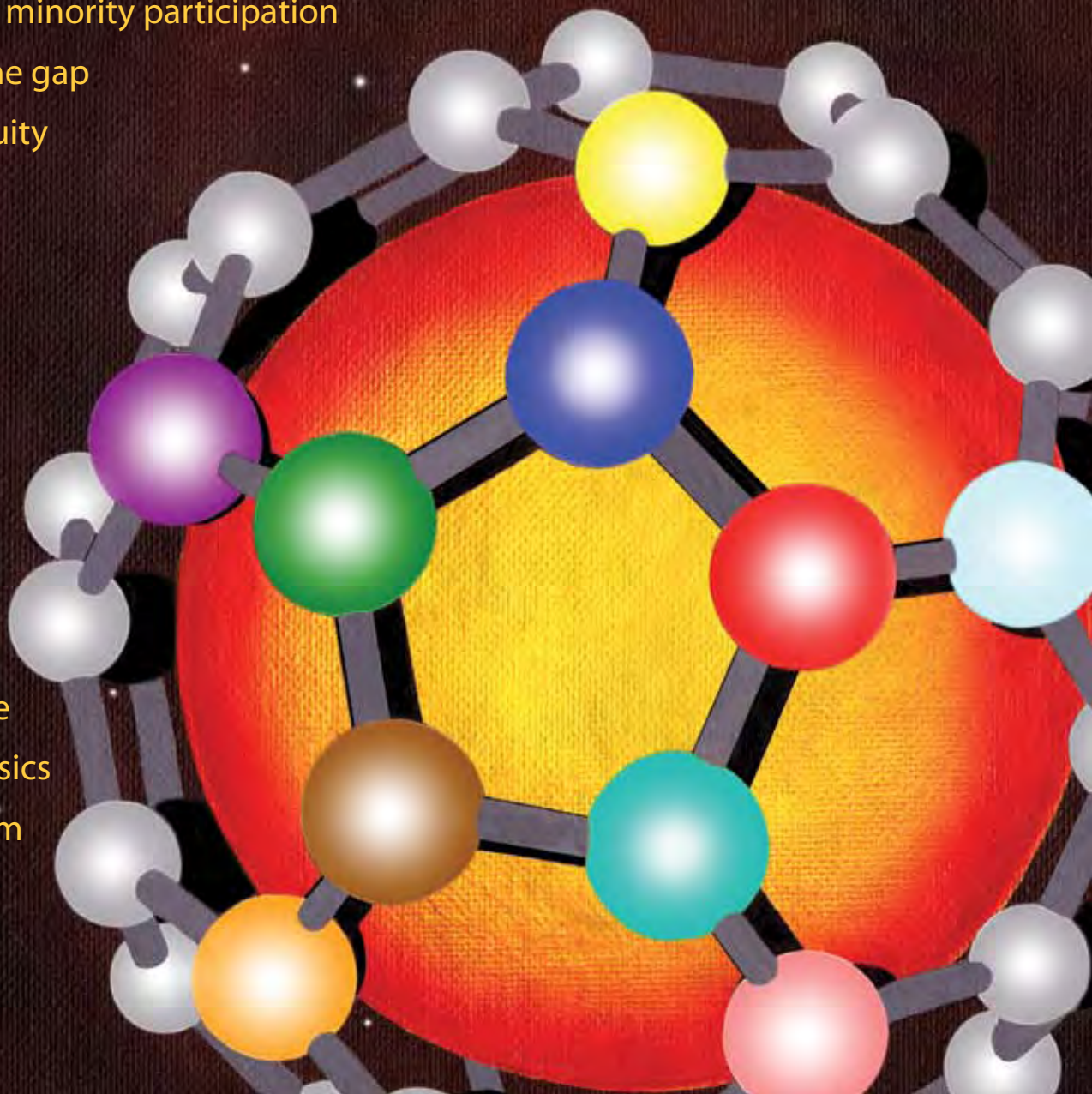
Focal Point

Diversity Across Physics

promoting minority participation

bridging the gap

gender equity



plus:

Iron Science

Buffy + Physics

Physics Mom

InterActions
across physics and education

About INTERACTIONS
Interactions is a general-interest magazine about physics education. Our mission is to inform and stimulate diverse conversations on teaching and learning by publishing thought-provoking news, analysis, and commentary on the people, programs, and policies that interact to influence scientific practices and knowledge—and, ultimately, human destiny.

Reader Comments
The editors welcome your response. Send comments, questions or suggestions to interactions@aapt.org or mail letters to Interactions Forum, One Physics Ellipse, 5th Floor, College Park, MD 20740. Please include your full name, mailing address, and daytime contact information. Space is limited and all published comments are subject to editing.

Contributor Guidelines
Although most of the articles are commissioned by the editors, we encourage writer queries and story ideas. Email your query, and attach any writing samples, to asst-editor@aapt.org. Or mail the letter along with samples to Interactions Editor, One Physics Ellipse, College Park, MD 20740. We typically respond via email or letter within four weeks. Writing samples and other submitted materials will not be returned.

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Back Issues
Back issues of *Interactions* are not currently available but will be at a later date. Call (301) 209-3322 for updated information.

On the Cover
The Fullerene, a hollow, pure carbon molecule named after R. Buckminster Fuller, the inventor of geodesic domes. Fullerenes can be considered, after graphite and diamond, to be the third well-defined allotrope of carbon. *Illustration by Matt Payne.*

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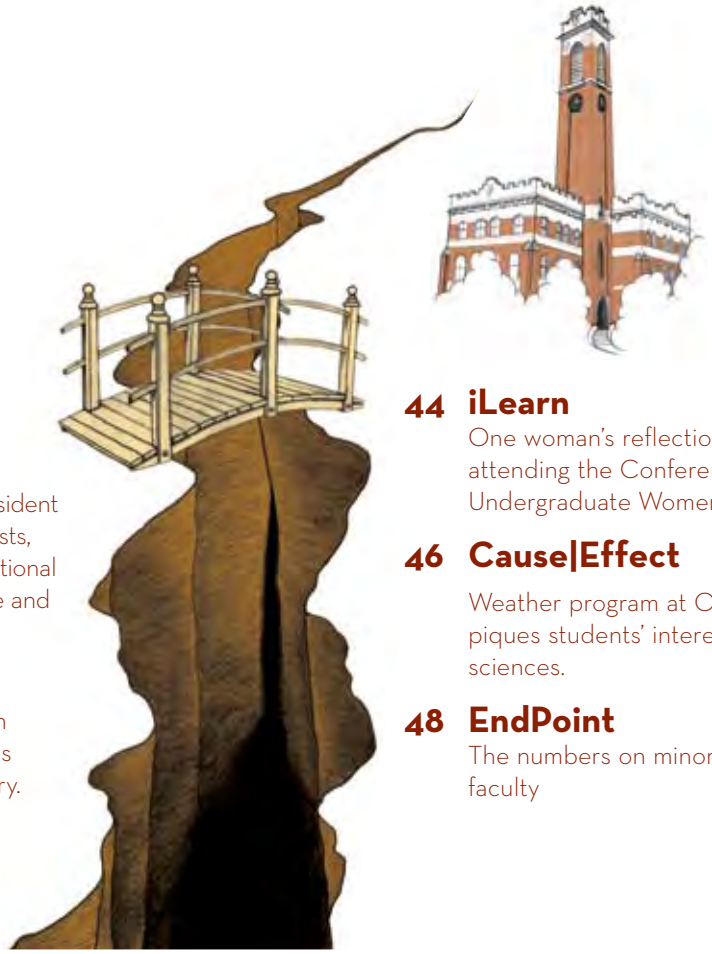

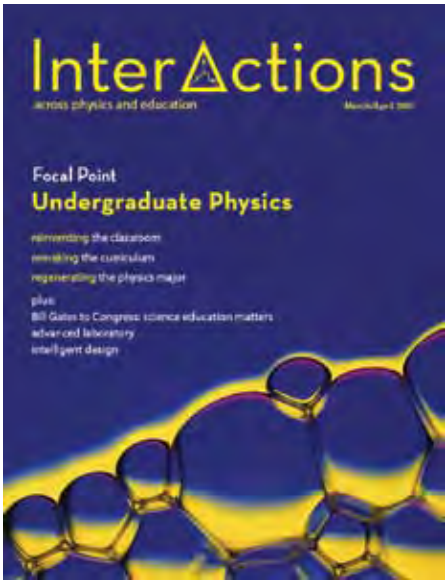

Physics First Further

I was reading the comments about high school Physics First and have noticed a glaring problem (December 2006).

According to Dr. Lederman, Physics First is becoming more and more popular. However, most of these courses use conceptual physics, a nonmathematical approach to introductory physics. Therefore, the students who take Physics First are really not prepared to take an AP course, nor are they really prepared to take a college course in the way a third-year mathematical physics student is prepared, especially if he uses Zitzewitz's *Physics: Principles and Problems*, which is student friendly.

I believe that most freshman high school students do a basic mathematical physics course first if the teacher is willing to help the students a lot. I have found that even the most at-risk students can pass and do well in an algebra-trigonometry type course with properly prepared lessons and a lot of help. Further, mathematical physics is the only type of course that will help the students in second-year high school chemistry, since true chemistry is mathematically based also.

From my many years of experience with at-risk students in the inner city of Chicago, there is a lot of selling these students short. A course in basic mathematical physics can work if the student has a calculator, drills, and practices in problem solving and lots of aggressive teachers being ready to give lots of help to the students at first in the course. Δ

Stewart E. Brekke
Downers Grove, Illinois

Fear Not Intelligent Design

Thank you for running the articles on intelligent design and the case against evolution (March/April 2007). This topic is very worthy of discussion; however, your articles try to stifle the discussion. It seems to be the goal of the establishment to try to silence the voices before we get a chance to hear the debate.

Your two articles were sadly typical of what we find too often in the media. The following two straw-man arguments are put forth:

Assume that this is really "young Earth creationism" in disguise. Hoping we buy this, your first article then gives us the blather that has been over-stated for the past 50 years against this fallacious perspective. Is the assumption valid?

Assume this isn't really science—they have no data. This is followed by your second article's condescending explanations of what science really is and what evolution really means. The *enlightened* helping the *fools*. Is this assumption valid?

When science is done properly and with a minimum of bias, it will help us understand the truth about nature. The evolution debate has been raging within the scientific circles for years. Why pretend this isn't happening?

The case against evolution was best explained by an atheistic evolutionist—Stephen Jay Gould. In his book Wonderful Life, he explains the problem with the Burgess shale (the oldest life forms ever found at the time) and an evolutionist's (Charles Walcott) extraordinary misrepresentation of the data to try to fit it into the neo-Darwinian synthesis. Walcott's mistake came about because life shows up far too suddenly to be explained by evolution.

In the late '70s and early '80s, Gould and Niles Eldridge came up with the modified evolutionary theory known as punctuated equilibrium. Needless to say, these two were very much maligned by their colleagues for many years. Now after an exceptional amount of heated debate within the science establishment itself (anyone can find and read this), punctuated equilibrium is accepted.

The only thing these two (opposing) evolutionary theories have in common is the word "evolution." The neo-Darwinian synthesis always had the mechanism for evolution, but as the data accumulated, very little supported it. Punctuated equilibrium has the data, but they debunked the mechanism that was the cornerstone to the theory.

In his book *The Blind Watchmaker*, (atheistic) evolutionist Richard Dawkins tries to bridge the chasm between the neo-Darwinian synthesis and punctuated equilibrium. Needless to say, he falters terribly. There is very little science, and tons of conjecture masquerading as science.

The mechanism of the neo-Darwinian synthesis is basically that small changes occur over long periods of time. These manifest themselves as big changes—but this is only because of gaps in the fossil record. Unfortunately, every life-form ever found throughout history shows up suddenly, remains almost completely static (which was not expected), and then disappears suddenly. The data simply does not support the mechanism of evolution.

Punctuated equilibrium better conforms to the data. Evolution happens quickly in small periods of time (punctuated), and then stops (equilibrium)—just as the fossil record shows. The problem of course is: how does evolution happen quickly—and why does it stop? What happened to the mechanism?

Read it for yourself!

Whenever data is inconclusive within science, speculation and conjecture are considered. In essence, evolutionists are trying to convince us that they are the only ones who can conjecture. They are trying to define science so that evolution is the de facto theory. What is worse is that they try to convince the public that the data is conclusive. That is just bad science.

There is nothing to fear from the intelligent design data and perspectives. They bring up some very valid questions. The questions can be considered because the data is not conclusive—in other words, they want to conjecture as well.

The intelligent design scientists do not disagree with the data used by evolutionists. But they very much disagree with the sweeping claims made when the data is so inconclusive. And they disagree with the conclusions made, primarily because of the exceptional number of assumptions that one must believe in order to accept the conclusions offered. Is this science?

It is remarkable that the arguments given to explain why intelligent design is not science can be used to explain why evolution is not science. But many people have a lot invested in evolutionary theory—and thus they cannot see past their own shaded spectacles.

Please look into this for yourself. You have nothing to fear from the Intelligent Design data and the problems with evolution debate. I guarantee you will come out of your study a much better scientist and educator. Δ

Greg Fazzari
Walla Walla, Washington

Sports vs. Academics

Bill Gates reports that our fourth-grade students are among the top students but are near the middle by eighth grade and near the bottom at 12th grade (iAmonitor, March/April).

Sports are not so important up to 4th grade. Fifth graders are encouraged to be on a sports team. Eighth-grade sports teams rate newspaper and TV reports of their games. Sports are more important than academics in most of our high schools. Schools in Germany and several other countries do not have sports in their schools!

Bill, how can we make academics more important than sports in high school? Δ

James F. Jackson
Carlisle, Indiana

Diversity: What's at Issue

BY JUAN R. BURCIAGA

A few years ago I was watching the Anna Deavere Smith conclude her one-woman show on race relations in America. For nearly two hours she had entertained and educated the audience with her portrayals of various personae brushed by the shadow of racial conflict. Near the end of the performance she paused and challenged us by remarking, "And now we can talk about the gap between understanding and action. And how do we close it?"

Though her question was aimed at the general problem of racial inequities in America, it offers a powerful perspective to view the continuing lack of diversity in physics and other disciplines.

Despite the talent, effort, and money spent on the problem of underrepresented groups in science and mathematics, there has been scant progress. And yet the work of educators such as Uri Treisman and Jaime Escalante show that even those students whom society might expect to fail, can succeed.

But why does a gap remain between our understanding of viable solutions and our ability to take action that will result in significant, permanent change?

There is no single barrier that prevents underrepresented groups from going into the sciences—rather, there are many small hurdles, which no single person or group can eliminate entirely. Students representing minority groups experience the same "chilly climate," low expectations, mismatched teaching and learning paradigms, and lack of appropriate support that have hindered women in science. But, rather than a "leaky pipeline," I am more inclined to to think of an arroyo: a dry creek bed in desert areas, which under flood conditions can conduct some water from one point to another. But mostly the little water that is around gets trapped, moves only small distances, or is quietly absorbed.

The physics education community represents a potentially formidable agent of change. Most of us are already dedicated to being the most effective teachers that we can be. And our most effective changes will be those in and near the classroom. So we should start by asking, "What can I do to make the study of physics a more challenging, engaging, and productive experience for all students?" If each of us were to make a thoughtful commitment to a more inclusive physics, this alone would bring about a quiet revolution. The number of students from all cultures and races who are willing, able, and prepared to study physics would increase.

Throughout the physics community there are signs—not necessarily of change, but of the beginnings of change.

In December 2002 the National Task Force on Undergraduate Physics met with minority physicists to gain perspective on issues related to diversity and inclusion. The American Geophysical Union hosted a Joint Society on Increasing Diversity in the Earth and Space Sciences in June 2003. The 2003 National Assembly of Project Kaleidoscope (PKAL) focused on "Ensuring Success of Underrepresented Groups in STEM Learning Environments." And women and minority faculty continue to make slow progress, opening new doors and quietly meeting each challenge (see the profile of Martha Baylor, page 13, the Insight article by Rachel Ivie, page 24, and "When We're Not Alone, page 44). But possibly the most lasting effect will come from those meetings held by, and for, students.

At the 2005 meeting of the Society of Physics Students National Council students tried valiantly to reach consensus on a set of resolutions. But realizing the complexity of the problem they chose to explore the issue at the 2006 National Council meeting. These conversations have resulted in a call for a year-long series of discussions on diversity.

The focus of this issue of *Interactions* is "diversity across physics." Reading the Focal Point articles can be your first step (or your ten thousandth) on the path to revolution.

Maria Ong (page 26) writes on some of the challenges minorities may encounter in the sciences and how we can help students overcome them. This theme is repeated in both Sherry Yennello's article (page 30) and Theodore Hodapp's report (page 29) on the recent workshop on "Gender Equity: Enhancing the Physics Enterprise in Universities and National Laboratories." Keivan Guadalupe Stassun and Arnold Burger (page 36) describe a bridge program to help the cultural transition to graduate school. The Q&A features a candid discussion with Sergio Ulloa, president of the National Society of Hispanic Physicists, and Quinton Williams, president of the National Society of Black Physicists, on the needs and promise of their respective societies (page 20).

The work of mentors and the value of mentoring are slowly gaining recognition. Resources are increasingly becoming available for teachers and faculty actively involved in building inclusive learning environments (for example, see "Operation STEM," page 32). Education/training programs on diversity occur almost regularly at AAPT's national meetings and have always been part of the Workshop for New Physics and Astronomy Faculty. Furthermore, the lives and works of minority physicists are achieving greater recognition through programs like the SACNAS Biography Project, the APS Edward A. Bouchet Award, and the NSBP's Morehouse Physics Prize.(See page 34 to read about this year's Bouchet Award winner.)

You may think that even if a large number of physics educators undertake change this will still not be enough to make a difference. You may be right.

But though it may not be our task to finish the work of making physics a more open, inclusive community, the work is, I think, ours to start. Δ

Juan R. Burciaga received his Ph.D. from Texas A&M in 1986. He has been the Education Officer for the National Society of Hispanic Physicists since 1998. Burciaga has taught a workshop on "Reaching, Teaching, and Keeping Underrepresented Groups in Physics" at a national meeting of the AAPT. He is now at Whitman College.

Programs

ED in '08

Flanked by scores of parents, volunteers and education reform advocates on the eve of the first 2008 presidential debate, the Bill & Melinda Gates Foundation and The Eli and Edythe Broad Foundation announced in April the launch of the Strong American Schools campaign aimed at elevating American education to the top of the presidential campaign agenda between now and November 2008. Strong American Schools is a nonpartisan public awareness and action campaign designed to give a voice to every American who demands strong leadership to improve our schools.

"Each year more than 1 million students drop out of high school. That's one child every 29 seconds," said Bill Gates, co-chair of the Bill & Melinda Gates Foundation. "We all must demand that candidates and our leaders share their opinions and policies on how our country will offer all young people Strong American Schools."

"The American dream is slipping away, and unless our leaders dramatically improve our public schools, our standard of living, our economy and our very democracy will be threatened," said Eli Broad, founder of The Eli and Edythe Broad Foundation. "Our country's education system is no longer the best in the world. We need every American to demand better schools and specific policy solutions from presidential candidates. Our future depends on it."

Strong American Schools has launched "ED in '08"—a sweeping public awareness and action campaign that will mobilize the public and presidential candidates around solutions for the country's education crisis. The campaign brings together for the first time leaders of all major political parties who are willing to address education as an American challenge rather than a narrow political issue. Strong American Schools will use the tools of a modern presidential campaign to take the issue to the general public and give Americans many ways for their voices to be heard—including on-the-ground activities in key presidential primary states and a cutting-edge interactive e-campaign based on the web at http://www.EDin08.com.

"We're calling on every American to support 'ED in '08.' Together, we can make education a top priority for all presidential candidates in this election," said Strong American Schools Chairman Roy Romer, who has been a leader in education and government for the last 50 years. Romer was elected to three terms as governor of Colorado and most recently led the nation's second largest school system as superintendent of the Los Angeles Unified School District. "If candidates aren't talking about education, they're not talking about the future. Without an educated and skilled workforce, America's competitiveness and security are undermined. A strong America depends on strong American schools."

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ED in '08 representatives discuss education with Los Angeles high school students.

As part of its call to action, Strong American Schools will urge leaders to address and debate three common-sense priorities that hold tremendous promise for improving education:

1) Strong American education standards. Regardless of where they live, all students need to acquire knowledge and skills that prepare them for college, for the workplace, and for life.

2) Effective teachers in every classroom. We need to enable teachers to improve their skills, measure teachers' performance in the classroom, and pay them more if they produce superior results or take on challenging assignments.

3) More time and support for learning. We need to provide successful and struggling students alike more time for in-depth learning and greater personal attention.

Strong American Schools' steering committee is comprised of prominent business, education, and political leaders. In addition to Broad and Romer, the steering committee includes: Allan Golston, president of the U.S. program at the Bill & Melinda Gates Foundation; Janet Murguia, president and CEO of National Council of La Raza; Lou Gerstner, former CEO of IBM Corporation; John Engler, former governor of Michigan and president of the National Association of Manufacturers; and Marc Lampkin, former 2000 Bush for President deputy campaign manager and current executive director of Strong American Schools. In addition to the steering committee, the South Carolina leadership team is comprised of prominent political and civic leaders, including former governor Richard Riley and former U.S. Secretary of Education; former governor David Beasley; former lieutenant governor of South Carolina, Bob Peeler; former South Carolina Superintendents of Education: Barbara Nielsen and Inez Tenenbaum; and Iris Rhodes Campbell, the wife of the late governor Carroll A. Campbell Jr.

"The issues currently being debated on the campaign trail—national security, the environment and health care—share a core underpinning: education. Without highly educated students, America's competitiveness and security are undermined, and our ability to solve the most complex challenges of the day is severely

threatened," said Murguia. "But this is about a moral failing too. Every child, regardless of his race or income, has a right to attend a high quality school and make a better future for himself. Right now in America, that is simply not the case for too many of our children."

The foundations have committed up to $60 million to support the campaign through November 2008. The effort is a project of Rockefeller Philanthropy Advisors, an independent nonprofit organization providing program and management services for the campaign. It will be headquartered in Washington, D.C., with state leadership offices opening across the country in the coming months. Strong American Schools does not support or oppose any candidate for public office and does not take positions on legislation.

To join the "ED in '08" campaign, and for more information, log onto: http://www.EDin08.com. Δ

Encyclopedia of Life

Biodiversity, Science Communities Unite Behind Epic Effort To Promote Biodiversity, Document All 1.8 Million Named Species on Planet

Many of the world's leading scientific institutions announced in May the launch of the Encyclopedia of Life, an unprecedented global effort to document all 1.8 million named species of animals, plants, and other forms of life on Earth. For the first time in the history of the planet, scientists, students, and citizens will have multi-media access to all known living species, even those that have just been discovered.

The Field Museum of Natural History, Harvard University, Marine Biological Laboratory, Smithsonian Institution, and Biodiversity Heritage Library joined together to initiate the project, bringing together species and software experts from across the world. The Missouri Botanical Garden has become a full partner, and discussions are taking place this week with leaders of the new Atlas of Living Australia. The Encyclopedia also announced the initial membership of its Institutional Council, which spans the globe, and whose members will play key roles in realizing this immense project. An international advisory board of distinguished individuals will also help guide the Encyclopedia.

The effort is spurred by a $10 million grant from the John D. and Catherine T. MacArthur Foundation and $2.5 million from the Alfred P. Sloan Foundation, and will ultimately serve as a global beacon for biodiversity and conservation.

"The Encyclopedia of Life will provide valuable biodiversity and conservation information to anyone, anywhere, at any time," said Dr. James Edwards, currently Executive Secretary of the Global

Biodiversity Information Facility who was officially named Executive Director of the Encyclopedia of Life. "Through collaboration, we all can increase our appreciation of the immense variety of life, the challenges to it, and ways to conserve biodiversity. The Encyclopedia of Life will ultimately make high-quality, well-organized information available on an unprecedented level. Even five years ago, we could not create such a resource, but advances in technology for searching, annotating, and visualizing information now permit us, indeed mandate us to build the Encyclopedia of Life."

Over the next 10 years, the Encyclopedia of Life will create Internet pages for all 1.8 million species currently named. It will expedite the classification of the millions of species yet to be discovered and catalogued as well. The pages, housed at http://www.eol.org, will provide written information and, when available, photographs, video, sound, location maps, and other multimedia information on each species. Built on the scientific integrity of thousands of experts around the globe, the Encyclopedia will be a moderated wiki-style environment, freely available to all users everywhere.

"The Encyclopedia of Life will be a vital tool for scientists, researchers, and educators across the globe, providing easy access to the latest and best information on all known species," said Jonathan F. Fanton, President of the John D. and Catherine T. MacArthur Foundation. "Technology is allowing science to grasp the immense complexity of life on this planet. Sharing what we know, we can protect Earth's biodiversity and better conserve our natural heritage."

"For more than 250 years, scientists have catalogued life, and our traditional catalogues have become unwieldy," said Ralph E. Gomory, President of the Alfred P. Sloan Foundation. "The Encyclopedia of Life will provide the citizens of the world a 'macroscope' of almost unimaginable power to find and create understanding of biodiversity across the globe. It will enable us to map and discover things so numerous or vast they overwhelm our normal vision."

Scientists began creating individual web pages for species in the 1990s. However, Internet technology needed to mature to allow fast and efficient creation of a comprehensive Encyclopedia. While specific Encyclopedia of Life efforts, including the scanning of key research publications and data, have been underway since January 2006, work has accelerated due to the support provided by the John D. and Catherine T. MacArthur Foundation and the recent discussion of the Encyclopedia of Life by renowned biologist Edward O. Wilson at the March 2007 Technology, Entertainment, Design (TED) Conference.

One of the world's foremost scientists and environmentalists, Wilson, professor

emeritus at Harvard University, "wished" for the establishment of the Encyclopedia of Life during his TED Conference address. Noting that "our knowledge of biodiversity is so incomplete that we are at risk of losing a great deal of it before it is ever discovered," Wilson called for a contemporary, dynamic portrait of the living Earth.

"I wish that we will work together to help create the key tool that we need to inspire preservation of Earth's biodiversity: the Encyclopedia of Life," Wilson said at TED. "What excites me is that since I first put forward this idea, science has advanced, technology has moved forward. Today, the practicalities of making this encyclopedia real are within reach as never before."

Ultimately, the Encyclopedia of Life will provide users the opportunity to personalize the learning experience through its "my eol" feature. The site can be made available in all major languages and will connect scientific communities concerned with ants to apples to zebras. As part of its work, the Encyclopedia of Life will collaborate and partner with a wide range of organizations, individuals, and experts to help strengthen the Encyclopedia and its impact on communities throughout the world.

"The solidarity of the U.S. and global communities for the Encyclopedia of Life is tremendously exciting and lifts my confidence that this vast, romantic global effort will succeed," Edwards said. "We are also encouraged by the declaration in March 2007 by the environment ministers of the G8 nations to foster a global species information system."

While initial work will emphasize species of animals, plants, and fungi, the design can be extended to encompass microbial life.

To provide depth behind the portal page for each species, the Biodiversity Heritage Library (BHL), a consortium that holds most of the relevant scientific literature, will scan and digitize tens of millions of pages of the scientific literature that will offer open access to detailed knowledge. In fact, the BHL now has scanning centers operating in London, Boston, and Washington DC, and has scanned the first 1.25 million pages for the Encyclopedia.

"I dream that in a few years wherever a reference to a species occurs on the Internet, there will be a hyperlink to its page in the Encyclopedia of Life," concluded Edwards. Δ

Iron Science

From the Exploratorium Teacher Institute comes the Iron Science Teacher.

Cheer on the competitors in this zany, science cook-off, where teachers compete before a live audience at the Exploratorium in San Francisco for the revered title, "Iron Science Teacher." In a fast-paced atmosphere where showmanship and creativity reign, science teachers are

Matt Payne

given ten minutes and a secret ingredient to concoct a science activity that can be used in the classroom. The event takes place on Fridays, June 29, July 6, 13, and 20, and August 3, 10, at noon, and is free with admission to the Exploratorium.

The Iron Science Teacher competition is a series that takes place throughout the school year and in July at the Exploratorium. Iron Science Teacher is one of the more lighthearted programs of the Exploratorium's Teacher Institute.

Parodying the syndicated, tongue-in-cheek, cult Japanese TV program, Iron Chef, the Exploratorium's Iron Science Teacher competition showcases actual Bay Area science teachers as they build experiments around a given "secret ingredient" — an everyday item such as a paper-towel tube, a straw or a soda can. According to astrophysicist Dr. Linda Shore, Director of the Exploratorium Teacher Institute and host of the competition, "We try to show we can do science with anything. We show teachers how to use low-tech materials to illustrate classic principles of science and math." As contestant Don Rathjen summed up, "This helps teachers teach the $10 million state science standards on a $10 budget."

After building the gizmos, the teachers have a few minutes to explain what they are and the scientific principles they demonstrate. Judging is done on a less scientific basis, using what Dr. Shore refers to as "the clap-o-meter"— audience applause as measured by the human ear.

© The Exploratorium, www.exploratorium.edu / Photo Credit, Amy Snyder

Former Iron Science contestant Linda Paparella shows off her fruit-powered clock.

In one competition where the secret ingredient was a soda can, the diversity of science activities based on a simple object became clear. Using soda cans, a mathematician demonstrated the X, Y, and Z-axes of geometric shapes, a physicist illustrated the Bernoulli Effect (which affects such things as lift on an airplane's wing), a biologist demonstrated that Classic Coke is denser than Diet Coke, and a chemist rigged up alcohol burners.

Given the popularity of the Iron Science Teacher competition, the Exploratorium is bringing science to teachers nationally via the World Wide Web.

The Exploratorium Teacher Institute provides teacher development for middle and high school science and mathematics teachers in the form of intensive summer long workshops and follow-up programs through the school year. There are currently 3000 alumni of the Teacher Institute, funded by the National Science Foundation, the State of California, the William and Flora Hewlett Foundation, the Noyce Foundation and the Eisenhower Program.

The Exploratorium Teacher Institute was rated in a recent survey as one of the top two science education resources among teachers and district leaders from throughout Northern California. Δ

People

Buffy + Physics

Simple, Hip Science

Jennifer Ouellette is a modern girlie girl with a closet full of shoes, a pink Razor cellphone and a huge obsession with... astrophysics?

That's right. This Seattle Pacific University alumna has become, rather by accident, a nationally recognized science writer and an invaluable liaison between hardcore physics scholars and the average Joan.

In both her long-running physics blog, "Cocktail Party Physics," and her first book, "Black Bodies and Quantum Cats: Tales from the Annals of Physics," Ouellette uses pop-culture metaphors to explain complex topics in modern physics—astro—and otherwise. She references Magneto of Marvel Comics to explain magnetism, Fabio to explain the physics of roller coasters and Tarot cards to illustrate the dynamic probabilities of our physical universe.

Her second book, "The Physics of the Buffyverse" (Penguin, $15), published in January, follows the same formula. Only this time, Ouellette employs a rather more offbeat metaphor: The popular TV series "Buffy the Vampire Slayer" and its spinoff, "Angel."

At first glance, it's a pretty tough sell. Especially considering that the plot lines of both "Buffy" and "Angel" hinge on the idea that vampires and demons regularly bubble up from the underworld and must be rebuffed by a ragtag clan of high-school hotties who, when they're not battling evil, are like totally worried about prom. Not exactly fertile ground for the staunch realism of modern science, right?

But against all odds, Ouellette pulls it off.

In one particularly enticing chapter, Ouellette recounts the time that Buffy, our starring demon-slinging blonde, crosses into another universe to relate the potentiality of a tear in the time/space fabric. While I wouldn't recommend bringing up references to special relativity in "Buffy" episodes on a first date, the book is a great way to commune with your inner nerd.

As an English major and one-time physics-phobe herself, Ouellette writes in a style that is both charmingly accessible and non-condescending.

"Not knowing the basics of physics doesn't make you stupid," Ouellette explains. "I know lots of very educated people with advanced degrees, who speak many languages, and they don't even know what Schrodinger's cat is."

Uh, whose cat?

Exactly.

But by not assuming any prerequisite knowledge of her readers, Ouellette's work is evidently infuriating to some people within the scientific community.

One physicist wrote a 26-page critique of Ouellette's first book, pointing out every chapter that he believed to be wrong.

"These are really, really, really complicated concepts"—wormholes, quantum physics and multiverses, to name a few—"but I just give people the big picture of what's going on," she says. "The stuff he cited wasn't wrong. It just didn't include all the detail and complex equations that he would have liked."

"And anyway," she adds, laughing, "It's like, 'Don't you have anything better to do?' "

Beneath her occasional ditz-talk—or "Buffy-speak" as she calls it in her book—Ouellette herself is actually a very smart cookie. Science-savvy enough to swap shop with the big dogs, Ouellette travels regularly to physics conferences across the country, receiving awards and notoriety for articles, which cover everything from the acoustics of Mayan pyramids to that thing that happens to your speakers right before your cellphone rings.

Ouellette is in the process of moving from Washington, D.C., to Los Angeles, where she'll live with her science-y, cosmologist fiancé ("I know, isn't it a match made in heaven?" she says). When she's not keeping up her prolific blog and freelancing for an array of science journals—articles in "New Scientist" and "Nature" are forthcoming—this black-belt in jujitsu is planning a lecture on "The Physics of the Fight" (based on the eponymous chapter in "Buffyverse"), complete with a jujitsu demonstration.

She's also embarking on her third book, which she describes as "more straight science," sans vampire metaphors. But take heart, physics-phobes: It'll have the odd pop-culture reference, too. Ouellette blames her predilection for entertaining metaphors on what she calls her "humming bird brain."

"I lose focus really easily. It's like, 'Ooh! something shiny!' and I totally forget what I was doing," she laughs. "When it comes to physics, it's the same. You could sit there and talk to me about sine and cosine and blah blah blah, and I'm gone. But if you

start talking about Buffy and Spike and portals? I'm there."

But why Buffy? Of all occultish, cultish pop-phenomenon, why use vampires and demons and ditzy blond cheerleaders to explain, say, String Theory?

Because Buffy flaunts the stereotype, Ouellette explains. Buffy is both high-school hottie and a smart, science-savvy, martial-arts-wielding take-no-prisoners girl. She likes the mall and she's smart.

"There are all these stereotypes for smart women in science," says Ouellette. "They think you have to be all professional and serious."

"I'm really into physics and I love my Prada handbag. Come on, people," she laughs. "Get with it." Δ

—Haley Edwards

Haley Edwards is a Seattle Times staff reporter. Contact Haley at 206-464-2745 or hedwards@seattletimes.com.

In a Class By Herself

Martha Baylor becomes University of Colorado's First African-American Woman to Earn Physics Ph.D.

When Martha-Elizabeth "Marty" Baylor defends her doctoral thesis this summer at the University of Colorado at Boulder, she will be on the verge of two milestones. First, if all goes well, she will obtain her Ph.D. in physics. Second, she will be the first African-American woman in the history of the University of Colorado to do so. According to the National Science Foundation, only 42 African-American women were awarded physics doctorates between 1976 and 2005.

The doctorate is a goal Baylor worked diligently toward for the past four years. The other distinction is one she never gave a second thought.

"I don't think about it," Baylor said. "You go into the lab and do your work. You don't think 'I'm black' or 'I'm a woman' while you're working on a physics problem."

Her disinterest may be a bit disingenuous, as Baylor is a leader in minority affairs, using her unique status to get minorities excited about science. She served as both a delegate and a presenter at the annual meeting of the National Society of Black Physicists. Her commitment won Baylor CU's 2007 President's Diversity Award.

Laser-focused

Baylor's doctoral research involves building laser models for "blind source separation," a term given to the process of picking individual signals out of a mass of information. The problem is often described as the "cocktail party question," since the goal is to mimic how we are able

to selectively home in on one voice among many at a noisy gathering.

Where other researchers have used digital processing to replicate this process, Baylor and her colleagues have worked on an analog model using lasers. Applications of such a model could eventually have a huge impact in the areas of biomedicine, telecommunications, and space exploration.

Baylor's laser model for separating signals is a good analogy for her own straightahead ability to home in on a problem tirelessly until she finds a solution.

"Marty has the gift of persistence, which is very important for a researcher," says Zoya Popovic, Hudson Moore Jr. Professor in CU-Boulder's electrical and computer engineering department and an academic co-adviser to Baylor. "If you're not persistent, you get discouraged very fast."

Persistent doesn't mean single-minded. Whereas some researchers focus on their work with a monomania that can make them come off as socially dysfunctional, even antisocial, Popovic calls Baylor an "extremely good citizen." Says Popovic, "She's very tuned into what others are doing around her."

Courtesy of University of Colorado

Doctoral candidate Martha Baylor fine-tunes a laser model used in her research.

The more she observed her advisee in action the more impressed Popovic became with Baylor's "intellectual curiosity combined with a desire to understand the material deeply."

"Every time we met, she showed up with her notebook and a list of good questions," Popovic said.

From fossils to the future

Baylor grew up in Columbia, Md., a planned community midway between Baltimore and Washington, D.C., and hometown of such creative minds as novelist Michael Chabon, cartoonist Aaron McGruder, and actor Edward Norton. At the age of 5, Baylor informed her parents

of her plans to become a paleontologist. In high school, she excelled in science and math, and eventually won a berth in a NASA summer internship program three years running. Baylor earned her bachelor's in physics from Kenyon College in Ohio, where she also minored in Chinese. She taught middle school and high school physics in Washington, D.C., before moving on to NASA Goddard Space Flight Center to work as an engineer for two years.

Once she completes her long educational journey by defending her thesis on August 15 and obtaining her doctorate, Baylor will have little respite. She begins a job teaching physics at Carleton College in Northfield, Minn., this fall. Δ

—Steve Davolt

Practice

Asian Educators in Search of American Innovation

Students in a Loudoun County, Virginia, laboratory studied tiny, genetically altered plants one recent afternoon, drawing leaves and jotting data in logbooks. Meanwhile, visiting scientists studied the students.

In spiral notebooks, the visitors recorded how long the teacher waited for students to answer questions, how often the teenagers spoke up and how strongly they held to their views.

The scientists had come thousands of miles from the island nation of Singapore to the Academy of Science in Sterling in search of ways to improve their teaching. This could be considered surprising, given that Singapore's eighth-graders rank No. 1 in science and math globally and those in the United States rank ninth in science and 15th in math, according to the 2003 Trends in International Mathematics and Science Study.

But rankings aren't everything—how America teaches is admired.

In a 21st-century economy that rewards quick thinking and problem solving, many educators in Singapore and elsewhere in Asia worry they are creating a generation of scientists who can memorize facts but can't keep up. These educators want to go beyond teaching facts and concepts that appear on tests and start teaching skills that are harder to gauge.

"How do you measure excitement? How do you measure creativity?" asked George Wolfe, director of the two-year-old public magnet school in Loudoun. "There's so much publicity about Americans not scoring well on tests, but few people ask the question: Then why are we producing so much innovation from our scientists?"

Tracy A. Woodward / The Washington Post

At Dominion High School in Sterling, VA, math educators from Singapore observe a ninth grade physical science class at Loudoun's Academy of Science. Ng-Ang Siew Hoon (from the Hwa Chong Institution in Singapore) talks with Peter Satagaj, 15 (cq-white shirt) and Nicholas Guichon, 15 (cq) while working on an Arabidopsis lab.

Hungry for new scientific and technological breakthroughs, Singapore's government has been asking this question. And it is rethinking lesson plans in a public school system for a country of about 4.3 million. In an initiative known as "Teach Less, Learn More," Singapore has trimmed its curriculum in recent years to focus on quality of instruction rather than quantity and to give students more time to think. And its educators are circling the globe to hunt for new methods.

Loudoun's Academy of Science weaves together math and science concepts and stresses hands-on learning through real-world applications. Teachers use the "inquiry approach" to education, giving students tools and guidance rather than step-by-step instructions. The goal is to have more " 'Gee whiz!' and 'Holy mackerel!' " moments and "to inject a love of science in addition to the facts," Wolfe said.

In a room filled with molecular models and playful posters of Albert Einstein and the periodic table, Har Hui Peng watched as the Loudoun students debated why some plants grew faster than others.

"Just by watching, you can see students are more engaged, instead of being spoon-fed all day," said Har, research coordinator at the Hwa Chong Institution, a secondary school that draws from the top 3 percent of Singapore's students.

There, she said, the laboratories are fully stocked but stark, and the students are bright but reluctant to volunteer answers. But that's changing. To encourage spontaneity, she said, Hwa Chong now bases 10 percent of each student's grade on oral participation.

Changes to spur creativity are unfolding across Asia. Top high schools in Beijing and Shanghai are emphasizing independent research, science competitions and entrepreneur clubs, said Vivien Stewart, vice president for education at the New York-based Asia Society, who arranges cross-cultural tours for educators. China's goal, she said, is to foster a higher-wage economy built on science and innovation.

Japan is retooling schools to engage students and ease pressure. Officials cut the national curriculum by 30 percent in 2002, eliminated mandatory Saturday classes and created a period for general studies meant to build on the interests of individual teachers or students. But the Japanese shift to yutori kyoiku, or relaxed

education, has fueled a back-to-basics backlash from parents who worry that their children are not learning enough and that test scores are slipping.

Experts say the obstacles to change are high in Asian countries with historically large class sizes, a teacher-dominated classroom culture and rigorous high school and university entrance exams.

The middling performance of U.S. students on international exams has led to controversy about math and science instruction. Some argue for a more traditional approach oriented toward drills and memorization; others say children learn best when they discover concepts for themselves. Arguments also have escalated over whether U.S. officials are reading too much into the test results and whether the political mandate for high-stakes testing under the No Child Left Behind law is stamping out the very creativity other countries covet.

But the success of Singapore and other Asian countries has inspired much interest in their teaching methods. Singapore's math books have been tried in classrooms from Rockville, Md. to Chicago. The National Council of Teachers of Mathematics published a curriculum guide last year that drew on the in-depth approach to math found in Asia.

In 2005, a report commissioned by the U.S. Education Department compared math teaching in the United States and Singapore. It found that U.S. texts place less emphasis on understanding math concepts in depth and that U.S. teachers are less likely to clearly understand the subject. William Schmidt, a Michigan State University education professor, said the United States could learn a lot from Singapore. He said the success of scientists here owes more to a business and cultural environment that rewards risk-taking than to the U.S. education system.

Yet such schools as the Academy of Science are forcing students to think on their feet.

Ishan Bardhan, 15, a sophomore at the academy, analyzed plants that afternoon with his classmates. He said his math and science classes are highly challenging. "They don't tell us what to do," he said. "We have to figure it out for ourselves. It's not straight out of the textbook. I like this better." Δ

—Michael Alison Chandler

Policy

Colorado Rejects H.S. Math, Science Requirements

Legislative committee's defeat of secondary education bill bucks national trend.

Bucking a national trend, Colorado legislators rejected a bill this spring to establish math and science requirements for the state's secondary schools. In May, the House education committee voted down a proposal, sponsored by Republican Rep. Rob Witwer, to require high school students to take four years of mathematics and three years of science to graduate. Subsequently, the state legislature and Gov. Bill Ritter passed into law a "roadmap" directing local school boards to review the academic rigor of their secondary schools and to draft guidelines for attaining excellence in their curricula. But the educational rewards remain to be seen.

Colorado is among a handful of states that have failed to establish math and science requirements for high school students in recent years, according to the Denver-based Education Commission for the States (ECS). Iowa and Michigan recently adopted such curriculum requirements and North Dakota appears headed in the same direction. That leaves Nebraska, Massachusetts, Pennsylvania, and Colorado as the only states without prescribed math and science course loads.

"Colorado appears to be moving in the opposite direction," says Jennifer Dounay, an ECS policy analyst. Much research in recent years shows that students undergoing an academically intense curriculum are better prepared for postsecondary education and the modern job market. Meanwhile, many policy-makers fret lagging educational standards could dull America's competitive edge in the global economy. As a result, measures upping science and math course loads have been sweeping through the states.

But the Colorado State Constitution leaves such decisions concerning the curricula of public schools in the hands of the local school boards. "Colorado has a very strong tradition, backed up by our state constitution, that local school boards have power over curriculum choices," says Rep. Michael Merrifield, a former high school choir director who opposed the bill.

Opponents of the bill argued that students subjected to its mandate would forgo a "rounded education" and get shortchanged in such subject areas as the arts, humanities, and foreign languages. Arts groups lobbied hard against the bill.

The Colorado Association of School Boards (CASB) also opposed the measure. "While we understand that more rigorous math and science must be offered, we want to come away from a prescriptive, seat-time curriculum to one where learning is fixed and time is variable" to accommodate the different learning rates of students, says Jane Urschel, executive associate director for CASB. "We understand that not everyone will go to a four-year college."

In the wake of the original legislation's defeat, Colorado passed House Bill 1118. The new legislation directs school boards to review the academic rigor of schools in their jurisdiction and develop guidelines

for curricula that will give students the option of multiple career paths. The school boards are charged with seeing that their schools meet or exceed those guidelines. And the state's education department is charged with creating a committee that will tour the state to ensure local school boards are doing just that.

Rep. Merrifield further pointed out that he opposed the original bill "because the proponents put forward no evidence that requiring four years of math and science would close the achievement gap or decrease the drop-out rate." He cited research indicating the benefits of the arts to student achievement. "I believe [the arts and humanities] are invaluable in giving students the opportunity to pursue their passions, think creatively, think outside the box, and become well-rounded high-functioning citizens," Merrifield said. He added that cost estimates for implementing the new requirements would run into the millions of dollars. Δ

—Steve Davolt

Places

Sleepless in Birmingham

University of Alabama student crunches numbers, bends time to earn double major in half the duration.

One might suspect Chris Culbert, 20, has discovered a secret time warp. How else to explain how the University of Alabama student compressed a four-year degree into a mere 24 months?

Yet there he stood in UA's Coleman Coliseum on May 12, proudly grasping his sheepskin for a double major in mathematics and physics. Only two years before, he had received his high school diploma from Vestavia Hills in Birmingham.

Culbert is nonchalant. "I guess I just wanted to challenge myself," he says, by way of explanation.

One almost has to be a math whiz to follow how Culbert squeezed 121 credits (120 are needed to graduate) into two years. First, Culbert arrived at UA with 19 credits earned in Advanced Placement courses at Vestavia Hills, where he was also a member of the school's award-winning math team. He also tested out of a three-credit economics course. Then came the Herculean class loads: 20 credits each of his first two semesters, 10 and 7, respectively during abbreviated, back-to-back summer sessions, and 21 each his last two semesters to finish. Do the math.

The science of sleeplessness

Culbert concedes he evolved a "21-hour day" to maintain his balance. He slept in four-hour cycles, followed by 17 hours of study and class. "Things just seemed to work better that way," he says.

Courtesy of University of Alabama

"I guess I just wanted to challenge myself," says University of Alabama student Chris Culbert, who earned a physics bachelor's in two years.

When asked why he keeps up a pace that seems grueling to everybody but him, he responds with what would surely be mistaken for a joke if it weren't for the insouciant delivery: "I'm not getting any younger."

Culbert gives the helpful, resourceful faculty at UA much of the credit for his success. "You feel like you can approach them with any question or problem," he says.

Minding the MINT

Last summer, Culbert volunteered to work in the University of Alabama's Center for Materials for Information Technology [MINT]. He calls the facility, where much of the research is directed toward devising smaller, more efficient data storage, the best of its kind.

"His energy and perceptiveness amazed me," said Dr. Bill Butler, who oversees Culbert's research at MINT.

Butler credits Culbert with performing first principles calculations of the electronic structure of transition metal alloys and discovering several new half-metals. As he works toward master's degrees in physics and math at UA, Culbert is continuing his research at MINT, fabricating and characterizing those materials.

Mathematics must be encoded in Culbert's DNA. Later this year, his 23-year-old sister will earn a master's in education at Southern Georgia University in Savannah. She plans to teach middle school math.

Culbert is noncommittal about setting a deadline for the doctorate he intends to earn, speculating, "Oh, maybe by the time I'm 24 or 25."

No doubt Chris Culbert will be doing the time warp again. Δ

—Steve Davolt

New Faculty Workshop Reunion

A popular month for weddings, it turns out, is also popular for class reunions. Over three sultry days in June, 50 past participants of an annual teaching workshop for new tenure-track physics faculty, gathered for a reunion workshop at the American Center for Physics, near the University of Maryland campus, just outside Washington, D.C.

The physics teachers were past participants of the Workshop for New Physics and Astronomy Faculty, a program intended to enhance the teaching effectiveness of new physics faculty. By

improving physics educators' classroom performance, the program aims at increasing the time and energy that physics faculty need to devote to research and scholarship. Held annually since 1996, the workshops introduce the faculty to a wide array of pedagogical ideas, practices and materials they can choose from to develop more effective teaching styles and techniques. For the most part, the lesson plan is derived from physics education research, a burgeoning area of study seeking to discover how best to teach physics.

"It's a great introduction to the latest techniques and practices in physics education," said Charles Sukenik of Old Dominion University, in Norfolk, Va. "Juggling the different demands on our time—research, administration, instruction—it's important to make our classroom time as effective as we can."

The workshop is jointly administered by the American Association of Physics Teachers, the American Physical Society, and the American Astronomical Society and partially underwritten with funding from the National Science Foundation.

With an average of 70 participants, the workshop reaches about 25 percent of all physics faculty embarking on the tenure track each year in the United States. And the workshop, at least to some degree, seems to be making an impact. About 94 percent of the past participants reported that the faculty workshop had resulted in at least some change in their approach to teaching. About two-thirds of past workshop attendees surveyed believed that the workshop had helped them improve student learning, while even more, nearly 75 percent, of their department chairs confirmed they had witnessed such improvement.

Returning with various degrees of experience under their belts, reunion attendees gave high marks to both the original workshops and the June encore. Several participants noted the initial meeting was the first time they were exposed to peer instruction, while they lauded the reunion programming for covering studio classrooms, interactive Physlet modules and Just in Time Teaching techniques.

Senta Greene of Vanderbilt, who attended her initial workshop in 1997, said this year's reunion did a good job of building on the groundwork laid by the original. "Advanced versions of those first ideas seem to have percolated upwards," Greene said.

Jacob Roberts of Colorado State University commended the diversity of the latest pedagogical methods and practices presented at the reunion workshop, which will better enable him to return to make recommendations to his department.

"There might be little improvements you could make here and there, but the important thing is to maintain the quality of the programming," he said.

For more information, contact AAPT at aapt-prog@aapt.org, (301) 209-3344 or http://www.aapt.org/events/new

—Steve Davolt

A Conversation of Representation

Sergio Ulloa, president of the National Society of Hispanic Physicists, and Quinton Williams, president of the National Society of Black Physicists, were invited by managing editor Daryl Malloy to talk about the critical issues influencing minorities in physics and the importance of promoting diversity in physics education.

INTERVIEW BY DARYL MALLOY

Malloy: Sergio and Quinton, what are your organizations doing, respectively, to increase the number of Hispanics and African Americans pursuing a physics degree?

Ulloa: NSHP focuses on students. Hispanic physics students are often single individuals in a class and may lack faculty mentors and role models. NSHP tries hard to provide opportunities, particularly through its meetings, to remove the isolation and provide support for its student members. We concentrate on students at the university level because of our history (our founders were university professors and our membership is largely academic). Although all stages in the pipeline are important, our expertise and knowledge lie mostly at the university level.

We run a GRE physics workshop at the SACNAS (Society for the Advancement of Chicanos and Native Americans in Science) meeting, and also do work at the K-12 level: A good part of the SACNAS program is dedicated to K-12 science education, although this is not where we have made the greatest impact. Similarly, the NSHP Education Officer offers a workshop at national AAPT meetings on *Reaching, Teaching and Keeping Underrepresented Groups in Physics*.

Williams: NSBP's primary focus is on students who are already in college working towards degrees in physics. We work to provide nurturing and guidance to students in the pipeline to give them the highest probability of completing a doctorate in physics. We seek to provide a supportive network for students, which include professional mentors and workshops on the graduate school process. Our annual national conference is an exchange where students can gain access to high quality research experiences and a venue for them to present their work among peers and future professional colleagues. The society also offers educational scholarships to high school students as incentives to pursue physics as a career.

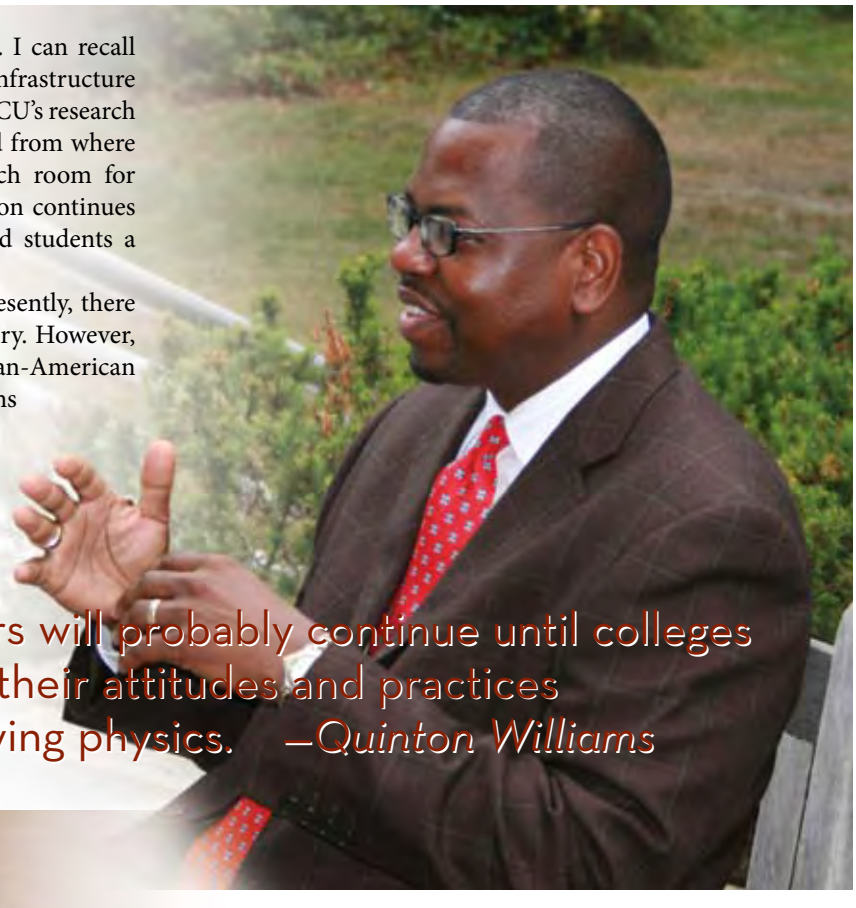
On a collaborative front, NSBP and NSHP have proposed the concept of a Physics Diversity Council (PDC) whose mission will be to facilitate a significant change in the demographics of the physics community to better match the national demographic while still ensuring the highest standard of scientific achievement. The PDC will be an assembly consisting of a representative from each of the member societies of the American Institute of Physics (AIP), NSBP, NSHP, and representatives from other interested societies. AIP has embraced the concept and established a liaison committee on Underrepresented Minorities, which has a member representative from each of the member societies under its umbrella organization. This committee will facilitate a process of each organization learning what the other is doing regarding diversity. The intent is to develop actions that member societies can synergistically implement to increase diversity in a more coordinated way.

Malloy: Quinton, NSBP was founded in 1977, at Morgan State University in Baltimore, Maryland, "out of a need to address many of the important issues of concern for African-American physicists." In your opinion, what are the pressing concerns of African-American physicists today?

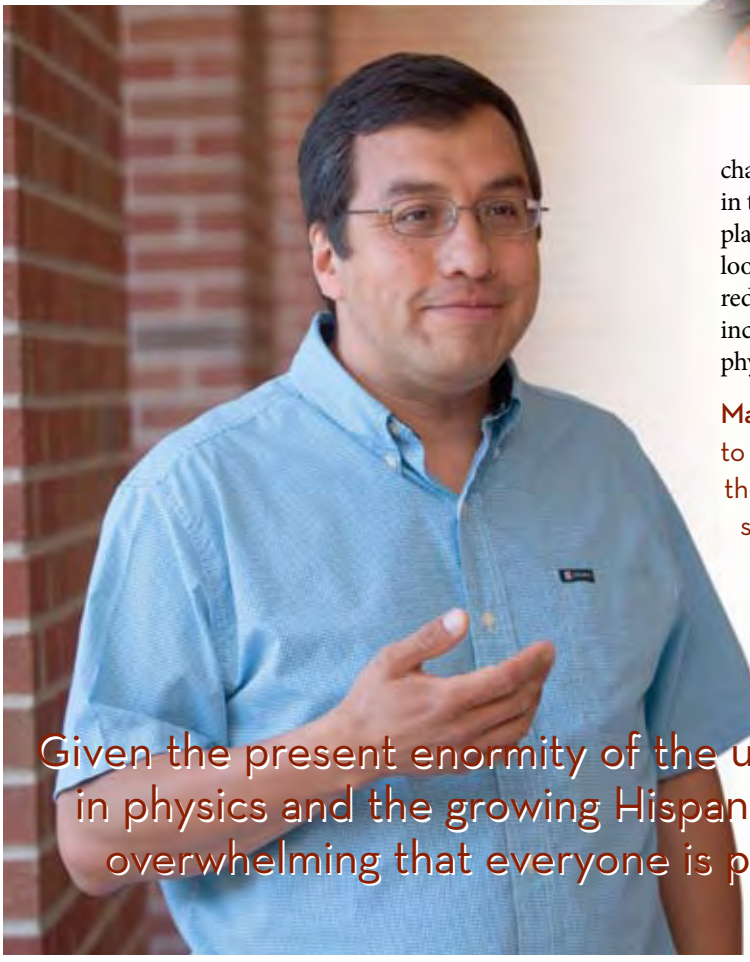
Williams: I attended my very first NSBP meeting in the mid 80s, some ten years after NSBP was founded. During that time a single conference room could accomodate the national conference with various scientific lectures being given throughout the day.

The majority of the members were from HBCUs. I can recall discussions by the "elders" on the issue of HBCU infrastructure and resources for research and student training. HBCU's research and training infrastructure has certainly improved from where it was some 30 years ago but there is still much room for improvement. Of course, the high cost of education continues to make financial assistance for underrepresented students a great concern.

Diversity in physics is also a huge concern. Presently, there are 756 bachelor's granting programs in the country. However, 34 HBCUs are producing the majority of African-American physics bachelor's. Many of the major institutions produce no African-American physics graduates year after year, and very few have African-American faculty members. Major institutions must play a larger role in physics education to improve diversity in the field.



The issue of low numbers will probably continue until colleges and universities change their attitudes and practices towards minorities studying physics. —*Quinton Williams*



Finally, due to globalization, workforce diversity is a major challenge. It has always been difficult for blacks to gain employment in the area of physics, with obstacles such as negative stereotyping playing a major role. Now, with scientists from abroad actively looking for employment in the United States, coupled with a reduction in job opportunities for physicists, it is even more incumbent for NSBP to work to ensure that African-American physicists are provided full access to careers in physics.

Malloy: Sergio, given that the stated mission of NSHP is to "promote the professional well-being and recognize the accomplishments of Hispanic physicists within the scientific community," would you describe some of the programs and services you provide?

Ulloa: We strive to provide information to young Hispanic physicists and students, as well as to improve their awareness of science opportunities and general

Given the present enormity of the underrepresentation of Hispanics in physics and the growing Hispanic population, the challenge is so overwhelming that everyone is pulling together to help everyone. —*Sergio Ulloa*

networking. We carry out these activities by participating in student-oriented meetings. Being new and relatively small, we do this in collaboration with existing meetings and conferences that focus on students and partner with the existing infrastructure. For example, we started in 1997 partnering with SACNAS, actively participating in their national conference. At that first meeting we counted only six students and a similar number of faculty, where most of the faculty there attended the official NSHP board meeting. By advertising the meeting and working to increase the sessions relevant to physics students, we now have well over a hundred students at the physics and astronomy sessions we organize. The SACNAS meeting also provides many sessions directly geared toward the student, including mentoring sessions, advising on graduate school applications, etc.

What we have done is add a significant physics component to the meeting as well as hold our annual board meeting at a time and location where a number of members can attend. We staff the Meet the Scientist tables, where students interested in the physical sciences get to ask questions of practicing professionals, and have also been able to award prizes to the best posters presented in the physical sciences at the conference. We have also added a partnership with NSBP, our sister organization, to hold a joint annual conference in the spring. This meeting has excellent student support sessions, as well as a significant research content. This mode offers faculty and students a venue to present scientific results. Uniquely, the students and faculty present at the same sessions, giving the students an opportunity to present in front of a supportive and knowledgeable audience, to receive feedback from peers and faculty, and to learn about exciting things that have been done in their area of research.

Both meetings provide a great opportunity for the students and faculty to network and interact one-on-one. The NSBP-NSHP meeting has become an important venue for schools to recruit minority graduate students and for prospective students to meet with faculty and scientists from a great variety of institutions.

An important vehicle for communication and link in our community is *The Hispanic Physicist* newsletter. A flow of information to members—some of whom are not Hispanic but have a strong interest in expanding the participation of minorities in physics—now exists that was previously absent. Information of relevance to our community now regularly reaches this community, including announcements of achievements and successes by our members, as well as practical tips and news.

Various NSHP members are active in AAPT and APS and they promote our agenda and activities whenever possible.

Malloy: Quinton, you stated earlier that some improvements have been made since NSBP was founded some 30 years ago, but much is still needed. Why do you think these problems persist?

Williams: I would say that the blatant acts of racism and bias which led to the formation of NSBP have disappeared. However, some of the vestiges of these types of race relations have morphed into systemic institutional practices that have contributed to maintaining low numbers of minorities in physics. In science and engineering, physics is severely lagging and is doing only better than the geosciences in granting degrees to minorities.

The United States cannot allow this segment of its citizenry to remain virtually untapped if it is to stay competitive. Remember, you can't become a physicist until you receive a degree in physics.

The issue of low numbers will probably continue until colleges and universities change their attitudes and practices towards minorities studying physics at their institutions. Let me also add that NSBP is open to anyone who wishes to help us achieve our mission of creating a diverse environment that is productive and fair for all who endeavor to work in the physics profession.

Malloy: At what educational level should such outreach and recruitment start? Elementary and middle school? High School? Undergraduate level?

Williams: All of the literature that I am aware of points to middle school as being the critical point where students will either gain more or lose interest in science. NSBP, along

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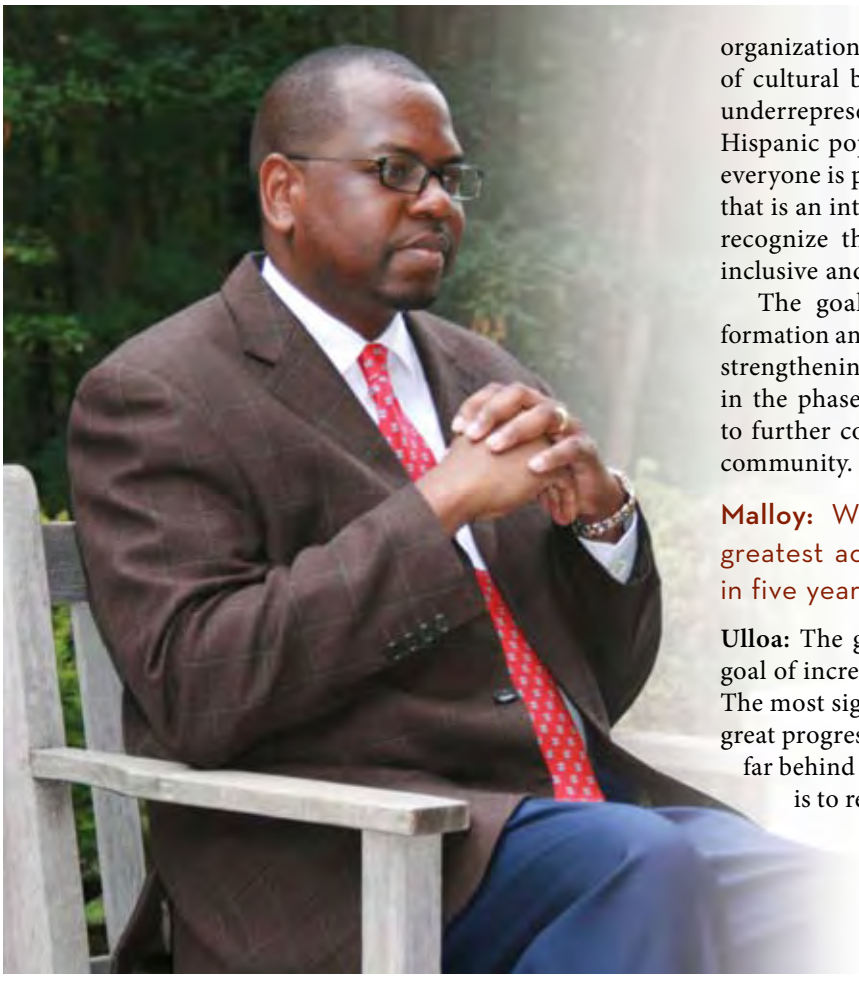


with NSHP, has an Education and Outreach Committee that is doing a wonderful job at going out into the community demonstrating science to children in a very visual and exciting way. This will not have an immediate impact, but it plants the seed of science in those students who participate. However, there is only so much volunteer time available and these dedicated members cannot physically go into every classroom across the country. We should probably discuss making a podcast of the presentation, although it will not have the same impact as having a person doing real things that the students can touch and experience first-hand. Education and outreach should begin in the middle schools with more physics-specific recruitment in the high school years.

Malloy: Sergio, NSHP represents a broad range of cultural and national backgrounds collected under the term "Hispanic." How have NSHP's goals and agenda evolved to represent the particular issues and concerns of its diverse constituency?

Ulloa: The formation of NSHP [1995-1996] included the broad diversity of those who constitute "Hispanic Physicists." Since its inception, NSHP has been completely open to anyone who wishes to join, and this inclusive attitude means that the organization works to support all members independently of cultural background. Given the present enormity of the underrepresentation of Hispanics in physics and the growing Hispanic population, the challenge is so overwhelming that everyone is pulling together to help everyone else, something that is an intrinsic part of the Hispanic culture. We of course recognize the diversity of our group, but continue being inclusive and cooperative.

The goals of NSHP have gradually evolved from its formation and structural shaping, to consolidation and further strengthening through student-focused activities. We are now in the phase of taking NSHP to legal, not-for-profit status, to further consolidate the organization and better serve the community.

Malloy: What would you predict will be NSHP's greatest achievement and most significant challenge in five years?

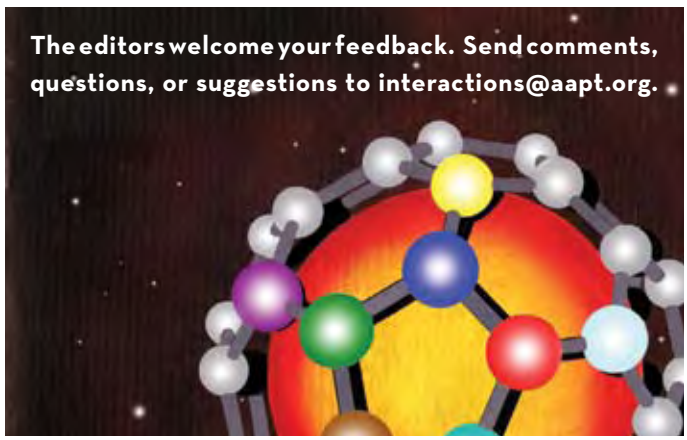
Ulloa: The greatest achievement will be reaching our main goal of increasing the number of Hispanics entering physics. The most significant challenge will be that even if we achieve great progress, even tripling the numbers, would still leave us far behind [based on national demographics]. The challenge is to reach the point where feedback mechanisms are in place so one can actually start to catch up.

Physics is an exciting and rewarding career. It is in the interest of physics and the country that it draws its talents from the entire population. Diversifying the backgrounds of those entering the field, Hispanic, African American, and women in particular, would greatly strengthen the field of physics. NSHP is working hard to achieve this major goal. Δ

Quinton L. Williams is an associate professor and the chair of the Department of Physics, Atmospheric Science and General Science at Jackson State University, Jackson, Miss.

Sergio E. Ulloa is a professor of physics in the Department of Physics and Astronomy at Ohio University, Athens, Ohio.

The editors welcome your feedback. Send comments, questions, or suggestions to interactions@aapt.org.



Deconstructing the 'Leaky Pipeline'

Gender discrimination may be a factor in explaining the absence of women physics faculty, but the numbers tell another story.

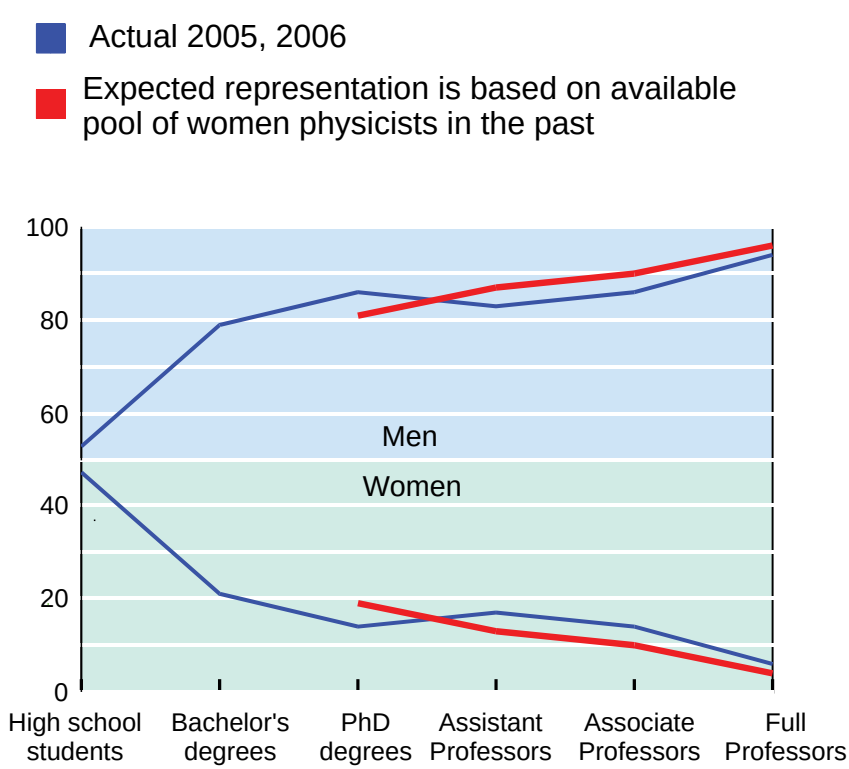
BY RACHEL IVIE

Compared to their representation in other fields, women are underrepresented in physics, especially at the top levels. In fact, the gap gets progressively wider at every rung up the academic ladder. For example, women accounted for 14 percent of all Ph.D.s earned in physics during 2005, but far fewer women—only six percent—were full professors of physics in 2006. This statistical phenomenon is commonly known as the "leaky pipeline," reflecting a widely-held belief that more women drop out of physics than men at every step along the educational path. In contrast to the prevailing view, however, data compiled by the American Institute of Physics (AIP) show that for women in physics, these leaks only occur at specific points along the path.

To understand the true nature of the leaky pipeline, we must examine not only the current representation of women at each level, but also consider past representation of women.

The graph (at right) compares the present, actual representation of women at each level (blue line), with expected representation (red line) based on the size of the available pool. For example, to understand the representation of women among full professors, we have to consider the available pool of degree recipients from prior years. Data gathered from surveys conducted by AIP show that most full professors of physics earned their Ph.D. during the 1970s, when women

Actual and Expected Percentage of Women and Men in Physics in the U.S.



Source: AIP Statistical Research Center

accounted for only 4 percent of physics Ph.D.s earned. Therefore, the primary reason women are underrepresented on physics faculties at present is they were poorly represented among doctoral candidates in the past. There are, in fact, more women physics professors than we would expect based on the representative number of Ph.D.s earned in the past. (See data on women in physics and astronomy at www.aip.org/statistics.)

Women who earn a Ph.D. do progress up the academic ladder. But the existence of a path doesn't necessarily mean the path is easy. Some women continue on, and some women leave the path, but so do some male physicists.

Data show leaks occurring for women at lower educational levels. For example, fewer women earn bachelor's degrees than would be expected based on high school physics enrollments. Because we don't know the proportion of women entering college with the intent to major in physics, we can't determine whether the leak occurs during college or before. However, culturally, physical science is still portrayed as a primarily male pursuit. Therefore, the leak more likely happens before college, when girls disproportionately fail to consider physics a viable career option.

Further leakage seems to occur somewhere between earning a bachelor's degree and earning a Ph.D. We know that the proportion of first-year female graduate students is nearly identical to the proportion of women who earned a physics bachelor's the previous year. This means the leak is almost certainly happening sometime during graduate school. The data also suggest that the leakage at the graduate-school level is greater for women who are non-citizens than for women who are U.S. citizens.

Does this mean there is no discrimination for women in physics? Of course not! Discrimination affects women in a variety of ways. For example, the climate for women in many workplaces continues to be chilly, if not outright hostile. Further, the data confirm a salary gap in physics between women and men, even after controlling for number of years since earning their degree as well as for employment sector. In fact, the difference is about $3,000 annually.

Although women are represented on physics faculties at levels consistent with their degree production in the past, this is not true in all scientific fields. A concern is that once women reach a certain proportion, decision makers may conclude that a gender gap is no longer a problem, and efforts to recruit and retain women will cease. Clearly, action on behalf of women in physics is still essential, and likely will continue to be. Δ

Rachel Ivie is research manager at the Statistical Research Center of the American Institute of Physics.

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Sowing the Seed of Diversity

The author identifies the challenges encountered by minority students—and offers a model for meeting them.

BY MARIA ONG

In the 21st century, promoting the interest of all students in physics as well as other STEM (science, technology, engineering, and mathematics) disciplines should be a central concern to U.S. educators, scientists, and citizens. As never before, we must focus on the recruitment and retention of females and students of color. The United States faces a crisis caused by a gap between an increasing need for scientists and engineers and the decline in the number of STEM majors. The growing void points to the neglect of our own young people as potential resources to fill critical positions in STEM. In recognition of the "quiet storm," as Shirley Ann Jackson termed the impending crisis, agencies such as the National Science Foundation, the American Society of Engineering Education, and the American Physical Society have called for the United States to cultivate its domestic resources that explicitly include women and racial/ethnic minorities.

However, before we can fix the problem, we need to better understand the cause. Through sociological research I have conducted over the past decade, I have sought to address effective ways to recruit and retain young people, especially women and racial and ethnic minorities, in physics. A number of studies amply document how physics departments and professional laboratories operate as cultures that are often unfriendly to women and minorities. My research focuses on contexts of success: the day-to-day work and academic environments as experienced by 28 female and minority students—of which ten are women of color—who would eventually earn bachelor's degreesand pursue graduate school and/or careers in physics or a physics-related field. Through annual interviews and ethnographic observations conducted over a 10-year period, I have endeavored to identify the challenges encountered by these students, as well as the strategies that fostered their ability to persevere.

One of the more important, and perhaps surprising, findings is that sometimes even subtle interactions can have a significant impact. For example, an undergraduate physics major's social experiences with peers and faculty can strongly influence his or her decision to abandon or pursue a physics degree. In my research, I have found that students' experiences of alienation and being disrespected by peers or faculty members often outrank other contributing factors, including grades. While most physics students might typically react to such experiences the same way, women and racial minorities are particularly vulnerable to messages that define them as outsiders.

To understand the perceptions held by women and minorities, consider the following remarks that were expressed by some of the students who participated in my research study:

> "A whole class of us will be working, like, two hours before some homework is due, and we'll have different answers. And everyone will make an argument as to why their answer's right. You know, for the benefit of everyone. And so we all help each other, and everyone's helping everyone. But there's so many [male] students who are so willing to help me, but unwilling to hear me when I say something."
>
> *— Chicana student*

> "If we asked [the professor] a question, he'd talk to us like we're kindergartners.... Whenever we asked him for something, it would take three hours to explain it to us, and we wouldn't have that time. When you have only four or five days to an experiment, you can't miss a whole afternoon on one minor thing."
>
> *—Latina student*

> "My [male] partner and I had this question on some lab we were doing and we were asking [the professor] questions, and the thing is, I would ask a question. He would say about one sentence to me, and then the rest of his conversation was directed at Dave, my partner. And I have no idea why he did that. Because [the professor's] a great guy. You know, I wouldn't think that he has anything against women. I'm sure he had no idea he was doing it."
>
> *— Filipina–American, recent graduate*

When members of a group that are marked by a particular stereotype risk the possibility of conforming to or being judged in terms of that stereotype (e.g., "females aren't good at math"; "African-Americans lack intellectual aptitude"), they respond—in an effort to reinforce their group identity—by "disidentifying" with a domain (e.g., math, science).

Psychologist and author Claude Steele called such domains "stereotype threats." Steele argued that this phenomenon can be especially harmful to "the academic vanguard," that is, high-achieving students of a particular group who choose to be in a domain for which their group is negatively stereotyped. These students can be successful in school and still be at risk for abandoning the discipline or dropping out of school entirely.

Even when women and minorities display greater skill and competency than their white male counterparts, they may continue to

experience stereotype threat and may eventually lose confidence in their abilities.

> "I just remember at times taking exams [in upper division] where I was the only minority woman…and just being so convinced that everyone just looks smarter than me. And I'll sit there and I'll think, 'No, it's not true.' But [it's hard] to really change the way you feel."
>
> —*Chicana student*

An important, and rather controversial, implication of Steele's work is that remedial programs for women and minority students, though well-intentioned, serve to reinforce the very stereotypes that would cause these particular students to underachieve in the first place. Perhaps a more effective approach with students who already identify with academic achievement would be to reduce stereotype threat by establishing learning environments where the bar for achievement is high and no student's ability is questioned.

For students who disidentify with a particular domain, instructors can foster more positive academic identities through safe learning environments where there is "little cost of failure," thereby fostering students' sense of self-efficacy and competence. One student comment from my study illustrates the impact of such an environment:

> "My grade in physics is what kept me in the University. And I would not have been able to get that grade had I not gone through the program, for sure. I have had more support than probably any one person deserves. I mean, I've had a really great support team. The instructors, program directors, teaching assistants, all of them, have always been really rooting for me. And that really means a lot. Probably the single most important thing that you need to get through this place is someone to say, 'We believe in you.' It really makes you rise to the occasion."
>
> —*African-American student*

Fortunately, models of positive learning environments for minority students already exist in physics and other STEM programs. Among the most well known, perhaps, are the Meyerhoff Scholarship Program at the University of Maryland at Baltimore County (www.umbc.edu/meyerhoff) and the "workshop" model, founded by Uri Treisman, which began in the mathematics department at the University of California at Berkeley, and has since been implemented in STEM disciplines all around the country. A "workshop" type of program—which had the characteristic collaborative group work and deep-level problem solving—was implemented in the lower-division physics courses where I conducted a large part of my research. While it welcomed all students, it served primarily minority ones. The physics department also sponsored the Women in Physics Group, which served as a resource for professional development. In addition to hosting a website that featured information on the graduate school application process and national conferences, the group sponsored monthly events that brought together undergraduate and graduate students, as well as faculty. The group's monthly meetings often revolved around the concerns of aspiring women scientists—ranging from discussions on how to balance family and a career in physics to lab simulations to help undergraduates gain experience using the tools and equipment common in experimental physics.

Indeed, subtle messages that convey exclusion undermine efforts to recruit and retain women and minorities. Yet, small, incremental attempts at social inclusion can have a significant impact on increasing the number of minorities in physics. Toward that end, more physics departments should sponsor support programs and social events that welcome undergraduates. Such efforts require money, space, and time, but the more undergraduates are engaged in their education and departmental culture, the higher the return on investment.

Due to the still prevalent assumption that gender and racial equity and the attainment of excellence are incompatible goals, STEM fields, in general, and physics, in particular, continue to be among the most segregated and conservative of domains.

Due to the still prevalent assumption that gender and racial equity and the attainment of excellence are incompatible goals, STEM fields, in general, and physics, in particular, continue to be among the most segregated and conservative of domains. Last year, I founded Project SEED (Science and Engineering Equity and Diversity) as an initiative of The Civil Rights Project at UCLA to point to the many benefits of gender and racial diversity; call upon diversification and equity in STEM as a social justice issue as well as a national security issue; and challenge the prevailing exclusionary definitions of "best and brightest" and "excellence" in order to make it more inclusive and compatible with the demands of a democratic society.

In the end, diversity benefits not only women and minorities but all individuals and institutions by making them more creative and competitive. Δ

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A Meeting of Minds on Welcoming Women

BY THEODORE HODAPP

Girls now make up approximately half of all high school students studying physics, but only one in four undergraduate degrees in physics is given to women. Worse still, in the United States, only about 8 percent of all physics faculty at large research institutions are women. The country is clearly missing out on a huge talent pool at all levels.

To help address this disparity, the American Physical Society's Committee on the Status of Women in Physics (CSWP) recently held a conference of department chairs, managers of national laboratories, and funding agencies, with the express intent of increasing these percentages and attaining CSWP's broader goal of working to double the number of women in physics over the next 15 years. Chairs of more than 50 of the largest doctoral degree-granting institutions and more than a dozen managers of national laboratories attended, along with high-ranking officials from both the Department of Energy and the National Science Foundation, co-sponsors of the event.

A number of recommendations and best-practice ideas were discussed during the workshops and panel sessions. Nearly all of the ideas and suggestions made are as applicable to the recruitment and retention of minorities within physics as they are to other disciplines. Recommendations for policies and practices that will make physics departments more inclusive fall under three broad categories: students, faculty, and chairs.

Clearly, student concerns relate to how we inspire the next generation of women scientists, teachers, and technically educated citizens. Perhaps the simplest and most compelling idea was having the department chair meet regularly with the female physics majors. Not only does the chair get an inside view of departmental climate, but these meetings also encourage and support open communication, transparency, and the pursuing of a physics degree. (This is also a great idea for graduate students.) Best of all, such meetings cost nothing but the time invested, and are quickly and easily implemented.

Other ideas that emerged from the CSWP meeting included active recruitment for the physics major, designing special degree tracks for high school teaching, and creating three-year programs allowing late entry or interdisciplinary majors.

Concerted efforts to recruit and retain more female faculty take high priority in building and maintaining this pipeline. Departments are encouraged to begin searches early and, where possible, track and help mentor potential candidates as they enter the field. Candidate interviews are potential stumbling points as well because, although we might deny it, there are still inappropriate questions being asked of women during interviews (affirmed by a number of women participating), including their marital status, and whether they plan to have a family. Departmental chairs at the American Physical Society meeting recommended educating faculty about the inappropriateness of such comments and adopting a zero-tolerance policy toward both public and private comments marginalizing women within the department (e.g., "she got that award because she is a woman").

A number of chairs voiced creative approaches for attracting women (and men) to the field. For example, to draw those with academic spouses, physics departments could sign agreements with other departments either within the university or in neighboring institutions to share, for some time, the costs of an additional appointment. Other family-friendly suggestions included stopping the "tenure clock" for all faculty with new family members as a matter of policy rather than as an option, and scheduling meetings not to conflict with family duties (such as picking up children from school or childcare). Furthermore, it was suggested that departments establish a junior faculty club to allow staff to bring concerns as a group rather than individually.

The outcomes and recommendations of the CSWP meeting are currently being written and will appear on the conference website (http://www.aps.org/programs/women/workshops/gender-equity.cfm) this fall. The site also includes a number of references to available resource materials.

Those in attendance stressed that diversity is an ongoing effort that requires transparent procedures, frequent reminders of proactive actions, and clear policies regarding harassment. Graduate students attending the conference noted that they had witnessed a number of egregious actions by male faculty members only recently, reminding us all that there is still a great deal of work to be done.

Theodore Hodapp is on leave as chair of the physics department at Hamline University, in Red Wing, Minn., and is currently the Director of Education and Diversity Programs at the American Physical Society.

The Missing Talent

What can the physics community do about gender equity in science?

BY SHERRY YENNELLO

The figures are daunting. The U.S. physics community is currently ignoring 70 percent of the intellectual capacity of the country. Thirty percent of the population are white males, and yet white males make up 90 percent of the physics workforce. Nearly half of the high school students who take physics are women, yet only 4 percent of the full professors in physics departments at research institutions are women. Women are better represented in nonresearch universities and part-time or nontenure track positions, but even there they represent only 14 percent of the higher education workforce. Although 87 percent of high school teachers are women, among physics teachers that number drops to 30 percent.

A workshop on "Gender Equity: Enhancing the Physics Enterprise in Universities and National Laboratories" was held to address this issue. Department chairs from 50 top research departments and 14 unit managers from national laboratories were brought together with representatives of the Department of Energy and the National Science Foundation and nationally recognized social scientists in the area of gender equity to design an equity action plan. The workshop began by helping participants recognize the issues. There were talks about the recent National Academy of Science report "Beyond Bias and Barriers," how the overlap of gender schemas with schemas of successful physicists results in unintentional bias against women, and the impact of children on careers. There was also an interactive performance of a faculty meeting by the University of Michigan CRLT (Center for Research on Learning and Teaching) Players. There were panel discussions on institutional challenges; the recruitment, hiring and retention of women; training the next generation; and funding agency issues. The participants actively engaged in breakout sessions where they brainstormed how to deal with particular situations that could result in additional burdens being placed on women and to formulate a set of recommendations for concrete actions they could take back home to their units. Many of the findings of the presenters and participants are available on the Gender Equity Workshop website hosted by the American Physical Society for use by anyone interested in increasing the participation of women in physics. The workshop was supported by the National Science Foundation and the Department of Energy.

As physics teachers we can have a very large impact on the students who will become the faculty of tomorrow. So what can you do in your department to make a difference?

Make a commitment

First you should decide that this is an issue on which you want to spend some time and energy. There is no magic potion to ensure gender equity. However, physicists are the most creative problem solvers I know, and if they decide to own this issue, there is no reason that the challenge cannot be met. After you have made a personal commitment to address issues of equity in opportunity, you should seek the buy-in of other stake holders in your department. Lead by example, but others must also commit to investing the energy to change the status quo. It is much easier to do things the way they have always been done, to view situations from our own perspectives, but that rarely leads to broadening the pool of people involved.

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Analyze the current situation

The next thing you need to do is to examine all aspects of how you do business in your department. What process do you use to recruit students? To admit students? To teach and assess students? How do you decide which students are going to be encouraged to take advantage of opportunities? For example, many male faculty see themselves in the male students, with such thoughts as, "Johnny has the same curiosity I had as a first-year student."

These sentiments can easily be extrapolated to, "Johnny could grow up to be me." Then the well-meaning faculty member may actually try to encourage Johnny to do an independent project, get involved in research, apply for a special program (summer school, REU, conference or workshop to present research). After three or four years of such mentoring, Johnny will be well situated to go on to the next level (university, graduate school, postdoc) at a prestigious institution, perhaps with a well-paid fellowship. This is great for Johnny, but what about Jane or José who didn't make the same initial connection with a faculty member?

Revealing data

Do you know the retention statistics for the students in your department? Are they different for women and men? Do you know the number of papers published and conferences attended by the male and female students in your department? Is there any inhomogeneity in the distribution of these publications that could be correlated with individual faculty or research groups? As a leader, you should acquire and analyze these data as rigorously as you would for any physics problem you set out to solve.

Recruit students for a diversity of careers

Recruiting more women into physics requires not only getting them excited about the opportunity to uncover nature's hidden secrets, but also letting them know about the diversity of possible careers that they can pursue with a degree in physics. How many sophomores in high school know what a physicist does? How many of them think about patent law, government, teaching, medicine, or business as places where people with degrees in physics are enjoying very rewarding careers? We need to change the attitude shared by many physics professors, namely that, "The best of you will become me and the rest of you will find something else to do." We need to encourage people to appreciate the education of a physicist as the creation of a creative problem solver who can apply her vast knowledge of how the world works to a variety of interesting careers.

You should also reevaluate your curriculum. What is the bar to an undergraduate student changing her major to physics in her sophomore or junior year? Many physics departments teach service courses to other majors in the first two years of their undergraduate career. These service courses can be a mechanism to excite students about physics, but then it is essential that there is a visible pathway to becoming a physics major. When Carnegie Mellon University reexamined its undergraduate curriculum in computer science and created various pathways to success, the number of women majors increased.

At the graduate level, what process do you use for admitting students to candidacy? What are the highest hurdles for graduate students? Do these affect different groups of students in different ways?

Retain students through increased communication

Treat all students better than how you were treated as a student—the way you would like your daughter or granddaughter to be treated as a student. Communication is essential. Don't assume that you know what your students are thinking or feeling or understanding. Ask. Also, do not assume that students know things they have not been told, particularly when it comes to special opportunities. You could have an open-door policy, or at least some set hours when you are available for students to come talk to you. But it is even better if you take the initiative and invite the students to discuss with you how things are going from their perspective. An occasional pizza party will facilitate such communications. It can also be helpful for you to encourage student organizations, both for the student/postdoc population at large and for women or minorities in physics in particular. Supporting such student-led efforts with funding for occasional speakers and refreshments for meetings will help foster such organizations. Then make sure to cultivate a dialogue with representatives of these groups so that any student concerns can be brought to you in a way that allows the students some amount of anonymity. Last, when students bring concerns to you, respond to their concerns—even if just with a follow-up meeting saying you looked into the particular issue and nothing can be done about it at this time. They will continue to communicate with you only if they feel they are being heard.

Encourage students

Faculty should be encouraged to involve all of their students in class and scientific discussions and talk openly about opportunities that are available such as involvement in research, conferences, or workshops. For some of the more reserved students (who may well be those in the numerical minority), make the extra effort to encourage them and invite them to participate in extra activities. When faculty are thinking about whom to extend that research assistantship to, they need to acknowledge their own inherent ideas of who will be successful and then question if this is really the right metric to use in evaluating students.

Little things matter

Everyday language is important. Be cognizant of your own actions and language. If you always refer to physics students as "he," the female students will not feel nearly as welcome as if you say "he or she." Encourage dialogue in your department about diversity and equity. Much inequity is merely the unintentional consequence of people doing things the way they have always been done. Challenge the people in your department to question their assumptions about issues related to who belongs in physics much the same way they challenge and test the basic assumptions in their experiments. Finally, as a leader you should establish and enforce a zero-tolerance policy to unwelcoming and inappropriate words and actions on the part of everyone in your department: faculty, staff, and students. Δ

Sherry Yennello is a professor and associate dean at Texas A&M University.

Operation STEM

Hispanic organizations are on a mission to get more students to pursue the sciences

BY DINA HORWEDEL

For the first time in the 30-year history of the Society for Advancement of Chicanos and Native Americans in Science (SACNAS), the organization is focusing on the nurturing of scientific talent in preschoolers and very young children.

SACNAS, whose mission is to encourage Chicano/Latino and American Indian students to pursue graduate education and advanced degrees in the sciences, has long focused on K-12 teacher education to prepare students for science, technology, engineering, and mathematics studies on the college level. Until now.

The country's growing Hispanic population has not translated into increasing numbers of Hispanic students entering or graduating with degrees in STEM disciplines. Organizations such as SACNAS and the Hispanic Association of Colleges and Universities (HACU) want to change that, recognizing that STEM fields hold the key to America's future competitiveness.

According to a recent study, Black and Hispanic students are entering the STEM fields, but they aren't earning enough credits to graduate in six years. The report, "Increasing the Success of Minority Students in Science and Technology," examined six years worth of U.S. Department of Education data for 12,000 students who entered college in 1995. Black and Hispanic students were able to complete the STEM "weeding out" courses, says Eugene L. Anderson, associate director of the American Council on Education's Center for Policy Analysis and co-author of the report. But after the third year, a significant percentage of those students had dropped out. Only 62.5 percent of Black and Hispanic STEM students completed their coursework, compared to 87 percent of White students and 95 percent of Asians.

Antonio Flores, HACU's president and CEO, says his organization has conducted a number of pilot programs in middle and high schools to increase Latino enrollment in STEM fields. A five-year program, funded by NASA and held at 10 schools nationwide, offers "conclusive proof that with the right investment and the right tools, Hispanic kids are able to complete college preparatory high school programs as well as enroll in [STEM] fields at a higher rate," he says.

The Battle Is on the Supply Side

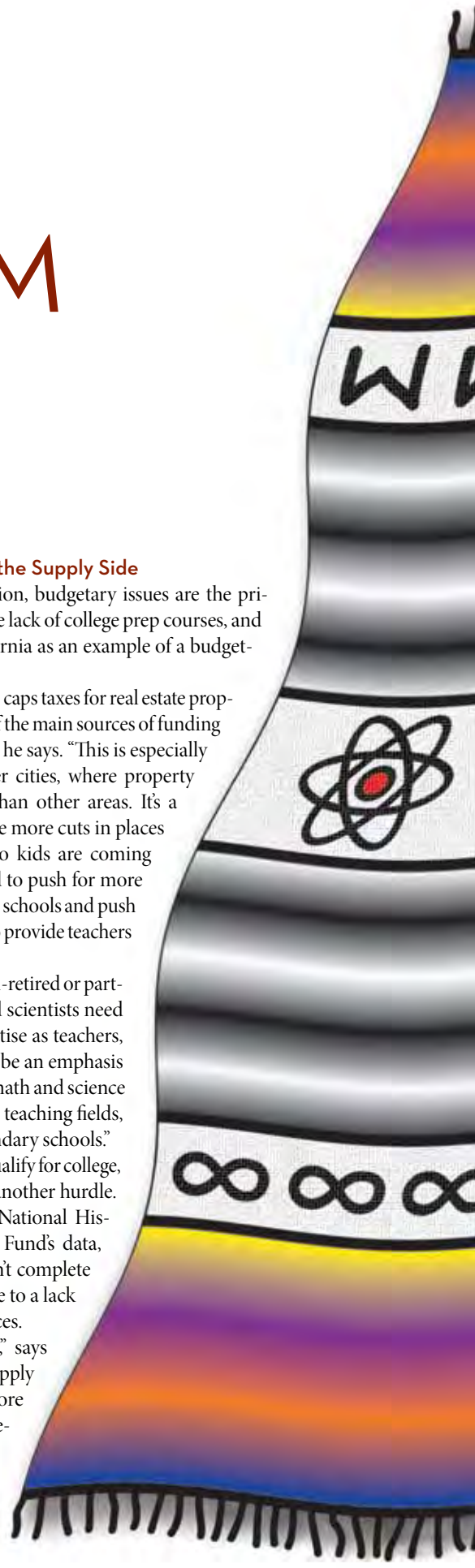
In Flores' opinion, budgetary issues are the primary reason for the lack of college prep courses, and he points to California as an example of a budget-borne roadblock.

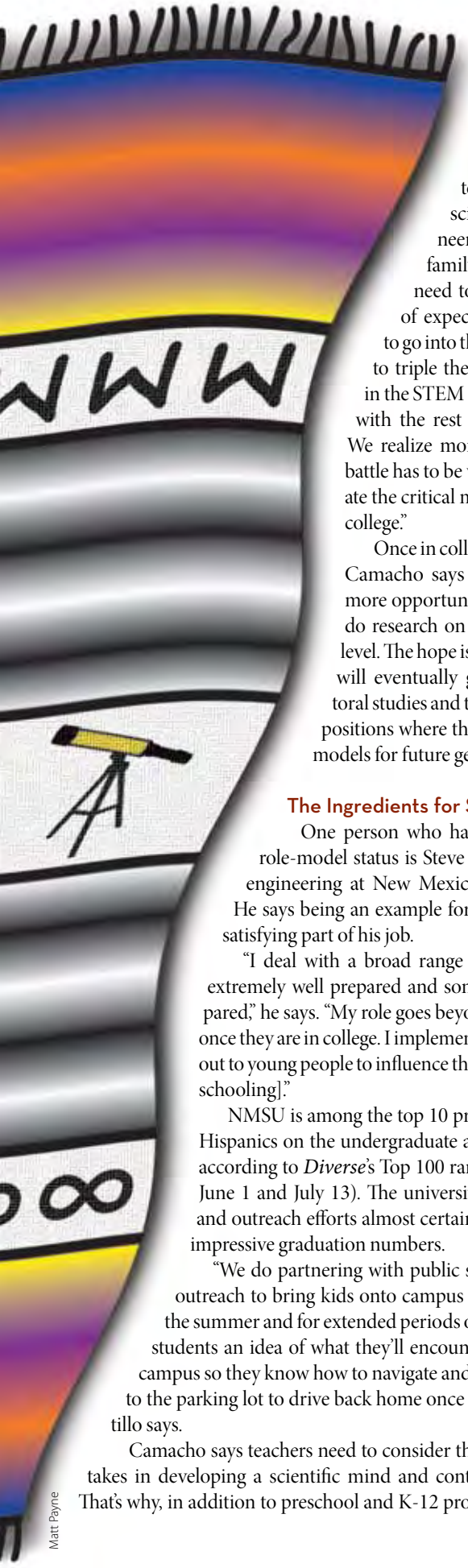
"Proposition 13 caps taxes for real estate property, which is one of the main sources of funding for public schools," he says. "This is especially a problem in inner cities, where property values are lower than other areas. It's a Catch-22. There are more cuts in places where more Latino kids are coming to school. We need to push for more investment in these schools and push the private sector to provide teachers in public schools."

Flores says semi-retired or part-time engineers and scientists need to lend their expertise as teachers, and there needs to be an emphasis placed on getting math and science majors to enter the teaching fields, "especially in secondary schools."

Once kids do qualify for college, funding becomes another hurdle. According to the National Hispanic Scholarship Fund's data, many students don't complete their education due to a lack of financial resources.

But "the battle," says Flores, "is on the supply side. We need more and better college-prep programs for math and science





Matt Payne

education, and we need to secure teachers in the math, science, and engineering fields." On the family side, he says, "We need to develop a culture of expectation for students to go into those fields. We need to triple the number of people in the STEM fields to gain equity with the rest of the population. We realize more than half of the battle has to be won in K-12 to create the critical mass to get kids into college."

Once in college, SACNAS' Judit Camacho says there needs to be more opportunities for students to do research on the undergraduate level. The hope is that these students will eventually go on to postdoctoral studies and then into leadership positions where they can serve as role models for future generations.

The Ingredients for Success

One person who has already achieved role-model status is Steve P. Castillo, dean of engineering at New Mexico State University. He says being an example for others is the most satisfying part of his job.

"I deal with a broad range of students—some extremely well prepared and some not so well prepared," he says. "My role goes beyond mentoring kids once they are in college. I implement strategies to reach out to young people to influence their decisions [about schooling]."

NMSU is among the top 10 programs graduating Hispanics on the undergraduate and graduate levels, according to *Diverse*'s Top 100 rankings (see *Diverse*, June 1 and July 13). The university's early recruiting and outreach efforts almost certainly play a role in its impressive graduation numbers.

"We do partnering with public school systems and outreach to bring kids onto campus to attend classes in the summer and for extended periods of time to try to give students an idea of what they'll encounter once they're on campus so they know how to navigate and don't head straight to the parking lot to drive back home once they are here," Castillo says.

Camacho says teachers need to consider the trajectory a child takes in developing a scientific mind and continue to nurture it. That's why, in addition to preschool and K-12 programs, SACNAS is developing examples of culturally relevant science, such as the Mayans' contributions to mathematics.

"There is often a lack of expectation on the part of teachers or others in children's lives about their performance in [STEM] fields," she says. That's why it's essential that students receive encouragement, preparation, and mentorship before they reach college, adds Camacho.

"One half of all postdocs are foreign born. Yet, there is an increasing population of Latinos and we are not utilizing our human resources and capacity," Camacho says. "We will have huge populations of underutilized populations. Right now what keeps us competitive is science and technology. Without competition our economy will fall behind."

Start Young and Stay Focused

In the pursuit of engineering degrees: Two students share their experiences

Kiki Robles, a fifth-year mechanical engineering major at the University of Miami, echoes the sentiments of higher education professionals who say starting young and keeping the end in sight is important when pursuing a STEM major.

> "If there was one piece of advice I would give kids, it would be to keep on fighting," says Robles.

She says she was encouraged by a high school math teacher to develop her skills "in math and as a person." And although it hasn't always been easy as a Hispanic woman in the sciences, Robles says she has encountered more encouragement and support than resistance in her engineering pursuits.

Miami's mechanical engineering department trails its other engineering programs in the number of women enrolled, so Robles tries to keep a high profile and establish close relationships with her professors. Set to graduate this spring, she plans to stay at Miami and earn a master's degree. In *Diverse*'s Top 100 rankings, the university ranked sixth among all institutions for conferring engineering master's degrees to Hispanics in the 2004-2005 academic year. And although Robles is not technically a first-generation college student, she will be the first in her family to earn a master's degree.

"If there was one piece of advice I would give kids, it would be to keep on fighting," she says. "Many times when I've been down and out, there were times I haven't been able to see the light. But you have to take the punches and keep on going."

It was a sixth-grade science class in his Los Angeles school that got Luis Gonzalez interested in engineering. His teacher had the class

build and launch rockets, and that experience propelled Gonzalez from California to the East Coast, where he graduated in 1992 with a bachelor's degree in aerospace engineering from the Massachusetts Institute of Technology.

Gonzalez says his mind was made up after that pre-teen experience. From then on, "The focus in junior high and high school was that I had to do well," he says, noting that both his teachers and parents encouraged him. "My parents did not push school nor did they overwork me, but they respected my teachers a great deal and made me understand how important school was. They never actually verbalized it until much later, but we came to this country [from Mexico] so that we could get a quality education." Gonzalez was actively involved in the Math, Engineering and Science Association (MESA) and attended engineering-oriented events at local colleges, which provided exposure to the discipline. It was in high school that an adviser suggested he apply to MIT's summer engineering program, called Minority Introduction to Engineering and Science (MITES), designed for students entering their junior year in high school. Admission into the program is said to be more competitive than admission into MIT itself, but Gonzalez applied and was accepted. He says that experience also had a profound impact on the direction his life would take, spurring him on to apply for undergraduate admission at the university.

"To see all of the resources available at MIT was amazing to me," he says. Yet, he confesses that he didn't feel prepared for the rigors of MIT as a freshman, even though he was a top scholar in high school. Like many first-generation college students, he says he didn't know how to take advantage of all of the resources the institution had to offer, and he looked at the professors as people who were there to give him work, rather than help him.

But with age comes wisdom, and before long he realized the importance of role models. Consequently, Gonzalez and his wife, Luisa, have tutored and assisted Hispanic students with college admissions paperwork. "I see the boost of self-esteem students get when they see others in these roles," he says. "Not having many graduate students or professors that I could relate to from my background was a little tough."

Now working in Phoenix in the information systems field, Gonzalez says the analytical and engineering skills he developed have opened many doors for him.

"There are all kinds of people and all kinds of degrees," he says. "What matters is that you must be able to learn on the job, and you must have hard skills." Δ

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2007 Edward A. Bouchet Award Winner

Argentinian Physicist Recognized

Gabriela Gonzalez, an Argentine-born physicist researching the detection of cosmic gravitational waves at Louisiana State University, has garnered the American Physical Society's 2007 Edward A. Bouchet Award. The annual prize recognizes the contributions of a minority physicist.

An associate professor in LSU's physics and astronomy department, Gonzalez conducts research in detecting gravitational waves at the nearby Laser Interferometer Gravitational-Wave Observatory, or LIGO. The 2.5-mile-wide installation intercepts cosmic gravitational waves as they reach the Earth, yielding data with implications for both astronomy and physics. LIGO and other such gravitational detectors may help physicists test several facets of general relativity theory and trace the lifecycles of stars.

"Being able to view the universe through these ripples of space-time will open a completely new window to the universe," Gonzalez writes on her faculty Web page.

The Bouchet Award is APS' primary vehicle for recognizing and promoting the participation of minorities in physics. It is intended to help publicize the winner's research and career to a wider audience. The award comes with a $3,500 stipend and covers travel to an APS annual meeting and to give presentations at three academic institutions to promote his or her research and career standing.

"I think—or at least hope!—the most important benefit of this award is the financial support to present the excitement of the science of gravitational waves to young students," Gonzalez says.

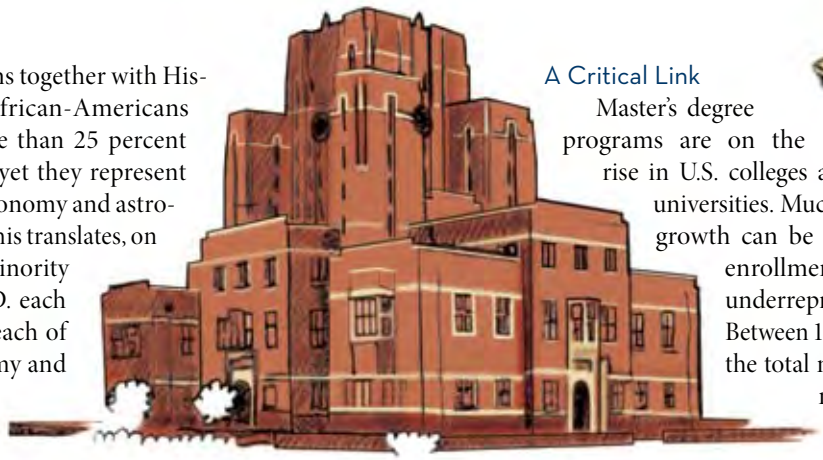
Gonzalez was born in Cordoba, Argentina, and earned her undergraduate degree in physics at that city's university. In 1989, she was pulled into the gravitational field of U.S. physics and attended Syracuse University, where she completed her doctorate in 1995. She first worked with the LIGO team from 1995 to 1997, and after a four-year stint on the faculty of Penn State University, returned to the observatory in 2001. She was promoted to assistant professor in 2004. Δ —**Steve Davolt**

Steve Davolt is a contributing writer for Interactions magazine.

Bridging the Gap

A unique collaboration helps pave the way for minority students to successfully transition from master's program to Ph.D.

BY KEIVAN GUADALUPE STASSUN AND ARNOLD BURGER



Native Americans together with Hispanic- and African-Americans comprise more than 25 percent of the U.S. population, yet they represent only 3 percent of all astronomy and astrophysics Ph.D.s earned. This translates, on average, to about four minority students earning a Ph.D. each year. Put another way, each of the roughly 50 astronomy and astrophysics Ph.D. programs in the United States awards a doctorate to a minority candidate once every 13 years. This pattern of underrepresentation has remained largely unchanged for the last 30 years.

In 1999, at an NSF-sponsored summit on Promoting National Minority Leadership in Science and Engineering, Richard Tapia, director of the Center for Excellence and Equity in Education, observed that to truly broaden minority participation requires that we identify and support nontraditional students, or "diamonds-in-the-rough," who are certainly capable, but have not been properly developed or evaluated.

Their potential can take a number of forms, depending on circumstances and the characteristics of the student. For instance, one student's undergraduate transcript might show a low GPA, which, on closer inspection, shows a slow start with an upward trajectory. Another may have an excellent GPA, but is missing critical upper-level courses that were not offered at his or her undergraduate institution.

Recruiting and developing students who don't meet traditional criteria for graduate school is analogous to the "farm" league in baseball. Rather than build a team by recruiting only immediate "starters," the aim is to identify unproven talent and provide the resources and training needed for that talent to blossom and to perform at a high level—the major leagues.

A Critical Link

Master's degree programs are on the rise in U.S. colleges and universities. Much of this growth can be attributed to increasing enrollment by traditionally underrepresented groups. Between 1990 and 2000, the total number of master's degree recipients increased by 42 percent. During this same time period, the number of women earning master's degrees increased by 56 percent; African-Americans increased by 132 percent; Native American Indians, by 101 percent; and Hispanics, by 146 percent.

A 2006 study conducted by S.E. Lange of the University of Washington provides valuable insight into the role of the master's degree as underrepresented minority students proceed to the doctorate in STEM disciplines. Data from the Survey of Earned Doctorates (SED) were used to examine institutional pathways to the Ph.D., and transitions from master's to doctoral programs by race and gender. According to Lange's study, White/Asian science students are more likely to forgo earning the master's degree en route to the doctorate altogether. For underrepresented minorities, however, pursuit of the master's degree can often be a critical interim step along the path to the doctorate. Unfor-

tunately, it is often a step fraught with the uncertainty and discomfort that can arise in the transition from one institution to another.

A program developed by Vanderbilt and Fisk Universities has taken careful consideration of cultural, logistical, and academic influences and modeled a new approach. Opportunities for students at Fisk, a historically black college located 1.5 miles from Vanderbilt, to earn graduate-level degrees in a physical science discipline tops out at a master's. The Fisk-Vanderbilt Masters-to-Ph.D. Bridge program (see www.physics.vanderbilt.edu/bridge) is designed for students who need (or want) additional coursework or research experience before beginning Ph.D.-level work.

The Bridge program is, in effect, predicated on the premise that the underrepresentation of minorities in the space sciences is one of the major challenges facing the United States' science, technology, engineering, and mathematics (STEM) workforce and that minority-serving institutions are a critical link in the higher education pipeline for underrepresented minority students.

The Fisk-Vanderbilt Masters-to-Ph.D. Bridge program was developed to (a) leverage the market forces that are driving underrepresented students in STEM fields to increasingly pursue a master's degree en route to the Ph.D., and (b) provide a path to the Ph.D. that includes deliberate mentorship as students cross the critical junctures that attend institutional transitions. Students are identified through strategic, faculty-led recruiting coupled with a paradigm shift in admissions decisions: Scout out talent early while it is still rough, provide the resources and training to allow that talent to blossom and mature without lowering standards or expectations, and in so doing sustain the future vitality of the program. Overall, program outcomes have been extremely positive.

Admission begins with application to the Fisk M.A. program in physics, which includes undergraduate transcripts, letters of recommendation, a personal statement, and general GRE scores. Once admission to the Fisk M.A. program has been formally decided by the Fisk faculty following Fisk's standard admissions procedures, admission to the Bridge program is determined by the Bridge program steering committee, consisting of three faculty members each from Fisk and Vanderbilt.

The primary recruitment vehicle of the Bridge program is faculty emissaries at minority-serving institutions and at national meetings of professional societies of underrepresented students. Both print and online advertising materials are broadly distributed and made highly visible through personal connections with minority-serving institutions and professional societies of minority scientists. However, reliance is primarily placed on research faculty to personally visit nearby institutions and to participate in national conferences. The recruiting function is too important to be relegated only to nonacademic staff; it is faculty—faculty who are positioned to convey the excitement of their research, who have discretionary authority to offer opportunities in their labs, and who are able to communicate their commitment to student success—who make the most effective recruiters.

Matt Payne

A key way by which the Bridge program is effectively advertised to minority students is to make use of faculty and current Bridge students attending the meetings of professional societies that represent minority scientists and engineers. The Fisk-Vanderbilt Bridge program has developed very close ties to three of these organizations in particular: The Society for the Advancement of Chicanos and Native Americans in Science (SACNAS), the National Society of Hispanic Physicists (NSHP), and the National Society of Black Physicists (NSBP).

In formulating an admissions strategy for the Bridge program, registrars have been forced to abandon the usual mindset of filtering applicants on the basis of proven ability to one of identifying applicants with unrealized potential that can be honed and nurtured.

Officially speaking, admission to the Bridge program does not constitute admission to the Vanderbilt Ph.D. program, nor does it carry with it a formal promise of admission to Vanderbilt in the future. The seeming appearance of a "back door" into the Ph.D. program and subsequent guarantee of admission at the outset might encourage passivity both in the students admitted and in the faculty mentors responsible for preparing them.

But this does not mean that the program makes no promises. On the contrary, Bridge students are guaranteed support and mentorship in a number of concrete forms. More importantly, Bridge students receive an explicit commitment that they will receive the personalized attention, guidance, and one-on-one mentoring relationships that allow students to develop—and to demonstrate—their full scientific talent and potential. The program has adopted the view that failures in student retention are programmatic failures. Of course, the proof is not in promises made but in real student outcomes.

The vehicle by which successful transitions to the Vanderbilt Ph.D. program are realized is through carefully orchestrated student-faculty mentoring relationships. Faculty mentors not only provide key guidance on course selection and research topics, they also become the student's most important advocates in the Ph.D. admissions process. The fact is that a student who is well known to the faculty of the admitting department is more likely to have his/her potential for success evaluated holistically and on the basis of direct faculty interaction, and not simply on how the student appears "on paper."

Indeed, fostering individual mentoring relationships between Fisk students and Vanderbilt faculty is at the very heart of the Bridge program, and is the guiding principle for all other programmatic design considerations. To that end, the Bridge program includes the following key elements, requirements, and benefits:

- Provision of full financial support in an amount that is standard for full-time graduate research assistants at Fisk University. *Rationale*: Financial burden should not be an impediment to full participation and satisfactory progress. Funding is provided through a combination of institutional support (e.g. tuition waivers) and extramural support, as appropriate, for a minimum of two years leading to the conferral of the M.A. degree. Core funding partners to date have included NSF and NASA, in combination with institutional funds from Vanderbilt in the form of dedicated "bridging fellowships" for Bridge students in their first year at Vanderbilt after completing the Fisk program.
- Assignment of both a primary Fisk adviser and a secondary Vanderbilt adviser. *Rationale*: Joint mentoring is the best way to track student progress and to ensure student readiness for Ph.D.-level work. For students who are certain of the area of research interest, every attempt is made to match the secondary adviser to that interest.
- Scheduling of at least two meetings per year with the Bridge program steering committee to review progress and receive guidance, in addition to the day-to-day interactions with primary and secondary advisers. *Rationale*: Keeping key personnel, particularly the directors/liaisons of the participating Ph.D. programs, abreast of student progress helps to keep each Bridge student on the Ph.D. program's "radar screen" and helps Ph.D. program directors in planning the needs of each year's incoming Ph.D. class.
- Participation in supervised research, at Fisk or Vanderbilt (or both), during at least the second academic year of the program, and participation in supervised research at Vanderbilt (or at a

In formulating an admissions strategy for the Bridge program, registrars have been forced to abandon the usual mindset of filtering applicants on the basis of proven ability to one of identifying applicants with unrealized potential that can be honed and nurtured.

Vanderbilt-affiliated research site) during at least each summer of the program. *Rationale*: Demonstrating research promise, skill, and maturity in the lab of a potential Ph.D. adviser is the single most effective way for students to develop relationships with faculty who can serve as recommenders and advocates.

- Requirement of at least B grades in all graduate courses, with at least one of these courses being a core Ph.D. course taken at Vanderbilt. *Rationale*: Demonstrating competency in a core Ph.D. course is essential to demonstrating promise for Ph.D. study. Together with a judicious selection of courses taken in fulfillment of the MA degree at Fisk, many Bridge students complete most of the course requirements for the Ph.D. by the time they apply to the Vanderbilt Ph.D. program.
- Provision of: cross-registration privileges for Vanderbilt courses through a memorandum of understanding between the two universities; Vanderbilt parking permit; Vanderbilt photo ID card, email account, and library access. *Rationale*: These privileges and benefits support the programmatic goals and elements listed above, and specifically enable course attendance and research participation. In addition, these services provide Bridge students with a sense of welcoming and belonging at the institution that they strive to call their home, and thus serve a critical retention function as well.

In addition to providing Bridge students with the one-on-one mentoring, coursework, and research experiences that form the program's core, a variety of ancillary programmatic elements have been implemented to form a scaffold of support that helps to ensure student retention and satisfactory progress. These include:

- Annual program orientation and kickoff. A mandatory, all-hands meeting each fall serves to welcome and initiate new Bridge students with a celebratory and community-building event.
- Social support structure. We have helped the students organize an informal social group (the "Bridge Club") with student officers who serve as a conduit for program information between faculty and students. An electronic calendar system keeps students reminded of departmental events (colloquia, journal clubs, etc.) and of important deadlines (e.g., course registration). The club includes senior Bridge students as well as Vanderbilt graduate student mentors who can share their experiences and provide access to social networks at Vanderbilt.
- GRE preparation study sessions and tutoring. The subject GRE is but one component of the whole system of assessments by which Bridge students are holistically evaluated for admission to the Vanderbilt Ph.D. program. Nonetheless, it is a formal requirement, and we want to help students perform to the maximum of their ability.
- Early identification of course difficulties and proactive intervention are essential to bolstering success in the critical core graduate courses that form an essential component of student retention. The courses that Bridge students enroll in and the progress they make are monitored as part of the advising process. Instructors promptly notify Bridge coordinators at the first signs of concern. One-on-one tutoring is provided, as needed, by advanced graduate students, and course-load adjustments are made mid-stream if it is determined that remedial instruction is required before reenrolling in the course.
- Encouragement in fellowship applications and conference participation. All Bridge students are required to apply for national fellowships and to submit abstracts to national conferences. This provides critical skills in grants development, communication, and professional networking.

Since its inception in 2004, the Fisk-Vanderbilt Masters-to-Ph.D. Bridge program has attracted a total of 18 underrepresented students. Of these, 16 have either already transitioned to the Vanderbilt Ph.D. program of their choice or are making satisfactory progress toward that goal, a retention rate to date of approximately 90 percent. These initial outcomes reinforce the efficacy of the approach and suggest that the program may well serve as a model for other programs built on active partnerships with minority-serving institutions.

To be sure, the Fisk-Vanderbilt Bridge program is not for all students, nor is it intended to be. Students with strong undergraduate backgrounds will usually want to enter a Ph.D. program directly, and will not seek nor require this type of bridging opportunity. In these cases, the Bridge program can play an important recruiting role, conveying as it does a serious commitment to student success. Indeed, in the time since partnering with Fisk to develop the Bridge program, Vanderbilt University has witnessed a significant increase in the number of strong minority students applying—and gaining admission—directly to the Ph.D. program. Δ

Keivan Guadalupe Stassun of Vanderbilt University's Physics and Astronomy Department and Arnold Burger of Fisk University's Physics Department are members of the Bridge Program Oversight Committee.

2007 SUMMER MEETING

JULY 28 - AUGUST 1

Joseph S. Koury
Convention Center
Greensboro, NC

AAPT GREENSBORO 2007

Greensboro: A City of Connections

Beautiful parks and recreation areas, historical sites, educational institutions, dining, and nighttime entertainment will greet you in Greensboro, NC. Nestled in the Piedmont Triad area along with Winston-Salem and High Point, Greensboro is host to AAPT's 2007 Summer Meeting beginning July 28.

History of Greensboro

Saura and Keyauwee Indians were the earliest inhabitants of Piedmont North Carolina. Permanent settlement of the area by Europeans began around 1740. The city is named after Maj. Gen. Nathanael Greene, who led 4,400 American rebels in three battle lines at Guilford Courthouse on March 15, 1781. Gen. Cornwallis held the field after an intense two-hour fight, but lost one-quarter of his army, which hastened his eventual defeat at Yorktown seven months later.

The town was officially formed in 1807. By the mid-1800s the seeds for its future as a textile, insurance, and transportation center had been planted. In 1828 the first textile mill opened, and in 1850 the first insurance company opened. The first coeducational institution in North Carolina was established here in 1837 by Quakers. Called the New Garden Boarding School, it continues as Guilford College today. Quakers here also established the first Underground Railroad in the 1830s. North Carolina was the last state to secede from the union during the Civil War.

The textile industry and the railroad contributed to progress into the 20th century.

In 1960, Greensboro was the site of the first Civil Rights era sit-in, when four African-American students from N.C. A&T University refused to accept a lunch counter color bar. Today they are memorialized with a statue on the campus of N.C. A&T. The original lunch counter at the Woolworth Building is to be the centerpiece for the International Civil Rights Center and Museum, currently under construction.

Education

The University of North Carolina at Greensboro is part of the University of North Carolina system, which was the first public university to open in the nation. The city is home to several other universities and colleges, including: Bennett College for Women, Elon University School of Law, Greensboro College, Guilford College, Guilford Technical Community College, and North Carolina Agricultural & Technical University.

Things to Do in Greensboro

- **Blandwood Mansion:** The former home of Governor John Motley Morehead, this beautiful mansion is surrounded by four acres of beautiful gardens. The main structure, an example of Italianate architecture, was built onto an original four-room farmhouse that was constructed on the site in the 1790s. (447 West Washington St., Greensboro.)
- **Natural Science Center:** This hands-on museum features a zoo, an aquarium, a planetarium, educational programs, and an educational gift shop. Visitors can roam through a Dinosaur Gallery, see snakes and amphibians in the Jaycee Herpetarium, learn about gems and minerals, and enjoy a petting zoo while at this center. (4301 Lawndale Drive, Greensboro.)
- **Greensboro Historical Museum:** Discover American history through the stories of Piedmont people and events in 12 galleries and two restored houses. (130 Summit Ave., Greensboro.)
- **The Guilford Courthouse National Military Park**: A memorial to the March 15, 1781 Revolutionary War Battle, it's located off U.S. Highway 220 at 2332 New Garden Road.
- **Greensboro Children's Museum**: store and more. (220 N Church St., Greensboro.)
- **Wet 'n Wild Emerald Pointe:** water park located on S. Holden Road. (www.emeraldpointe.com)
- North Carolina is home to 61 wineries, including wine tasting vineyards. Guilford County has Grove Winery and Stonefield Cellars Winery, where tours and tastings, along with sales, are available. See www.ncwine.org for details.
- Greensboro Scenic Tours, history comes alive through costumed interpreters who reveal the city's past through the eyes of the people who lived it. (301 S. Greene St., Suite 12; 336-697-7275.)

Shopping

- The Shops at Friendly Center – includes Macy's, Banana Republic, Old Navy, Ben and Jerry's, and more.
- State Street Station – 35 specialty shops, restaurants, and boutiques housed in elegant refurbished 1920s vintage buildings.
- Four Seasons Town Centre – recently renovated mega mall with Dillard's, Belk, Ann Taylor, more.
- Replacements Ltd. – tour showrooms, museum, warehouse, and restoration facility of the world's largest retailer of old and new china, crystal, flatware and collectibles.

Transportation

Piedmont Triad International Airport is served by six major carriers. Amtrak and Greyhound Bus also serve the area. Interstates 40, 85, and 73/74 all intersect in Greensboro.

Weather

The warmest month of the year is July, with an average maximum temperature of 88.20 degrees F. Temperature variations between night and day tend to be moderate during the summer with a difference that can reach 22 degrees. The annual average precipitation at Greensboro is 46.92 inches. Rainfall is fairly evenly distributed throughout the year. The wettest month of the year is July, with an average rainfall of 4.73 inches.

More Information

Sheraton Greensboro/Koury Center
http://www.kourycenter.com/default.shtml
Greensboro Convention and Visitors Bureau
www.greensboronc.org/
Greensboro Chamber of Commerce
www.greensboro.org

Our Featured Awardee Speakers

Neil deGrasse Tyson
Astrophysicist and Director, Hayden Planetarium at the American Museum of Natural History, New York

2007 Klopsteg Memorial Award

In recognition of a notable physicist with extraordinary accomplishments in communicating the excitement of physics to the general public.

Award presentation: Monday, July 30, 2007, at 2:00 p.m
Dr. Tyson will present his Klopsteg Memorial Lecture on "Adventures in Science Illiteracy."

Dr. Tyson earned his B.A. in physics from Harvard University in 1980 and his Ph.D. in astrophysics from Columbia University in 1991. From 1991–1994 he was a post-doctoral research associate at Princeton University. Tyson's professional research includes star formation, exploding stars, dwarf galaxies, and the structure of the Milky Way.

In 2001, Tyson was appointed by President George W. Bush to serve on a commission that studied the Future of the U.S. Aerospace Industry. In 2004, he was appointed again by President Bush to serve on a commission on the Implementation of the United States Space Exploration Policy.

In 2006, Michael Griffin, the head of NASA, appointed Tyson to serve on his prestigious Advisory Committee. Tyson is the recipient of eight honorary doctorates and the NASA Distinguished Public Service Medal. His contributions to the public appreciation of the cosmos have been recognized by the International Astronomical Union in their official naming of asteroid "13123 Tyson."

David R. Sokoloff
Professor of Physics, University of Oregon, Eugene

2007 Robert A. Millikan Award

In recognition of educators who have made notable and creative contributions in physics education.

Award presentation: Tuesday, July 31, 2007, 11:00 a.m.
Dr. Sokoloff will give an address "Building a New, More Exciting Mousetrap Is Not Enough!" a review with lessons from his two decades of work in physics education research and curriculum development.

Dr. Sokoloff began his physics education at Queens College of the City University of New York, and went on to earn his Ph.D. in AMO physics from the Massachusetts Institute of Technology in 1972. He has been on the physics faculty of the University of Oregon since 1978. For more than two decades, he has conducted research into students' understanding of physics, and used the results of physics education research to develop active learning laboratories and interactive lecture demonstrations that connect students to the behavior of the physical world. Since 1999, he has been part of a UNESCO team presenting active learning workshops in Australia, Vietnam, Korea, Sri Lanka, Ghana, Tunisia, Morocco, India, Tanzania and Brazil. He is a previous recipient of AAPT's Distinguished Service Citation (1997).

Jan Mader
High School Teacher, Great Falls High School, MT

2007 AAPT Excellence in Pre-College Physics Teaching Award

In recognition of contributions to pre-college physics teaching and awardees are chosen for their extraordinary accomplishments in communicating the excitement of physics to their students.

Award presentation: Wednesday, August 1, 2007, at 11:00 a.m
Ms. Mader will present the award lecture "Those Who Can Teach."

Ms. Mader earned her Bachelor of Science degree in physics with an educational endorsement from Montana State University. She was awarded a NASA Fellowship in 1990 and received a Master of Science degree from the University of Northern Iowa in 1991 with an emphasis in physics education. Her active affiliation with AAPT and the Physics Teaching Resource Agents (PTRA) program began in 1987 and she became an official PTRA in 1992. She has authored or coauthored curriculum for Waves, Optics, and Holography for Montana State University's STIR Program, Space Science Projects and Activities for Secondary Education (S.P.A.S.E.), for the Iowa Space Consortium, the NSF Comprehensive Conceptual Curriculum for Physics: C3P Project, NSF PRISMS Enhancement Project, and many resource guides for AAPT.

Steven L. Manly
Associate Professor, Dept of Physics & Astronomy, University of Rochester, NY

2007 AAPT Excellence in Undergraduate Physics Teaching

In recognition of contributions to undergraduate physics teaching and awardees are chosen for their extraordinary accomplishments in communicating the excitement of physics to their students.

Award presentation: Wednesday, August 1, 2007, at 11:30 a.m
Dr. Manly will present the award lecture "Experiences in Collaborative Learning at the University of Rochester—It's All in the Shoes."

Dr. Manly graduated from Pfeiffer College in 1982, earned a Ph.D. in experimental high-energy physics from Columbia University in 1989, and was a Yale faculty member from 1990 to 1998 before moving to his current position. His research interests are high energy, nuclear, and gravitational physics, with a focus on the nature of matter and the fundamental forces of nature.

Manly has published more than 150 articles in scientific journals. His efforts in the classroom have focused on large introductory physics courses for both physics and non-physics majors. Since arriving at Rochester, Manly has adopted proven group learning techniques to support his courses and then worked with other faculty in order to institutionalize the use of these techniques in the introductory physics curriculum.

Gerald F. Wheeler
Executive Director, National Science Teachers Association, Arlington, VA

Plenary Speaker I: "The Many Ways to Do Physics"
Presentation: Monday, July 30, 11:00 a.m.-Noon

Dr. Wheeler received an undergraduate degree in science education from Boston University, and a Master's degree in physics and a Ph.D. in experimental nuclear physics, both from the State University of New York at Stony Brook.

As the Executive Director of the National Science Teachers Association (NSTA), Gerald Wheeler heads the world's largest professional organization representing science educators of all grade levels. Prior to joining NSTA, Wheeler was Director of the Science/Math Resource Center and Professor of Physics at Montana State University. He also headed the Public Understanding of Science and Technology Division at the American Association for the Advancement of Science (AAAS) and has served as President of the American Association of Physics Teachers (AAPT).

For much of his career Wheeler has played a key role in the development of mass media projects that showcase science for students. He was involved in the creation of 3-2-1 Contact for the Children's Television Workshop, served on advisory boards for the Voyage of the Mimi and the PBS children's series CRO, and created and hosted Sidewalk Science. Wheeler is the recipient of numerous awards for his teaching and mass media work, including outstanding teaching awards from Temple University, the University of Hartford, and Montana State University, as well as the AAPT Millikan Award.

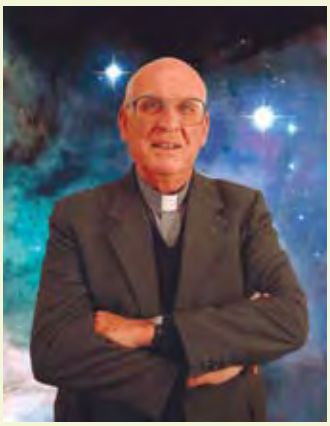
Janet Guthrie
President, Guthrie Racing LLC, Aspen, CO

Plenary Speaker II: "Racing As Metaphor"
Presentation: Tuesday, July 31, 2 p.m.- 3 p.m.

Ms. Guthrie graduated from the University of Michigan with a B.S. in physics, and then joined Republic Aviation in Farmingdale, NY, as a research and development engineer, working on aerospace programs.

Before becoming the first woman ever to compete in the Indianapolis 500 and the Daytona 500 in 1977, Janet Guthrie had a diversified background. She was a pilot and flight instructor, an aerospace engineer, a technical editor, and a public representative for major U.S. corporations. She had 13 years of experience on sports car road-racing circuits, building and maintaining her own race cars, before being invited to test a car for Indianapolis. She finished ninth in the Indianapolis 500 in 1978, with a team she formed and managed herself. Her 2005 autobiography, *Janet Guthrie: A Life at Full Throttle*, was described by *Sports Illustrated* as "an uplifting work that is one of the best books ever written about racing."

Drawing on her difficult and sometimes hilarious experiences as the first woman ever to compete in this country's major oval-track auto races, Guthrie speaks of the qualities necessary for anyone to be successful on a fast track.



George Coyne
Adjunct Professor of Astronomy, University of Arizona, Tucson
(Former Director of the Vatican Observatory, Rome)

Plenary Speaker II: "Dance of the Fertile Universe: Cosmic and Human Evolution"
Presentation: Wednesday, August 1, 2 p.m.-3 p.m.

George Coyne obtained his Ph.D. in astronomy from Georgetown University (Washington, DC) in 1962 and the Licentiate in Theology from Woodstock College (Maryland) in 1966. In addition he has received Ph.D. degrees honoris causa from St. Peter's University (New Jersey), Loyola University (Chicago), The University of Padua (Italy), the Jagellonian University (Krakow, Poland), and Marquette University (Milwaukee).

Since 1966 he has been associated with astronomy programs at the University of Arizona (Tucson), and from 1976 to 1980 he served in various capacities in the administration of the astronomical observatories at that university.

From 1978 until 2006 he was Director of the Vatican Observatory (Specola Vaticana), which has its headquarters at Castel Gandolfo (Rome, Italy) and a research branch at the University of Arizona in Tucson. His research interests have ranged from the study of the lunar surface to the birth of stars; and he pioneered a special technique, polarimetry, as a powerful tool in astronomical research. Currently he is studying cataclysmic variable stars, the interstellar dust in the Magellanic Clouds, and the detection of protoplanetary disks.

When We're Not Alone

BY CANDACE PARTRIDGE

What could be better than leaving London, England, in January and traveling to Los Angeles, California? How about receiving a grant to attend the second annual Conference for Undergraduate Women in Physics at the University of Southern California? In fact, it was my first trip to a physics-related conference, and, furthermore, I was a wee bit outside what you might consider the "target demographic." See, I am still a lowly undergrad—I use the word "still" because, at that time, I was pushing 30 years old and not yet halfway toward earning my bachelor's degree in physics. But it didn't matter. I am happy to mix with people of all sorts, especially other women who are studying physics; let's face it, some of us still feel a little alone in this field.

People ask me all the time why I am studying physics, why I put myself through the hell of managing a full-time career in IT while attending classes in the evenings. The truth is I've always wanted to study physics, but despite my raging curiosity about the universe, for the first half of my earthly existence I believed that I was awful at math and anything really worth doing should come effortlessly—that is, not require any pesky studying. It is why I ended up with an English degree. In my dotage, however, I have gradually come to have great respect for hard work. Also, I have found that there is no shame in studying, and I'm not really bad at math. I've just been allergic to, you know…trying.

Now I spend nine months out of the year trying very hard indeed, and barely seeing the light of day even on the weekends. Every term or so I hit a low point where I have that "come-to-Jesus" moment when I sit down and wonder why I am inflicting such agonies of the spirit upon myself—that surely it would be easier to just quit and be happy with my nice, stable project management job, along with the nice, stable income. For those times when I do hit the wall, having stored up some inspiration from somewhere is crucial, which is precisely why I decided to attend the USC conference for women in physics.

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While the proceedings were liberally sprinkled with technical talks covering topics from neutrino physics to spin electronics, the focus was on the life advice offered by women currently in the trenches and those who spent years digging the trenches.

A particular highlight was a talk on advancing women in physics by a straight-shooting dean from Delaware State University named Beverly Hartline. Following her talk, I asked Dr. Hartline for the best way to respond to men who claim that encouraging women to enter the field of physics would lower the bar and foster too much competition. Hartline scoffed and replied, "Lowering the bar? We're raising the bar by expanding the pool of talent."

There were inspirational women present from many areas of physics—like K.C. Cole, who gave an impassioned talk about her joy of learning physics and of being a science writer. Her enthusiasm was contagious, and when I asked how one gets started in science writing, her advice was to "just do it!"

Although there were women representing all fields of physics, none were more inspirational (or intimidating) than the students who gave talks on their research work. I sat in the audience not only awed by their knowledge and dismayed at my own lack of research experience, but also inspired to do something about the disparity.

Speaking from personal experience, sitting in a room full of physics students where the vast majority are women is a strange experience. But stranger still were the long lines at the bathrooms during the breaks—typically, a female physics student is used to having the entire restroom to herself.

It was also unusual to attend a physics-related gathering and feel—how do I say it?—socially comfortable. It seemed that as a group of female physics students, we challenged a lot of traditional stereotypes about women and physics, but were responsible for a new generalization: We are definitely a very cool and very funny bunch of people to hang out with, not at all nerdy—even if we did gush over the webcomic xkcd and I carried my math homework everywhere.

Later, in the car on the way home from the airport, my mom asked me

The author, momentarily alone, contemplates the Undergraduate Women in Physics Conference.

about the conference. Specifically, she wanted to know "what was this conference for." I explained that the point was to sort of boost the morale of undergraduate women physics students so that we would have some momentum to carry us through graduate school or wherever life takes us. "Yes, but why just for women," she demanded. "Who cares?"

A bit puzzled, I said, "Because there aren't that many of us. We're under represented."

"Well, you know," she said, starting up her usual argument, "men's and women's brains are just different. It's just genetics you know. Women are naturally better at things like English. You're just a special one." Then she laughed.

"This is exactly the sort of crap that we're fighting against, and it's even worse that women themselves buy into it," I argued. "Thinking like that is what made me get an English degree, because I thought I wasn't good enough to do math—and you can see that's not true at all."

After finishing my spiel, I thought about the women in physics conference and that roomful of engaging and intelligent women, and I realized how good it feels to know that I'm neither special nor alone. Δ

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Physics Takes Oklahoma by Storm

Weather program at OSU and OU piques students' interest in physical sciences

BY WILSON J. GONZÁLEZ-ESPADA AND ANDREA D. MELVIN

Clearly, in today's highly technological environment, scientific literacy has become a political and economic imperative. Many of our everyday decisions are based on our scientific knowledge and ability to work with scientific data. Arguably, the types of data most accessible to students are related to physics applications, meteorology in particular. However, without access to real-world data to analyze and interpret, it is a challenge for students to gain a better understanding of scientific methods and principles. Weather affects students' lives every day, from the clothes they wear to the games they play. Analyses of weather data promote interesting discussions on physics concepts such as temperature, pressure, light, and density. And because everyone experiences weather, students bring a vast array of personal knowledge and perspectives into the conversation.

For students in grades 5-12 there are many advantages to working with weather data. For instance, students can personally experience weather phenomena such as changes in wind direction or temperature. Also, the data is contextually relevant because it is particular to the students' state or region; consequently, students are better motivated to understand how weather data are analyzed and to place it in a broader regional and national context. Another reason is students eventually understand the interdisciplinary nature of science as they learn how meteorology, geography, ecology, mathematics, chemistry, and physics are interconnected.

According to local teachers, one of the more encouraging advantages, however, has been the participation of female and minority students, as well as other students who are typically not interested in science classes. They may find working with real-time weather data a more interesting and engaging way to learn science.

Oklahoma Mesonet is a world-class network of environmental monitoring stations. The network was designed and implemented by scientists at the University of Oklahoma (OU) and Oklahoma State University (OSU).

Teaching Climatology

The Oklahoma Climatological Survey (OCS) was established around 1980 to provide weather services to the citizens of Oklahoma, conduct research on the impact of climate on human activities, and provide educational outreach. OCS provides weather data, hands-on instruction, consumer-grade software, reference materials, classroom lessons, and mentorship for K-12 teachers and students. The main source of this weather data is the Oklahoma Mesoscale Network (OK Mesonet).

OK Mesonet, a partnership between the University of Oklahoma and the Oklahoma State University, is a world-class network of environmental monitoring stations consisting of 116 automated measurement stations covering all 77 counties in Oklahoma. Every five minutes, the solar- and battery-powered outposts measure air and soil temperature, wind speed and direction, solar radiation, relative humidity, atmospheric pressure, and amount of rainfall. The weather data from each station is transmitted to a computer located at a police station (Oklahoma Law Enforcement Telecommunications System) and then to the central analysis center located at the University of Oklahoma in Norman, Oklahoma.

Although data from OK Mesonet is used in weather forecasting, agriculture, public safety, and a variety of business purposes, it also has significant educational applications. For example, through a nationally recognized outreach program of OCS called EarthStorm, education professionals help middle-school teachers and students gain familiarity with using computers and implementing learning activities that incorporate real-time weather data.

EarthStorm offers science teachers quality instruction on how to access, use, and apply national and state weather data and resources. In addition, teachers learn how to create inquiry-based activities for students. A particularly successful service is a four-day summer workshop for teachers interested in helping students explore weather phenomena, and design and implement science fair projects. (The workshop is free for Oklahoma and Kansas teachers.)

In addition, students have access to online lessons on meteorology, geography, mathematics, and technology. Other lessons offer instruction on reading legends and maps; computing averages, maxima, and minima; working with fractions, percentages, ratios, and decimals; and solving simple algebraic and trigonometric equations.

Students can also connect with meteorologists and other scientists, who serve as mentors to help students further improve their understanding of the science concepts. Each mentor has his or her own website, which includes the sort of information students need to find the appropriate person. The result is students are learning about meteorology, in particular, and scientific methodology, in general, directly from scientists.

Fair Play at Mesonet

Every February, OCS hosts the Oklahoma Mesonet/Atmospheric Radiation Measurement Science Fair on the University of Oklahoma campus. Students, separated into junior (K-7) and senior (8-12) categories, compete on a wide range of weather-related areas, such as agriculture and biology, behavioral sciences, climatology, forecasting, solar radiation, technology and economics, and weather systems. Members of OCS partner organizations serve as judges. In past years there has been on average 75 to 100 projects represented, with 175 to 200 student participants at the fair.

Because the Oklahoma Mesonet science fair takes place in February, students have an opportunity to improve their projects before entering other science fairs. In fact, several students have won awards at the state and national levels after making modifications suggested by the OK Mesonet judges. (To review some of the projects, visit the EarthStorm website at http://earthstorm.ocs.ou.edu.)

The impact of OK Mesonet and EarthStorm on Oklahoma students has been a tremendous sense of ownership and confidence. When students watch news coverage of the weather, they know the reporter is relying on the same data they access in class. Another example of enhanced student confidence and understanding comes from the parents, who acknowledge to participating teachers how much they have learned about the weather from their children. Δ

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The success of EarthStorm can easily be replicated in other states by accessing data from a local National Weather Service office.

To find a local office, visit the National Weather Service website at: www.nws.noaa.gov.

Additional resources:

Oklahoma Mesonet – Interactive maps and graphs of current state data, including the Oklahoma Fire Danger Model. www.mesonet.ou.edu

NOAA satellite – Images from NOAA's geostationary orbiting satellites. www.noaa.gov/satellites.html

ARM data – Interactive maps of recent data from the Atmospheric Radiation Measurement Program. www.arm.gov/data

NWS products – Images and text files of forecasts, watches, and warnings from the National Weather Service. www.nws.noaa.gov

NEXRAD – Local, regional, and national interactive maps from the Next Generation Radar (or WSR-88D Doppler radar). www.wunderground.com/radar/map.asp

Freeware programs known as WxScope and WeatherScope are available for download at the EarthStorm website: http://earthstorm.ocs.ou.edu. These provide a user-friendly interface for student data collection and analysis.

Minority Report

Chances are if you are an undergraduate physics student, none of your professors are Hispanic or African-American

BY RACHEL IVIE

The number of African-American and Hispanic faculty members in physics departments is low. Primarily because both groups are part of an underrepresented population of earned Ph.D.s in physics. In 2004, there were just 171 African-American and 223 Hispanic faculty members for 760 physics departments in the United States. The majority of physics departments have no African-American or Hispanic faculty members.

Number of African-American and Hispanic Physics Faculty by Department Type, 2000 and 2004.

	Type of Department		
	Ph.D.	Master's	Bachelor's
2004			
African-American	64	29	78
Hispanic	107	56	60
2000			
African-American	38	41	62
Hispanic	81	32	42

AIP Statistical Research Center: 2004 AWF Survey

African-American physics faculty work primarily at departments in the Historically Black Colleges and Universities (HBCUs). Of the 64 African-American physics professors at Ph.D.-granting departments, 28 work at just three HBCUs—Howard, Hampton, and Florida A&M University. There are only 12 bachelor's-granting physics departments that have more than one African-American faculty member, of which 10 are HBCUs.

Compared to African-Americans, Hispanic physics professors are not concentrated at certain universities. Still, only half of all Ph.D.-granting physics departments and only eight percent of 500 bachelor's-granting physics departments have an Hispanic physics professor.

Because of the low representation of African-American and Hispanic physics professors, most students never see a physics professor who is not white or Asian-American. When African-American and Hispanic students see no professors who look like them, they may have a difficult time seeing themselves as physicists. Δ

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