



“Teachers” Change Our Lives: Midwest Son to Miami *Star Gazer*

“Twinkle, twinkle little star, how I wonder what you are”

Anonymous



A simple yet direct inquiry with far-reaching implications because this simple question is probably what started it all for most American astronomers, professional or amateur. I'm no exception.

Raised in rural Wisconsin in the 40's, long before mercury and sodium vapor lights blotted out the wonders of the night sky, on most moonless nights I could reach up and almost touch the

Milky Way. Most urban children today haven't seen it outside of a planetarium. My Irish grandfather Edmund Foley got me started with, what else, the Big Dipper and Orion. My equally Irish grandmother Mary Foley assured me that whenever I saw a meteor it was some relative's soul on its way to heaven, which always puzzled me because it looked like they were going in the wrong direction. My publisher parents Arthur and Mary Foley Horkheimer did the cultural season every year in Chicago and my father considered no visit complete without a trip to the Adler Planetarium, the very name of which still warms my heart. A magnificent high school physics teacher John J. Scott, S.J. turned each class into a Broadway production number. Then in my late 20's I met Arthur P. Smith, past president of the Astronomical League, Southern Cross Astronomical Society and the Miami Science Museum, who asked me to write a show for the newly opened Space Transit Planetarium in 1967 where eventually my avocation became my vocation until my semi-retirement in October '09.

It wasn't the way I planned any of it. You see I am not what I would call a professional astronomer. I am more what my grandfather would call an Irish Seanchai, a storyteller. From childhood I was blown away by mythology and legend, be it ancient Egyptian, Greek, Roman or that of the Indians of Wisconsin Dells whose mythic tales could send me reeling into an alternate universe and which I still love to share.

The Miami Planetarium was struggling financially in 1967 and I saw a rare opportunity to turn what was essentially a classroom into a multi-media dome where I could translate science into adventure. It worked! And for 20 years the Miami Planetarium was the most cost effective in the country. But as the Apollo program died down people lost interest and because we had no money for advertising I knew that TV was the only way to go. So I agreed to do several half-hour specials for Miami's PBS station WPBT Channel 2 in exchange for a five-minute nightly-at-sign-off How-To-Find-The-Stars-and-Planets-of-the-Week show. It was called “Star Hustler” and originally it was simply an advertising device to make people aware that the Planetarium was still there so they'd come keep us solvent with their tickets.

It began on November 4, 1976 with “Some people hustle pools, some people hustle cars. But have you ever heard about the man who hustles stars? Here he is to tell you all about the night sky and the biggest show of all, the Universe.” Just before we taped our first show I had forgotten to choose a theme song so I grabbed an LP an RCA sales rep had given me from a stack they weren't interested in promoting which I could use for free, the operative word being free. I hastily picked an electronic version of Debussy's Arabesque #1 on an album called “Snowflakes Are Dancing” by a little known electronic musician named Tomita. And it seems that both the TV show and Tomita immediately caught on, first throughout Florida, then throughout the U.S. and later internationally.

It still reaches millions of viewers a week. But it started simply as a hook for future planetarium patrons. Or as I like to say, “Each show is a celestial hors d'oeuvre. We want to make you hungry for more, so you'll visit your nearest planetarium, astronomy club, science center, or go online to feed what I hope will become a star gazing addiction.” I had no idea where it was going to lead and didn't even want to do the show. It was simply a means to an end. And for the first ten years I was terrified every time I appeared on camera. Today I realize the TV show became much bigger than the Planetarium itself. And like every one of you who teaches astronomy, my greatest satisfaction is in having a science teacher, astronaut, student, etc. call or write to thank me for getting them interested in the night sky just like my grandfather and father, the Adler Planetarium, Father John Scott and Art Smith did for me.

SPaRk

The AAS Education Newsletter
June 2010, Issue 10



Published by:
The American Astronomical Society
2000 Florida Avenue, NW, Suite 400
Washington, DC 20009-1231
202-328-2010, aas.org

© 2010

Editors:

Gina Brissenden
Center for Astronomy Education,
Steward Observatory, University of Arizona
Jacob Noel-Storr
Center for Imaging Science,
Rochester Institute of Technology

Layout:

Crystal M. Tinch

Education Officer:

Timothy F. Slater, Chair
University of Wyoming

Astronomy Education Board:

Guy Consolmagno, (Vatican Obs.)
Laura Danly, (Griffith Observatory)
Ann Aidle Esin, (Harvey Mudd College)
Heidi B. Hammel, (Space Science Institute)
Edward E. Prather, (Center for Astronomy
Education (CAE) Univ. of Arizona)
Gerard Mark Voit, (Michigan State Univ.)
Sidney Wolff, (NOAO)

(ex-Officio):

John Huchra, AAS President
Kevin Marvel, AAS Executive Officer

The views expressed in this newsletter are those of the individual contributors, and not necessarily those of the American Astronomical Society, the Astronomy Education Board, or the Editors.

**To subscribe send email
to membership@aas.org**

In This Issue

Welcome to this issue of *Spark!*



Though slightly belated, we are sure that you will find this issue is packed with a bumper crop of great articles! Jack Horkheimer (Miami Science Museum) kicks the issue off with his account of his journey into astronomy education and the creation of *StarGazer*.



Also in this issue, we'll hear from all of the current members of the Astronomy Education Board as they introduce themselves to our readers, and the introductions continue further through the issue as our new Press Officer and Education & Outreach Coordinator, Richard Feinberg, describes his new role within the AAS. We'll hear about the development of the *Solar System Concept Inventory* from Seth Hornstein (UC Boulder), as well as learn about *From Earth to the Universe* from Megan Watzke and Kimberly Arcand of the Chandra X-ray Center. Dennis Schatz of the Pacific Science Center tells us about *Portal to the Public*, and the LBNL's Carl Pennypacker presents the *Galileo Teacher Training* and *Global Hands-On Universe* programs. Those teaching courses for majors will enjoy a discussion of active learning in upper-level classes by Marshall Perrin and Andrea Ghez (UCLA). Adrienne

Gauthier (Univ. Arizona) brings us up to date on the world of virtual astronomy. In policy, Ted Hodapp (American Physical Society), discusses how scientists can help increase the science literacy of the next generation. We'll also hear from several of our columnists, and we'll catch up with what's new in *Astronomy Education Review*.

We encourage all members of the community to contribute articles to Spark, which is published twice a year to coincide with the AAS national meetings. If you are interested in making a contribution, we recommend sending us a brief description of your proposed contribution in advance so that we can discuss your idea and suggest a suitable article length (generally around either 400 or 800 words). Our editorial meetings are held in February and September of each year, so suggestions received before those months are easiest for us to incorporate. Article deadlines are March 1 for the issue released at the summer meeting, and October 1 for the winter meeting issue. We look forward to discussing your ideas for contributions, and to reading your articles!

Gina Brissenden & Jake Noel-Storr
Editors

spark@aas.org

How Teachers Change Our Lives continued

Art Smith always said that astronomy was the ‘mother of all the sciences’ and I’d like to add that I believe it’s also the ‘mother of all the arts’ because once you become hooked on the wonder of the night sky you realize that every human discipline is somehow magically linked to it and that discovering the night sky is ultimately self-discovery. So whenever I meet someone who is head-over-heels in love with astronomy, I know that I’m face-to-face with the 21st Century’s versions of Renaissance Man and Renaissance Woman. And I am always humbled and in awe of those professionals who are at the forefront of research, because as each new wonder of the Universe is discovered in this greatest age of all discovery, I know I’ll have yet have more magic to weave into my story telling in the hopes that my cosmic hors d’oeuvres will whet yet new appetites. Perhaps the following piece of poesy from a multi-media show I wrote for NASA a quarter of a century ago expresses my passion for astronomy best:

“STARBOUND”
A Space Age Fable

Once upon a time . . .
In a galaxy not so far away . . .
There existed a creature strange
With an insatiable thirst for knowledge.
Now this is the peculiar part:
The more it learned, the less it knew.
For with every answer, came another question.
Now this is the beautiful part:
Of all the creatures thirsts,
This one brought him closest to the Gods.

Oh, by the way... Keep Looking Up!

Jack Foley Horkheimer
Executive Director of the Space Transit Planetarium
Miami Science Museum



Photo 1: At the Society banquet, AAS President John Huchra (CfA) gave Jean and Ric Edelman of Edelman Financial Services a certificate of appreciation for their generous donation of 15,000 Galileoscope kits to U.S. schoolteachers. **Photo 2:** CAE/AAE Educators Reception: Erik Fahlgren (W. W. Norton & Co., Inc.—reception sponsor) and Gina Brissenden (CAE, Univ. of Arizona—one of the reception organizers) pose for a moment before the crowd arrives for free cocktails and the chance to network and socialize—thanks, Norton! **Photo 3:** Ty Jones and Stephen DeCamp of Michigan State University Science Theatre are old hands at making astronomy exciting for kids—grabbing the attention of other astronomers is more challenging. **Photo 4:** Hundreds of students attended Sunday’s undergraduate reception to learn about summer internships and graduate programs in astronomy. Among them were (L to R) Eric Geier, Brittin Borland, Sarah Friberg, Alicia VonLanken, and Michael Huff, all currently or formerly of Indiana University. **Photo 5:** Renee James (Sam Houston State Univ.) and Neil de Grasse Tyson (American Museum of Natural History) pose for a picture to make Renee’s son jealous.

Meet the Astronomy Education Board



L-R: Guy Consolmagno, Laura Danly, Ann Aidle Esin, Suzanne Gurton, Heidi Hammel

Brother Guy Consolmagno (Vatican Observatory)

I'm past chair of the Division for Planetary Sciences and a full-time researcher in meteorites and trans-Neptunian objects, but I love the classroom; I take sabbaticals to teach astronomy—most recently at Fordham University and LeMoyne College. And I spend half my year giving public talks, often to faith-based groups. I've also written several popular books for amateurs (notably the bestseller *Turn Left at Orion* with Dan Davis of SUNY Stony Brook). My goal is to promote astronomical education outside of the classroom, as well as in more traditional settings. The sky belongs to everyone!

Laura Danly (Griffith Observatory)

When I was a post-doc at Space Telescope Science Institute, Eric Chaisson (then head of Outreach) said to me with pity, "You've been bitten by the bug." He meant the education bug, and the pity stemmed from the fact that, in 1987, education was still not a very promising path for a newly-minted PhD. Thankfully, things are different today. The astronomical community has, for the most part, embraced the importance of communicating what we do to the public, and doing so with the same kind of rigor and professionalism that guides our astronomical endeavors. The AEB helps the AAS maintain close ties between the research community and the public communicators who help interpret their work to lay-audiences, and it is a pleasure to play a part.

Ann Aidle Esin (Harvey Mudd College)

I am an associate professor of physics at Harvey Mudd College, an institution with a primary focus on undergraduate education, where I teach courses in introductory as well as advanced physics and astrophysics. I believe that the problems in secondary education that we are faced with in

this country require a major shift in attitude and funding policy by the Federal and State governments. I see the AAS as uniquely well-positioned for making meaningful contributions to the improvement of science education in the US, since astronomy tends to hold a universal appeal for people irrespective of their age or background. I am very excited to be part of this effort.

Suzy Gurton (Astronomical Society of the Pacific)

Back in the late 70's when I was an astronomy student at the University of Arizona my professor, Raymond White, made sure I joined the AAS. When I got my first full time job related to astronomy education at Griffith Observatory, my boss, Ed Krupp made sure I also joined the ASP. With two such amazing mentors in astronomy education and outreach, is it any wonder that my commitment to public programming is strong? I see this time serving on the AAS Education Board as an opportunity to be a liaison between the AAS and ASP so that our EPO efforts are mutually supportive.

Heidi Hammel (Space Science Institute)

I volunteer at my kids' elementary school library. As far as kids are concerned, astronomy rules the sciences: I frequently see them check out books on black holes and planets, galaxies and nebulae. The public, too, keenly appreciates astronomy. I've learned many lessons during decades of public outreach and astronomy education: the essence of story-telling; the need for passion; the importance of relevance. I look forward to sharing my experience with the Education Board. Together, we can provide the AAS membership with tips, tools, and time-tested techniques to enhance our ability to educate and inspire.



L-R: Ed Prather, Philip M. Sadler, Mark Voit, Sidney Wolff, Timothy Slater (Chair)

Ed Prather (Center for Astronomy Education, University of Arizona)

I have been teaching, and doing research on the effectiveness of, space science courses for over 15 years. The 250,000 students taking an Astro 101 course each year represent our country's future teachers, business leaders, artists, lawyers, historians, journalists, politicians, etc. I consider these students/citizens to be the most important population we AAS members have the opportunity to work with. Our ability to positively affect their understanding of our subject, and their attitudes about what we contribute to society, is absolutely critical. I believe the AEB has an important role to play in improving the scientific literacy of this important population who make up the very fabric of our nation.

Philip M. Sadler (Harvard-Smithsonian Center for Astrophysics)

Astronomers usually identify me with revealing astronomical misconceptions in the video, *A Private Universe*, but few also realize that many of their students had their interest piqued by a visit from one of my portable planetariums during elementary school. *Starlab* was the satisfying result of my middle school teaching stint that blossomed into an astronomy education career. My board membership helps to contribute the perspectives of both pre-college teachers and planetarium educators. I would like to see the AAS support broadening the range of experiences for students of astronomy to include project work, observational journals, kinesthetic approaches, and terrestrial applications.

Mark Voit (Michigan State University)

At STScI's Office of Public Outreach I worked to engage people in astronomical discovery through museum exhibitions and the *HubbleSite* website. Now as a professor

at Michigan State and textbook author, I concentrate more on educating university students. We astronomers are blessed with a science that is both visually compelling and deeply connected to the story of human life, and our outreach efforts work best when they capitalize on those advantages. We should also keep in mind that people are often more interested in the questions we ask than in the answers we give.

Sidney Wolff (NOAO)

Most of what I know about astronomy education I learned by reading the articles in the *Astronomy Education Review*. I have been very impressed with the research that is now available on how to improve student learning. This is becoming a data-driven field—careful studies show the effectiveness of new techniques that can be replicated in a variety of classroom settings. *AER* is now under the stewardship of its new editor, Tom Hockey, but I remain committed to finding even more ways that the AAS can assist in disseminating the results of astronomy education research to members of the Society.

Timothy Slater (University of Wyoming)

AAS Education Officer and Astronomy Education Board Chair is Timothy F. Slater, Ph.D., a professor at the University of Wyoming where he holds the Wyoming Excellence in Higher Education Endowed Chair for Science Education. At the University of Wyoming, he is creating a unique Ph.D. program in which his graduate students conduct education research on teaching science. His research focuses on student conceptual understanding in formal and informal learning environments, inquiry-based curriculum development, and authentic assessment strategies, with a particular emphasis on non-science majors and pre-service teachers.

Astronomy Education Research

Columnist: Ed Prather, Univ. of Arizona



Trying to assess if our students really understand the ideas we present in class can be difficult. It can also be tremendously valuable to evaluate the teaching and learning that occurs in our course with that which occurs in other courses across the country. Concept inventories are research-validated assessment tools that can provide us with data to better understand whether we are successful in the classroom.

In this edition of the *Astronomy Education Research* column we will learn about the development of the *Solar System Concept Inventory*. This project, which began among faculty at the University of Colorado at Boulder (UCB) and which has been expertly led by Seth Hornstein, a Senior Instructor in the Department of Astrophysical and Planetary Sciences at UCB, has become a key project of the NSF-funded Collaboration of Astronomy Teaching Scholars (CATS) program. Under Seth's leadership, the project has grown from a single-institution, in-house endeavor into a multi-year, multi-institution collaboration with significant contributions from faculty and students at UCB, Guilford Technical Community College, the University of Arizona, and California Polytechnic State University, San Luis Obispo.

Development of the *Solar System Concept Inventory*

Seth Hornstein, Univ. of Boulder—Colorado



Yes, another astronomy concept inventory! Unfortunately, astronomy is plagued by the fact that it is very difficult (if not impossible) to define a single concept (or even a set of concepts) common to all introductory astronomy courses. While a handful of concept inventories already exist in astronomy (e.g. the *Lunar Phases Concept Inventory*¹, the *Star Properties Concept Inventory*², and the *Light and Spectroscopy Concept Inventory*³) each concentrates on

a set of topics that may not be covered (or at least covered in the same level of detail) in every course.

The idea for the *Solar System Concept Inventory* (SSCI) was born after realizing that no concept inventory currently available covered details regarding the formation and evolution of our solar system. Many two-semester astronomy survey courses divide the topic into one semester on “the solar system,” and another semester on “stars and galaxies.” A first-semester course of this two-semester layout often covers more details on formation, evolution, and geological processes of the terrestrial and gaseous planets than would typically be covered in a single-semester survey course. Of

course, like many of its predecessors in the field, the SSCI is not intended to be a universal concept inventory suitable to all astronomy courses. Our intent was to provide faculty teaching a ‘solar system’ class with a validated instrument for use in assessing their students’ learning and evaluating any changes they make in their classroom.

However, we realized that if we expect faculty who might not otherwise think about formative assessment to buy into the idea of assessing their students’ conceptual learning, the instrument must 1) cover concepts most faculty considered relevant in such a course and 2) contain questions that they felt a majority of their students would be able to answer. To accomplish both goals, we began by asking University of Colorado faculty who had recently taught one of our two introductory solar system courses to provide suitable questions. While this led to a good selection of content topic areas, many questions were taken from final exams and thus were heavily laden with jargon and/or placed more of an emphasis on declarative knowledge rather than conceptual understanding. Our next task was to generalize and de-jargonize the supplied questions. Three faculty members evaluated over 35 questions that were eventually narrowed down to 29 for inclusion in the first version of the SSCI.

In the spring semester of 2008, this version of the SSCI was given to 193 students in two sections of an introductory solar system astronomy course at the University of Colorado.

The instrument was given both pre-instruction (pre-test; on the second day of class) and post-instruction (post-test; on second-to-last day of class). For this first version, the unmatched scores on the pre- and post-test were 40% and 67% correct, respectively.

While a post-test score of 67% was acceptable, the rather high pre-test score supported that our plan to perform a more detailed analysis of question statistics was needed. Each question was examined using a combination of point biserial, percent correct on the pre-test, and item difficulty to determine if the question was properly differentiating student understanding while also ensuring the question was not too easy or too hard. Additionally, student interviews were conducted during the summer of 2008 in order to fully understand students' naïve ideas about these topics and to make the distracters (wrong answers) phrased in language that would seem more natural to students.

In the fall of 2008, another round of pre- and post-testing was done at the University of Colorado, this time involving nearly 350 students and 2 instructors. Beginning in spring of 2009, a national multi-institutional field-test began which would eventually involve over 2000 students and 17 instructors from 9 different institutions over two semesters. Over the past two years, after each round of testing, a group of instructors from multiple institutions around the country

have worked together to analyze the data (using similar diagnostics as mentioned previously) and revise or eliminate underperforming questions.

As of spring 2010, the last stage in validating the final version of the SSCI (interviews with students after they take the post-test SSCI to understand their interpretation of questions and reasoning of their answer choices) is currently underway. Look for a final version of the SSCI coming to *Astronomy Education Review* soon!

- ¹ Lindell, Rebecca Susan (2001). "Enhancing College Students' Understanding of Lunar Phases." Ph.D. dissertation, The University of Nebraska—Lincoln, United States, Nebraska. ProQuest Dissertations & Theses: Full Text. (Publication No. AAT 3022646).
- ² Bailey, J. M. (2007). "Development of a Concept Inventory to Assess Students' Understanding and Reasoning Difficulties about the Properties and Formation of Stars," *Astronomy Education Review*, 6(2), 133.
- ³ Bardar, E. M., Prather, E. E., Brecher, K., & Slater, T. F. (2007). "Development and Validation of the Light and Spectroscopy Concept Inventory," *Astronomy Education Review*, 5(2), 103.

Astronomy in Unusual Places: Getting Sidetracked by Science

Columnist: Sara Mitchell, Goddard Space Flight Center



During the International Year of Astronomy in 2009, we were challenged to reach people—locally and globally—and help them connect with the universe around us. Groups around the world held special events to share astronomy with the public, helping millions take a look through a telescope (sometimes for the very first time), get their hands on astronomy activities, and see the beautiful imagery of space.

Some of these events were held in the usual places: science centers, planetariums, universities, and observatories. During IYA, it was especially exciting to see astronomy events held in unusual venues, such as the public parks and airports targeted by the "From Earth to the Universe" project featured in this issue. If you want to reach people who don't actively seek out science, you have to present appealing science in their natural habitat.

It's exciting to see people flock to an astronomy event, but it's a special thrill to see people encounter astronomy where they least expect it—and take a few moments away from their everyday activities to check it out. One evening in New Orleans, a sidewalk astronomer had set up his telescope next to Café Du Monde. Tourists didn't just get their beignets and coffee, but a taste of the night sky (on that particular night, Jupiter and its moons). They didn't seem to mind one bit, and many people hung around for a while to ask questions and take another look. It might not have been in their evening's plans, but the appeal of astronomy can be hard for even the non-scientifically-inclined to resist.

Connecting with Our Universe: *From Earth to the Universe*

(<http://www.fromearthtotheuniverse.org>)

Megan Watzke & Kimberly Arcand, FETTU Co-chairs, Chandra X-ray Center



Last October, President Obama hosted a star party on the White House lawn, highlighting the spirit of discovery, knowledge, and exploration that astronomy engenders. The White House event was one highlight of the International Year of Astronomy 2009 (IYA2009), the worldwide effort to use the 400th anniversary of Galileo's first telescope to inspire the public about the wonders of the Universe in which we all live in.



Astronomy is a science that many in the general public seemingly find very accessible. The reasons for this may include the "big picture" questions astronomy addresses: where are we, where do we come from, where are we going, etc.? It could also be the provocative topics astronomy covers such as black holes, extra solar planets, and other exotic phenomena that have moved from science fiction into being science fact.

Another way that non-scientists or even the non-scientifically-inclined connect with astronomy is through the dramatic visuals this field produces. From small telescopes wielded by amateurs to multi-billion dollar observatories controlled by professionals, astronomy has the capability of luring people in by the sheer aesthetics of its data – something many other sciences cannot claim to do.

Since 2009 the "*From Earth to the Universe*" (FETTU) project has tried to capitalize on this fact by taking astronomical images and science into places where they are not usually found. FETTU is a collection of some of astronomy's most spectacular images across the range of the electromagnetic spectrum. As both a global cornerstone project and a major component of the U.S. IYA2009 program, the community-driven FETTU project has spread to over 500 exhibitions in 70 countries on every continent except Antarctica, and in 40 languages. The free exhibitions have been held in such

places as public parks, airports, and other non-science-centric venues, engaging people who might not ever step foot into a planetarium.

In the U.S., a NASA grant provided the primary funding for the FETTU exhibits. FETTU has been placed on semi-permanent display at Chicago's O'Hare and Atlanta's Hartsfield airports. In addition, a traveling version of the exhibit has visited over a dozen U.S. cities such as Washington, D.C., Anchorage, AK, Memphis, TN, and New York City. Three tactile and Braille versions of the FETTU exhibit were also made possible by NASA funds, each of which has traveled to multiple locations around the country.

Worldwide, FETTU exhibits have been in such locations as the hallways of the Iranian Parliament, outside on a plaza in Reykjavik, Iceland, in an art museum in Shanghai, China, during a space art contest for children in Enayetpur, Bangladesh, throughout many villages in Uruguay, in a prison in Coimbra, Portugal, and at UNESCO World Heritage sites such as Stonehenge in the U.K., and the Alhambra in Spain. Past and ongoing lists of FETTU events are maintained at: http://www.fromearthtotheuniverse.org/table_events.php

The formal evaluation process is still in its preliminary stages, but the responses received thus far have been overwhelmingly positive to this "open source" approach to astronomy outreach. As part of the profession of astronomy, many of us may take for granted the slew of images and discoveries that the field seems to generate daily. However, it's clear from the FETTU project that many people do not have access or exposure to all that astronomy has to offer—be it for a lack of resources, awareness, or presumed interest.

If there is one lesson that FETTU has taught us it is that there must be widespread "science exposure" before there can be advances in scientific literacy and appreciation. We believe that FETTU, and other community-driven projects like this, are one way to make progress in this important goal of bringing more science, technology, and math into the popular lexicon.

There are plans to keep FETTU going in 2010 and beyond. For example, the panels from the Chicago and Atlanta airports are scheduled to go into children's hospitals in their respective cities. More than 30 countries around the world will keep their FETTU exhibitions going or create new exhibitions in 2010, and many more countries are working

to follow suit. From Slovenia to San Francisco, from Atlanta to Argentina, the world has shown its fascination with the cosmos above. It is heartening to think that some wonders

are universal in their appeal, reminding us that no matter where we are, we can connect to the sky we all live under.



Left photo: “From Earth to the Universe” on display outside the Smithsonian’s Air and Space Museum in Washington, D.C. **Right photo:** “From Earth to the Universe” on display at a prison in Coimbra, Portugal



Left photo: “From Earth to the Universe” on display along Lake Geneva in Geneva, Switzerland. **Right photo:** “From Earth to the Universe” on display at an outdoors arts and science exhibit in Mendoza, Argentina.



Locations of FETTU worldwide—70 countries and well more than 500 exhibitions.

Astronomy Education in Planetaria and Science Centers

Columnist: Lindsay Bartolone, Adler Planetarium



After hearing NASA Administrator Bolden's inspirational challenge for scientists to engage with students at the January AAS meeting in Washington D.C., I wanted to give Dennis Schatz, Senior Vice President for Strategic Programs at Pacific Science Center, the opportunity to share the results and plans of a collaborative program between researchers, museums, and the public called *Portal to the Public*. I first learned of this program at the September 2009 meeting of the Astronomical Society of the Pacific, and was impressed at how well the program was able to foster interactions between scientists and museum visitors. Should you choose to accept the challenge from Administrator Bolden, to help inspire the next generation of explorers, I hope programs like this one help make the journey more enjoyable and effective for all involved. And if you'd like to see Bolden's talk, here's the link: <http://www.nasawatch.com/archives/2010/01/video-boldens-s.html>

Portal to the Public: Where Scientists and the Public Meet Face-to-Face

<http://www.pacsci.org/portal/initiative/>

Dennis Schatz, Pacific Science Center



"I'm a typical academic in some respects in that I teach, but I've had no background theory in teaching whatsoever. [The Portal to the Public professional development was] really helpful in understanding my audience and how to interact with them."

Dr. Erika Harnett
Assistant Professor, Earth and Space Science Department and Astrobiology Program
University of Washington

"It's so important to have scientists talk to kids—have a conversation, face-to-face...not just kiosks and games but real contact. It makes a difference."

Parent participating in *Portal to Public* event at Pacific Science Center

These are typical responses from people involved with Pacific Science Center's *Portal to the Public* effort, which has a simple mission:

To be a portal to the public regarding current research and technology occurring in Washington State

Research Weekends

The longest running activity related to our *Portal* effort is the various "Research Weekends"—mini-science festivals—we offer at the Science Center. More than 50 scientists are on site for a long weekend (3 to 4 days) to provide demonstrations and activity stations where they convey current science and technology research.

The first event, *Polar Science Weekend*, was held in March 2006. Polar researchers from University of Washington (UW), National Oceanic and Atmospheric Administration (NOAA), and the Coast Guard were on site to share their research with Science Center visitors. In 2007 we added *Life Sciences Research Weekend*. More than 20 UW departments, non-profits and businesses participated in showing the latest research and technology in the life sciences. We just received a \$500,000 grant from NASA—in collaboration with researchers at the Polar Science Center at UW—that will support our *Polar Science Weekend* for the next three years.

During the last couple years we added a number of other Research Events—*Marine Exploration Weekend* that featured researchers from NOAA, state agencies and, UW; an *Earth Revealed Month* (a month-long celebration of research gathered by looking at Earth from space that featured researchers from UW, NOAA, and even Microsoft. You can see a visual sample of the Research Events here: http://www.pacsci.org/portal/download/PoP_research_weekend_images.ppt.



Professional Development for Participating Scientists

A key element of our *Portal to the Public* effort is to provide training for the scientists so that they can be effective communicators with public audiences. We offer single introductory three-hour workshops and a Science Communication Short Course (a four-part intensive workshop series). A professional development manual provides a set of experiences that are effective at developing the communication skills of science-based professionals.

Science Communication Fellows

Our latest *Portal to the Public* effort is to identify a number of Science Communication Fellows. You can find more information here: http://www.pacsci.org/portal/download/PoP_Fellow_Flyer.pdf

These are science-based professionals who agree to regularly offer activities as part of our new “*Scientist Spotlight*” program. This monthly program at the Science Center—which does not supplant the *Research Weekends*—has science-based professionals sharing their research through activities representing their work. A number of researchers from the UW astronomy department and astrobiology program participate in this program as well as in our *Research Weekends*.

Other Portal to the Public Activities

The Science Center’s long-term goal is to work with others in the region to add statewide *Portal* experiences. A recent Institute of Museum and Library Services (IMLS) grant allows us to expand our monthly *Science Cafe* program from one site in Seattle to additional locations in two neighboring cities. Our *Science Cafe* program is a collaboration with KCTS9 (our local PBS station), which puts each

From 9-11 April, Husky Research Weekend, a collaboration with UW (the Huskies) and its alumni association, will feature researchers and research specifically from UW.

Collaborative Work with Three Other Science Centers

In 2007 The National Science Foundation enhanced our ability to offer ongoing *Portal* programming by awarding the Science Center a \$2.1 million grant. For more information about the grant, which is a joint effort with two other museums (Explora in Albuquerque, NM and North Museum of Natural History and Science in Lancaster, PA) and the Institute for Learning Innovation, check out the following two links: http://www.pacsci.org/portal/download/pop_summary.doc and http://www.pacsci.org/portal/download/pop_update.pdf.

This effort is now being expanded through a dissemination effort at five other museums across the country.

program on its web site: <http://kcts9.org/series/science-cafe/archive>.

The IMLS grant will also help us offer science and society forums at several community centers in the area.

Additional efforts for the future include adding a permanent “portal space” on the Science Center’s exhibit floor where we can have an ongoing visitor engagement with current science and technology research. The space will include face-to-face interactions with science-based professionals when they are available, but also have high definition digital technology and interactive exhibits that are still effective when a science-based professional is not on site.

Photos: *Marine Exploration Weekend 2008*

K-12 Astronomy Education

Columnist: Wil van der Veen, Raritan Valley Community College



On January 11, 2010, at an official ceremony that was held at the French Senate in Paris, Dr. Carl Pennypacker was awarded the Prix Jules Janssen for his work with *Hands-On Universe*. The Prix Jules Janssen is named after astronomer Pierre Jules César Janssen, founder of the Paris Meudon Observatory and co-discoverer of helium. It is the highest award of the Société Astronomique de France and is awarded every other year to a non-French scientist. Past winners of this prestigious prize include Arthur Eddington (1928), Albert Einstein (1931), Lyman Spitzer (1980), and Gerard de Vaucouleurs (1988).

In this *K-12 Astronomy Education* section of *Spark*, Dr. Pennypacker, the founder of *Hands-On Universe* (HOU), will share with us some of the highlights of the *Global Hands-On Universe Program*. His article also shares results from the international *Galileo Teacher Training Program* (GTTP), one of the legacies of the International Year of Astronomy 2009. Both programs bring the excitement of doing science into primary and secondary classrooms worldwide by using the universal appeal of astronomy. Students integrate and apply concepts and tools from science, math, and technology to investigate the Universe. In combination with on-going

teacher training that is based on sound education research and best practices, programs like these help develop a more science literate global society.

Bring the Universe to the Hands and Minds of the World

Carl Pennypacker, Lawrence Berkeley National Laboratory, UC Berkeley, Space Sciences Lab



Astronomy has an almost magical ability to inspire awe and wonder. It is also a portal to the other sciences. Astronomy educators are blessed with such a subject. There are so many ways astronomers can contribute, and *Spark* has provided a forum for astronomers and educators to share their ideas. Here I will focus on two international projects aimed at reaching teachers and classrooms in secondary and primary schools: the *Galileo Teacher Training Program* (GTTP) and *Global*

Hands-On Universe (GHOU).

The *Galileo Teacher Training Program* (GTTP), co-led by Rosa Doran of Portugal, is a Cornerstone Project of the International Year of Astronomy, and is one of the largest classroom astronomy education programs to date.

Global Hands-On Universe (GHOU) is a model for global internet-mediated learning. Working as a global collaboration, we have developed, supported, and disseminated innovative activities at the forefront of modern astronomy. Our aim is to

increase students' conceptual understanding of deep science and math through astronomy. Students engage in activities using real digital images and data from the Hubble Space Telescope, remote telescopes, and web cams on 2" telescopes. As not all learning is computer based, we also teach how to use small telescopes and how to apply math concepts such as algebra, angles, size, proportions, ratios, data analysis, and modeling to astronomy. Students using HOU have made significant scientific contributions to asteroid and supernova research.

GHOU and GTTP have been remarkably successful as an international collaboration. Working together, GHOU and GTTP have developed workshops, powerful software, materials, and pedagogical tools to teach modern astronomy, fundamental science, and math. Over 5000 teachers in approximately 90 nations have taken a GTTP workshop. These teachers are using these new tools and skills to help reshape their classrooms. Over the next decade we expect to reach 10 times this number of teachers.

While *Hands-On Universe* originated in the United States, it has expanded to become truly global. Key developers of US HOU include our first teachers, Curtis Craig, Hughes Pack, and Vivian Hoette; Tim Barclay and Jodi Asbell-Clarke wrote our first curricula, and many great US teachers have kept US HOU going through funding cycles.

French collaborators, including Roger Ferlet, Anne-Laure Melchior, and Suzanne and Michel Faye have helped develop some of our latest software and exciting units such as Salsa J for image processing (available for free at www.euhou.net). We also use the French *Stellarium Planetarium* program (available for free at www.stellarium.org). Using Salsa J, students can rediscover an exoplanet using data from the Spitzer Infrared Satellite. They can discover central motion and measure Jupiter's mass by measuring the orbits of the moons of Jupiter from successive images. They can measure the masses of a black hole in external galaxies or the black hole in the Milky Way. These measurements touch on some of the most interesting sectors of modern astronomy.

From Japan, we have key modules in spectroscopy and other software developed by Hide Agata and Toshihiro Handa and their colleagues.

Other GHOU collaborators include Sweden, Germany, Australia, China, Portugal, Brazil, Kenya, and Chile, etc.

In Kenya GHOU is being used as a means to help bring Internet-mediated, modern education to Africa. GHOU has been instrumental in obtaining computers for educational programs in Kenya. Guided by Susan Murabona, students at Kenya High School are teaching astronomy to students in neighboring Kileleshwa Primary School. Using laptops, strings, sticks, tape, and paper, the teens teach the younger children to observe and discover new and exciting aspects of scale, size, and the Universe.

We believe we can replicate the Kenya model in many nations, including the United States, where *No Child Left Behind* strictures have severely reduced science education in many schools, especially in the lower grades. In El Cerrito, California, where I live, El Cerrito High School *Interact* students will soon be working with neighboring primary

school students in a program parallel to that of Kenya High. *Interact* is the youth branch of Rotary International, and *Interact* students are contributing much to the effort in Kenya.

Chile is our newest GHOU member, and our first workshop there in January 2010, was a great success. Richard Lohman, my good friend and GHOU trainer, led a workshop for Chilean teachers organized by Sergio Cabezon of NRAO. We met Sergio through Fátima Oliveira Saraiva of HOU Brazil. The great Chilean Astronomer, Professor Jose Maza, attended and contributed to the workshop. Chile's national curriculum now includes astronomy at many grade levels, and we were very pleased to be working with such enthusiastic educators.

This is a miraculous time. Growing access to good data makes it possible for students and teachers to analyze real scientific data and to make new discoveries: education becomes discovery. As GHOU reaches more people, we hope they learn to think positively not only about astronomy but also about all the sciences.

Acknowledgements: I want to thank all of the US and Global HOU collaborators, developers and teachers who have persevered for so long with our program, and taken these ideas, beginning in 1992, into something that works. GHOU is far, far richer because of their fundamental and central dedication to the well being of teachers and students around the world, and their selfless devotion to the betterment of all of us. In addition, the US Hands-On Universe has been supported by generous funding from the US National Science Foundation, through grants ESI-9252915, ESI-9554161, and ESI19819579. European Hands-On Universe has been generously supported by the European Union MINERVA and COMENIUS Programs, in grants 113969-CP-1-2004-1-MINERVA-M and 141928-2008-LLP-FR-Comenius-CMP. Finally, I would like to thank Lawrence Berkeley National Lab for their multi-dimensional support.



Left: Family Night filter fun! **Center:** Carl staring in amazement at his Prix Jules Janssen award. **Right:** Carl gives a very animated acceptance speech.

Majors, Undergrad Research, and Graduate Student Education

Columnist: We need one; are you interested...?

For over a decade members of our Society have been seriously focused on improving teaching in learning in Astro 101 – the non-majors college astronomy course. Curriculum and assessment materials have been developed (and research-validated), professional development opportunities have grown, and much of this has been based on the results of research on how the human brain forms new knowledge. Imagine what might happen if we put this same knowledge to work in informing how we teach our majors and graduate student! In our feature *Majors* article, we here from Marshall Perrin and Andrea Ghez (UCLA) who were wondering this very same thing: If the teaching strategies work for non-majors, shouldn't they work for majors? Aren't they both humans? Read on to learn more about what they found.

Applying Active Learning Techniques to Instruction for Astrophysics Majors

Marshall Perrin and Andrea Ghez, UCLA



Teaching tools such as Think-Pair-Share (TPS) questions and Lecture-Tutorials now have a proven track record for increasing engagement and improving learning in non-major courses ('Astro 101') for students from a wide range of backgrounds and at all types of institutions. But what about those students who intend to pursue the study of astronomy or physics more seriously? The vast majority of courses taught to undergrad astro majors still use the hallowed old method of lecture, lecture, lecture. Yet the same cognitive processes underlie learning for both majors and non-majors; if more active and participatory courses improve learning in Astro 101, shouldn't we hope for similar gains in classes aimed at majors, too? After all, most professional astronomers would likely agree that one learns best by doing something firsthand rather than just hearing about it!

One of us (Perrin) saw the power of active small-group learning as a graduate teaching assistant: The famed Berkeley undergrad astronomy lab is notoriously grueling, yet year after year students report that it's far and away the best and most instructive experience of their undergraduate career (See *Spark*, Issue 7, p. 4). By challenging students to conduct real astronomical measurements, and empowering them to collaborate in small teams learning to use telescopes, analyze data, and communicate their results, the lab environment creates a microcosm of the full scientific method, leading to deep learning and propelling many students onwards to careers in the sciences. But what about the middle ground, courses for majors earlier in the sequence before they are ready for an intensive lab class?

To test out ways to improve such classes, we set out to apply the lessons of modern education research to revamp the Introductory Astrophysics class that has been taught for several years at UCLA by one of us (Ghez). This is a calculus-based class in the fundamentals of astronomy, with an emphasis on stellar structure and evolution, taught each year to 20-30 UCLA sophomores and juniors. We retained the vast majority of the existing course (the weekly problem sets, the challenging midterms and final exams, etc.) and indeed, kept most of the lecture material. However, we added in two new elements: (1) explicit pre-class reading assignments in the textbook, followed by quick and fairly straightforward online reading questions to motivate



Consider two stars:

Star A: $T = 3000\text{ K}$ $R = 3 R_{\odot}$
 Star B: $T = 6000\text{ K}$ $R = 1 R_{\odot}$

How does star A's B-V color compare to that of Star B?

A $B_A - V_A > B_B - V_B$

B $B_A - V_A = B_B - V_B$

C $B_A - V_A < B_B - V_B$

D We need more information to decide

A nonrelativistic degenerate gas is compressed from an initial density ρ_i to a final density ρ_f .

The average momentum of each particle in this gas will increase by a factor

A (ρ_f/ρ_i)

B $(\rho_f/\rho_i)^{1/3}$

C $(\rho_f/\rho_i)^{-1/3}$

D $(\rho_f/\rho_i)^{5/3}$

Fig. 1: Examples of two of the Think-Pair-Share questions we developed for our class.

students to actually do the reading before coming to class. Our goal was to get students to come to class having already seen the material once, at least briefly, and thus ready to ask questions and engage in discussions; and (2) routine and common use of Think-Pair-Share questions throughout every lecture, typically 2-4 questions per class, to assess student understanding and give them a first chance to apply new knowledge (well before the typical last-minute crunch night for problem sets...).

For this we had to develop a set of about 70 new TPS questions based on our content and skill goals for this class. Our aim was for these questions to be answerable in just a minute or two using basic reasoning and simple mathematics (e.g. ratios or scalings, rather than detailed calculations, which were left for problem sets) but nonetheless to challenge students' conceptual understanding. Writing good questions proved one of the hardest and most time consuming aspects of this whole process, and not every question worked out the way we'd hoped! Yet the surprises were often valuable lessons for us, when some questions we'd expected to be easy proved surprisingly challenging for students, thus showing us areas where we needed to improve our instruction. Our team-teaching approach was valuable here, allowing one of us to concentrate on running the class while the other recorded notes on how well each activity worked out in practice.

We have now taught the revised course in two successive years. Our informal observations are that students are more engaged and alert, and score higher on exams than typical in previous years. This is anecdotal evidence, not hard data, and there is clearly a vast amount of work to be done

in this area. But these first impressions strongly encourage us that interactive instruction is superior to traditional lectures for this level of class, too. Students also seem to share this opinion, with around 90% agreeing in course evaluations that the TPS questions helped them understand the material better: "The questions definitely gave me a more immediate working knowledge of the material, because I didn't have to wait to the homework before seeing problems." "The questions are great as they encourage thinking and interaction with fellow students." Likewise, while some students grumbled about the online reading questions, a majority felt that having to keep up with the text did improve their learning: "The online questions were good indications of important points in the book, and they helped me to focus on the important concepts." "Reading before the lecture creates a background of what is going to be taught in the mind, which acts as an excellent base for learning."

Admittedly, this interactive approach to instruction does require more preparation than pure lectures, but we also found it to be more rewarding and enjoyable, since there is so much better immediate feedback on how well students are learning. The hardest part of the preparation lies in the task of creating good questions at the right difficulty. We have already shared material with colleagues implementing similar approaches at other universities and invite others to contact us to do the same. It is our hope that, over time, a rich communal library of tested resources will develop for students at all levels, promoting learning by majors and non-majors alike.

Engaging Students in Web 2.0

Columnist: Pamela L. Gay, Southern Illinois Univ., Edwardsville



Once upon a time people had real lives. They picked up phones to call one another. They met in real rooms over real food and they played board games across a physical dining room table. But that was once upon a time.

Today, people show up to parties with laptops, and WEP passwords are handed out as party favours. Our real lives are getting supplemented with online experiences, email and digital media. But sometimes, it's nice to just sit with a friend and listen to some music or to take in a lecture or art museum with someone with whom you can share your inner dialogue. *Second Life*® (SL) has become the virtual place where digital people can go to share these previously only real world experiences.

Over the years, I admit to taking my own share of harassment for the time I spend in-world, with various friends stating simply: "Get a life!" The thing is, there are certain experiences that SL makes possible when real life can't provide them. At my small mid-western college, the current economic crisis has led to a real dearth in colloquium speakers. Thanks to SL, I can attend weekly astronomy talks and round tables organized by CalTech's George Djorgovski (Curious George in SL) and others. Where I live, attending cool lectures at the local science center requires a drive time I don't always have the time to commit to. Thanks to the work of University of Arizona's Adrienne Gauthier (Ourania Fizgig in SL) I can attend talks given at Adler Planetarium from my desktop. SL has provided me opportunities to attend NASA image unveilings, to join friends to watch launches on the "Big Screen" on the Astronomy2009 island, and to be a part of a world where I can talk face-to-virtual face while sharing solid learning experiences and engagements.

I admit SL is not all goodness and light. There is porn. There are overly sexed up avatars. There will be days when you walk into walls or fly into buildings (sometimes even getting stuck in a digital tangle of limbs and architecture.) But then, real life has its own sets of problems too.

For me, SL is a place I can go to more fully engage in astronomy—where I can learn, and participate and collaborate. If you haven't explored SL yet, I encourage you to try it out for yourself. Start with the standard tutorials and then teleport yourself to *SciLands*—the collection of islands who work together to get science to the SL masses. It's not yet "Snow Crash"'s Metaverse, but it is someplace you can go launch to the Moon on an otherwise boring afternoon.

Go ahead—get virtual.

Got Internet? Get Virtual Astronomy

Adrienne Gauthier, Univ. of Arizona



In January 2009 the International Year of Astronomy 2009's New Media Task Group opened a spot of real estate in the virtual world called *Second Life*® (SL). Our "island" was placed in the well established science themed archipelago, *SciLands*. 'Astronomy 2009' island is currently home to a dozen

astronomy exhibits, with more to come through 2010. Yes, that's right! We're now a "Beyond IYA 2009" project having received sponsorship from the American Astronomical Society to continue the project. Start-up funding was provided by Interstellar Studios (400 Years of the Telescope) while the design/building/managing was absorbed by the The University of Arizona Department of Astronomy. Chandra X-ray Observatory and Spitzer Space Telescope also gave monetary donations and we received volunteer building/scripting support from Rob Knop.

During the year we welcomed over 8,500 unique visitors who experienced over 3,400 engagement hours through almost 16,000 visits. Successful and popular events included the mixed reality lectures from Adler Planetarium's *Far Out Fridays* and the innovative celebration for *Galilean Nights* in October 2009. This past February we hosted a Solar Dynamics Observatory launch party and in March Doug Isbell gave a talk on his (and Steve Strom's) book, *Observatories of the Southwest*. This summer Chris Impey will speak on his new book, *How It Ends* and we'll soon be opening our Spitzer GLIMPSE/MIPSGAL "island-sized" mural with a special guided walking tour from Robert Hurt.

The goal of this project was (and still is) to engage and inspire the general SL public in astronomy. Anecdotally, I believe we have. Our events are well-attended and our "heat maps" of where avatars travel on our island show there is level interest in all exhibits. We have a steady stream of new visitors each week even though we are not running many events. Soon, we'll survey our 500+ person interest group to evaluate what they found engaging and if their interaction and exposure to the astronomy exhibits affected their natural life interest in astronomy. Did they seek out a telescope/star party in their town? Visit a planetarium? Not change the channel during a *Discovery Channel*® astronomy segment? We'll find out!

My initial exhibit idea was to create an interactive and engaging display of the *From Earth to the Universe* imagery. When visitors encounter the full exhibit, they are presented with 7 artistically designed portals of images: Earth (images of Earth, Moon, and views of our galaxy), Sun (images of our Sun), Solar Nebula (solar system planets, comets), Molecular Cloud (star forming regions, star clusters), Supernova (Supernova remnants), Early Universe (galaxies, globular clusters, interacting galaxies), and the Milky Way portal from which a smattering of objects swirl out of a sculpted model of our home galaxy. Visitors can click on the swirling image cubes to be presented with a full image and FETTU caption on display boards. Our FETTU display is a key exhibit, however the single exhibit quickly grew into an entire island of exhibits.



Today, 'Astronomy 2009' island (256 m²) hosts virtual versions of IYA projects and some exhibits & events unique to *Second Life*. Our island has been modeled after a grand design spiral galaxy, M74. Using the spiral arms as grass covered pathways over a sparkling blue ocean, visitors are able to access all the exhibits by walking the arms. One spiral arm consists of the FETTU image portals, walking from the Earth to the Early Universe portal. FETTU leads to our space art building and The Artists' Universe, a digital rendering of the natural life IAAA IYA 2009 "traveling exhibit". Further on, avatars can grab over 300+ free multi-wavelength astronomy textures from Spitzer, Chandra, and Hubble. The end of the path leads up to Prospero's Planetarium, Rob Knop's fully functional virtual planetarium. Across a bridge sits a 'life size' historical replica of the Lord Rosse Leviathan telescope donated by Troy McLuhan.

Navigating along the other spiral arm will take you through The World at Night displays. We've hosted 2 exhibits with the help of Babak Tafreshi: "Introduction to TWAN Photographers" and "7 Continents: Trekking the Night Sky". The TWAN area leads to our Dark Skies Awareness area which features a pond walking trail to learn about the effects of light pollution on human health, safety, and wildlife.

You can also teleport up to the Let There Be Night interactive dome, funded and donated by Chuck Bueter. Visitors can see the effects of different lighting on a city street as well as explore Galileo's Villa. Walking further, you'll find our Astrophotography Grotto where we have featured the well-known astrophotographers Adam Block, David Malin, and John Gleason (current).

The IYA2009 presence will persist in Second Life through most of 2010 as a Beyond IYA 2009 project. We've got some new exhibits coming up – including an "island wide" mural of Spitzer's GLIMPSE/MIPSGAL survey, complete with an opening event live tour by Robert Hurt and Gordon Squires. Did you miss the mural at the AAS meetings? Want a tour? Join us in Second Life! Getting into Second Life is simple, ask Rick Fienberg about his experience! Follow us on Twitter (@astronomy2009SL) or check our blog for announcements and how to get to 'Astronomy 2009' island: <http://secondastronomy.org>. Contact Adrienne (adrgau@email.arizona.edu) for a private tour.

Education Policy

Columnist: Susana Deustua, Space Telescope Science Institute



Although many of us acknowledge the importance of science literacy, and agree that teaching the physical sciences should be improved, we are often stymied by the seemingly large task. As a consequence we despair of even being able to have any impact. However, Ted Hodapp, APS' Director of Education and Diversity Programs, describes a high-impact approach to teaching physics, directed at future elementary school teachers. *Physics and Everyday Thinking* focuses on the fundamentals of physics. Its curriculum is based on research into how people learn and on how the science community develops consensus. But read his article.

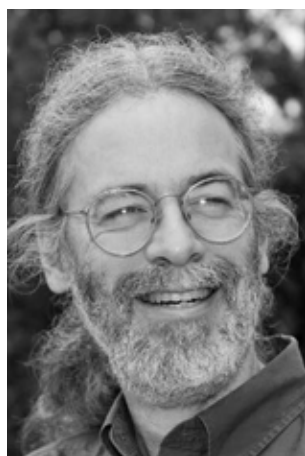
You may be interested in these related resources from the National Research Council:

- *Scientific Research in Education*; Lisa Towne & Richard J. Shavelson
- *How Students Learn: Science in the Classroom*; M. Suzanne Donovan, & John D. Bransford, Editors; Committee on How People Learn: A Targeted Report for Teachers
- *How People Learn: Brain, Mind, Experience, and School: Expanded Edition*; John D. Bransford, Ann L. Brown, and Rodney R. Cocking, Editors
- *Preparing Teachers for a Changing World: What Teachers Should Learn and Be Able to Do*; Linda Darling-Hammond, John Bransford, Pamela LePage, & Karen Hammerness Editors

as well as Physics Education Research Central at: <http://www.compadre.org/per/>

Making an Impact: Increasing Science Literacy in the Next Generation

Ted Hodapp, Director of Education & Diversity Programs, American Physical Society



Here you are, sitting in your office and wondering, "What can I do to have a significant impact on educating the next generation of citizens?" OK, that may not be what you think about every day, but as an academic, when I had time between grading papers and working in the lab (I won't even mention committee work), I occasionally had a chance to think about what might be the most efficient way to answer the "impact" question.

Now I sit at a desk working with a professional society (the American Physical Society), and I have had a chance to see educators all over the country. Some are making a huge impact, and some, well, they have good intentions. Recently, I was asked what I thought might be the single most important thing I would do as an instructor, and without hesitation my recommendation is: offer *Physics and Everyday Thinking* (PET). It used to be called *Physics for Elementary Teachers* (notice the clever use of the same acronym), and there is also a new version that includes chemistry called *Physical Science and Everyday Thinking* or PSET.

Why is PET (or PSET) the best thing since sliced bread? Also, why focus on elementary teachers? To answer the second question first: it is the impact factor. Elementary teachers reach hundreds of young minds, and there is good evidence that what they see at this age and how well it is presented makes a profound impression on their attitudes toward science. This is not to say that they still can't be "turned back" toward science at a later date, but a teacher who not only doesn't understand science but is afraid of it (or hates it) is unlikely to make a favorable impression on her or his students.

To answer the first question, you will need to explore the curriculum yourself, but I have discussed this with seasoned theoretical physicists who have tried PET with great trepidation, and came away with a profound respect for the goals of the curriculum. They found a totally new way to think about how students (especially non-science majors) think about the world. PET focuses on the "nature of science" and "how we know what we know." It does not ask the students to regurgitate formulas or use math at a level that they are unlikely to either know in the first place, or remember. It does ask how to design an experiment, what is the importance of data, how understanding of a question changes as you learn, and how one thinks about solving problems when one does not know the answer; and it does

this in the context of solving basic physics problems (e.g., a conceptual understanding of Newton's Second Law). This is what scientists do, but not—by and large—what we teach future teachers.

Be warned though, PET does require a different way of interacting with students. That being said, I can promise that, having used some of the student-centered active discovery techniques that are used in PET, you will not regret the time you spend learning how to offer this curriculum.

There are other curricula out there that consider the nature of science, and that get students to think about their own learning, but this is clearly one of the best. The barrier potential for offering it is low, and the rewards are high.

What's more, your school of education will probably be delighted to have your department helping them educate teachers that no longer hate science, and who will likely be excited about offering it to their students.

Want some more information? As always, check out the website, <http://petproject.sdsu.edu/>, or contact the leader of the group that developed it, Fred Goldberg, at San Diego State University. Fred and his co-workers are also developing a version of this for large lecture classes that still includes many of the student-centered pedagogical techniques. The best way to get into this game is to attend one of the group's workshops. They are offered regularly at meetings of the American Association of Physics Teachers (AAPT).

Meet Our New Education & Public Outreach Coordinator



On September 1, 2009, I joined the Society's staff as Press Officer and Education & Outreach Coordinator. I telecommute to work from my home just outside Boston, MA. Here I'd like to tell you a little about myself and my dual role, which is new at the AAS.

While I was working toward my Ph.D. at the Harvard-Smithsonian Center for Astrophysics, I discovered that I really like teaching and writing about astronomy. Eventually I decided I might be more successful as an educator and popularizer than as a researcher, so I was happy to snag an editorial position at *Sky & Telescope* soon after I finished my degree. I spent the next 22 years at the magazine, including nine as President of its parent company and eight as Editor in Chief. When I'd done everything I could think to do there, I realized it was time to move on. I left to spend the 2008-09 academic year as Visiting Scientist at Phillips Academy, a private high school in Andover, MA, teaching astronomy and supervising student research in the on-campus observatory. I also ramped up my volunteering for the International Year of Astronomy, especially on the Galileoscope, one of the IAU-designated Cornerstone Projects.

I wasn't sure what I might do next, but developments at the AAS changed that. Steve Maran retired after 25 years as part-time Press Officer, and Susana Deustua left her full-time position as Director of Education to work on HST's new Wide Field Camera 3, installed during the May 2009 servicing

mission. With a strong Astronomy Education Board and Education Officer, and with so many AAS members doing superb work in astronomy education throughout North America, the AAS Council decided there was no longer a need for a full-time educator on the Society's staff. Instead, they created a new position in which a single person would manage the press office and support members' efforts to advance astronomy education in keeping with the Society's mission statement. At the end of the hiring process, that single person turned out to be me—though actually I'm married.

If you want to know what I do as Press Officer, click on "Press Services" on the AAS home page or drop by the press room at any AAS meeting. Among my various duties as Education & Outreach Coordinator, I'm working on breathing new life into the Shapley Lectureship program, chairing the Small Research Grant committee (in part because a key criterion on which proposals are evaluated is the extent to which they involve students), and planning an overhaul of the aas.org education pages. I also serve as AAS liaison to other scientific societies' education programs. So, for example, I'm working with the Society of Physics Students to expand the range of activities for undergraduates at AAS meetings.

Because my position is new, and because both astronomy journalism and astronomy education are undergoing rapid changes, my role within the Society will surely evolve. If you have questions, comments, and/or suggestions, especially about the AAS education program, please e-mail me at rick.fienberg@aas.org. I look forward to hearing from you and working with you!

Richard Tresch Fienberg

Faculty Priorities Reconsidered: Rewarding Multiple Forms of Scholarship



By KerryAnn O'Meara & R. Eugene Rice (2005); Jossey-Bass Publishing, ISBN 0-7879-7920-1

Chris Impey, Reviewer
Univ. of Arizona

American universities face an unprecedented challenge. With the cost of higher education rising far faster than inflation or any other major component of modern life, they are being challenged to show that they provide good value for money and are training young

people for a changing workplace. Faculty members are at the epicenter of this debate. Most enjoy enormous intellectual freedom and are protected by tenure, leading to questions of whether or not their scholarship is serving the nation's needs.

Faculty Priorities Reconsidered: Rewarding Multiple Forms of Scholarship, edited by KerryAnn O'Meara and Eugene Rice, is a thoughtful collection of articles that asks whether anything has changed in twenty years since the publication of the landmark 1990 study *Scholarship Reconsidered: Priorities of the Professoriate* by Ernest Boyer. The *Boyer Report* called for a more flexible view of scholarship. It talked about four types of scholarship and argued that none should be valued any higher than the others: discovery (usually called research), teaching, application, and integration.

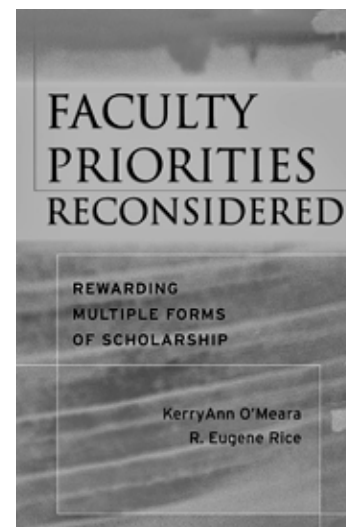
The *Boyer Report* energized university leaders and many funders and professional organizations. It seemed that the landscape of scholarship could be recast, with benefits to students and faculty who took a holistic view of their profession. The lessons of this book, told most clearly through case studies on nine campuses that range from a small religious college guided by "Franciscan values" to the huge (and hugely profitable) University of Phoenix, is that change is hard.

The book starts with a summary of the *Boyer Report* and a review of the four forms of scholarship. Then Robert Diamond puts idealism in context with a sobering summary of the barriers to change within any university. There are many: a graying professoriate that is loathe to change, lack of

mentoring and promotion and tenure processes that evolve on demographic timescales, the difficulty of devising equally persuasive metrics for teaching and research, and, often, the disengagement or apathy of professional organizations

Advocates of nuanced definitions of scholarship can be their own worst enemies; I read the opaque article on the scholarship of integration without being any wiser as to what it actually is! The major research universities have been slow to implement structural change, since so much of their prestige and funding derives from competing for federal grant dollars. Liberal arts institutions which already had a strong teaching culture are expecting their young faculty to build research programs as well. This leads to what KerryAnn O'Meara calls the "overloaded plate" problem. Ironically, the often-derided University of Phoenix offers one antidote to this faculty vise by unbundling the roles of a faculty member.

I recommend this book to anyone who cares about working towards a more balanced view of scholarship on their campus. While the overall progress has been agonizingly slow, the individual case studies show how a carefully built consensus can lead to real change. Training of graduate students, postdocs and young faculty in the multiple modes of scholarship is the key to accelerating this change.



Astronomy Education Review: New Editor, New Volume

Astronomy Education Review (AER), the journal of astronomy and space science education and outreach, published by the American Astronomical Society, is pleased to announce the appointment of Prof. Thomas Hockey (of the University of Northern Iowa) as the new Editor-In-Chief.

Hockey, who has been Managing Editor of the journal *Archaeoastronomy* and Chair of the Society's Historical Astronomy Division, takes over from Sidney Wolff, who founded the journal together with Andrew Fraknoi. Wolff is retiring; Fraknoi will remain as the Senior Editorial Advisor for AER. The online journal, which can be read at: <http://aer.aip.org>, will remain free for contributors and subscribers.

Hockey is the author of *The Book of the Moon* (1986, Prentice Hall) and *Galileo's Planet* (1999, Institute of Physics), as well as the Editor-In-Chief of *The Biographical Encyclopedia of Astronomers* (2007, Reidel), among other works.

AER has just closed its eighth annual volume of research papers, resource guides, reviews, PhD abstracts, and announcements relevant to the field. Among the papers in the second part of this volume are:

- "The Modern U.S. High School Astronomy Course, its Status and Makeup, and the Effects of No Child Left Behind" — Larry Krumenaker (U. of Georgia)
- "Meta-analysis of Planetarium Efficacy Research" — Bruce Brazell (Navarro Coll.) & Sue Espinoza (Texas A&M U.)

- "College Students' Pre-instructional Ideas About Stars and Star Formation" — Janelle Bailey (U. of Nevada), et al.
- "The Astronomy and Space Science Concept Inventory: Development and Validation of Assessment Instruments Aligned with the K-12 National Science Standards" — Philip Sadler (Harvard Smithsonian CfA), et al.
- "A Topical Index to Astronomy Articles in *Scientific American Magazine* 1999-2009" — Andrew Fraknoi (Foothill Coll.)
- "A Simple Demonstration of Absorption Spectra Using Tungsten Holiday Lights" — Jennifer Birriel (Morehead State U.)
- "A Mindset List for College Astronomy Instructors" — Fred Ringwald (California State U., Fresno)
- "The Astronomy Education Research Charter" — Aaron Price (Tufts U.)

When you go to the journal's web pages, you will see that Volume 9 is already under way. To see the full table of contents for Volume 8, click on "Back Issues" under the journal title.

AER welcomes papers, articles, and op-ed pieces on a wide range of topics in astronomy education and outreach. All contributions are refereed, and instructions for submission can be found on the journal site.

Contributions to *Spark*

We encourage all members of the community to contribute articles to *Spark*, which is published twice a year to coincide with the AAS national meetings. If you are interested in making a contribution, we recommend sending us a brief description of your proposed contribution in advance so that we can discuss your idea and suggest a suitable article length (generally around either 400 or 800 words). Our editorial meetings are held in February and September of each year, so suggestions received before those months are easiest

for us to incorporate. Article deadlines are April 1 for the issue released at the summer meeting, and November 1 for the winter meeting issue.

We look forward to discussing your ideas for contributions, and to reading your articles! Email the editors: Jake Noel-Storr and Gina Brissenden at spark@aaas.org.

Astro 101: The Majority of Those We Teach

Columnists: Rica Sirbaugh French, MiraCosta College; Danielle L. Martino, Santiago Canyon College



Welcome to the inaugural *Astro 101* column of *Spark*! *Astro 101* courses serve a surprisingly large percentage of the undergraduates we teach. They often times see it as the “path of least resistance” to fulfilling their general education science requirement. This is likely the last—and often the only—college science course most of them will ever take; it’s our last chance to “reach” them. These are future teachers, politicians, entrepreneurs, journalists, etc. As professionals, we must develop our abilities to further the “global knowledge economy” and empower our students to do the same.

But what does “reach” them mean? How is genuine success appropriately assessed? These questions may never fully be answered. The goals for every course are different, and success depends largely on whether the instructor truly knows his/her audience and what they are thinking—and it depends on what tools are in his or her teaching toolbox.

Educators, ask yourselves the following questions and *answer honestly!* What are the student learning outcomes for your course? What do you do to prepare students for them? How do you assess them? What kinds of skills do you want your students to develop? What do you *really* know about the population you’re trying to service? How can you tell if they “get it”? How can you tell what they’re thinking? What kinds of tools do you have to diagnose and treat both the symptoms and the problems?

We hope the feature articles in the *Astro 101* section of *Spark* will empower you in your teaching. Many community-building endeavors now exist that allow astronomy education researchers and *Astro 101* instructors to connect (see previous issues of *Spark*). None of us are alone in teaching astronomy and the research *should* continually inform our teaching and learning practices, just as it does our astrophysical research practices. This section will present relevant information on *Astro 101* materials, best practices, and addresses common issues in implementation and classroom management.

We (your columnists) know what it’s like to work hard to improve your instruction. We have attended many professional development workshops, tried out new teaching strategies, stumbled and improved on our implementation, been each other’s critical friends, assessed our students’—and our own—successes. If there’s one thing we’ve learned, it’s that it *is* possible to “reach” them—and that *you, the instructor, matter!* (Well, that’s two things, really—but they’re both important.)

It *is* possible to show students that astronomy—and science in general—is approachable, accessible, practical, and connectable to their everyday lives, and above all, it can (should?) be enjoyable. Recent results from multiple studies are sending a clear signal: properly implemented interactive learning strategies are critical and continued development of pedagogical content knowledge is crucial to student success. It’s all about how people learn—*all* people—including our *Astro 101* students. (Shhh... Don’t tell anyone, but they’re people, too...)

In the next issue of *Spark*, Julia Kregenow (Penn State) will write our *Astro 101* feature article. She’ll discuss the ins and outs of using concept inventories to assess our students’ learning—and our teaching. But that is just the beginning. There is much more to come in *Spark’s Astro 101* feature section, so sit back, relax, and prepare to improve your teaching skills!

SPaRk

The Education Newsletter of the
American Astronomical Society
2000 Florida Avenue, NW, Suite 400
Washington DC 20009

Periodical
Postage
Paid
Washington DC