Preparing for the International Year of Astronomy: Report from St. Louis

James G. Manning *Michael G. Gibbs*

It's arrived . . . the year 2009, the anniversary year of that autumn evening, 400 autumns ago, when one Galileo Galilei took his newly-crafted "spyglass," magnifying some 30 times, shrugged his shoulders, and pointed it at the sky to see what he could see. And what he saw set off a revolution in our understanding of the Universe and our place within it.

Some 399 years after that momentous act, in the late spring in St. Louis, Missouri, a throng of several hundred astronomers and astronomy educators met to share ideas, refine plans, forge connections, seek collaborations, and organize efforts to take advantage of this anniversary year to advance the cause of cosmic awareness, scientific understanding, and improved science education. It all happened at the Astronomical Society of the Pacific (ASP) International Year of Astronomy (IYA) Symposium, held 31 May-4 June, 2008 in conjunction with the American Astronomical Society (AAS) at its summer meeting. It was a "Meeting within a Meeting" to bring together those planning IYA efforts to make others aware of all that is in preparation to shine a spotlight on astronomy and to get the entire world to "look up" and pay attention sometime during the year.

The meeting began with a series of weekend workshops in which IYA practitioners could show their stuff to both their colleagues and to members of their target audiences. The workshops included a comprehensive NASA demonstration series showcasing the education and public outreach efforts of multiple space missions, and workshops focused on amateur astronomer outreach opportunities, storytelling, telescopes and optics, afterschool programs, programs for minority audiences such as Hispanics, dark skies education initiatives, using Galileo-like observing opportunities to teach the process of science, and how to take advantage of new online media to educate and communicate. All were well-attended and popular.

The Symposium itself kicked off with an opening plenary session in which IAU representatives provided a status report on the international effort focusing on a series of "cornerstone" events and activities (see http://www.astronomy2009.org for details) including a comprehensive website, teacher professional development, exhibits, programs, and a global "100 Hours of Astronomy" event enlisting the cooperation of museums, observatories, planetaria, astronomy clubs, and others in sharing the Universe with their public. Representatives of the AAS-coordinated U.S. national effort provided a similar report on U.S. signature activities and the efforts of a series of IYA working groups (see http://www.astronomy2009.us for details) focusing on themes ranging from families and classrooms involvement, to "citizen science" projects with the public providing useful data on variable stars, to enlisting the amateur community to help get as many eyes-to-the-telescope as possible. A prototype "Galileoscope"—a modern day reconstruction of the kind of telescope Galileo used for his sky-shattering discoveries—was unveiled, and is available for order world-wide along with supporting educational materials.

Catherine Cesarsky, IAU President, offered an overview of the IYA international effort in an AAS plenary session, commencing three days of posters, oral sessions, and hands-on presentations in which participants shared their plans and preparations for IYA. Presentations elaborated on projects for dark skies awareness, cross-cultural efforts, teacher professional development, serving the underserved and those with special needs, and using new online media, or art and music, or current space missions to advance IYA themes. Addressing science standards and pseudoscience, getting eyes to scopes, unveiling NASA Great Observatories images, using Google Earth and Sky, involving astronomers, and communicating the availability of a treasure-trove of resources across the spectrum of potential audiences and activities—including IYA as a virtual activity in Second

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SPaRk

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In This Issue

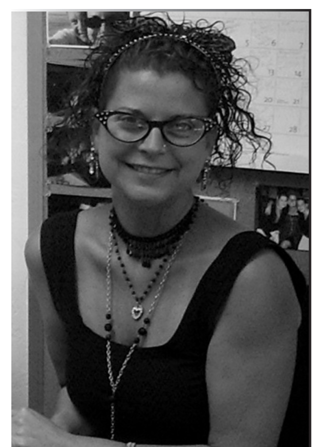
Dear Readers,

Welcome to the seventh issue of Spark, the AAS Education Newsletter! We are happy to introduce a new format for our newsletter including contributions from regular columnists in key areas of astronomy education. Featured for the first time in this issue are columns on Research in Astronomy Education (Ed Prather), Astronomy Education in Unexpected Places (Sara Mitchell), K12 Astronomy Education (Wil van der Veen), Astronomy Education Policy (Susana Deustua), Community Building in Astronomy (Gina Brissenden), and Astronomy Education in Out-of-School Time (Jake Noel-Storr).

Coming up in the summer issue we will also include columns on Astronomy in Planetariums and Science Centers (Lindsay Bartalone), Web 2.0 and Astronomy Education (Pamela Gay), Astro 101 (Jeff Sudol), and Astronomy Majors and Graduate Students (…any volunteers??)

As always we are happy to receive any feedback you have about Spark, and ideas for future articles or content. Please send your comments to spark@aas.org – we look forward to hearing from you!

Gina Brissenden & Jake Noel-Storr
Editors



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
spark@aas.org

***Preparing for the International Year of Astronomy** continued*

Life—filled three busy days. A NASA Town Hall meeting expounded on the NASA effort, Interstellar Studios hosted a reception preceding the ASP awards banquet, screening a trailer for its 400 Years of the Telescope film to air on PBS this year, and best-selling author Dava Sobel presented a popular lecture entitled How Galileo and the Telescope Changed Everything as part of the AAS public lecture series.

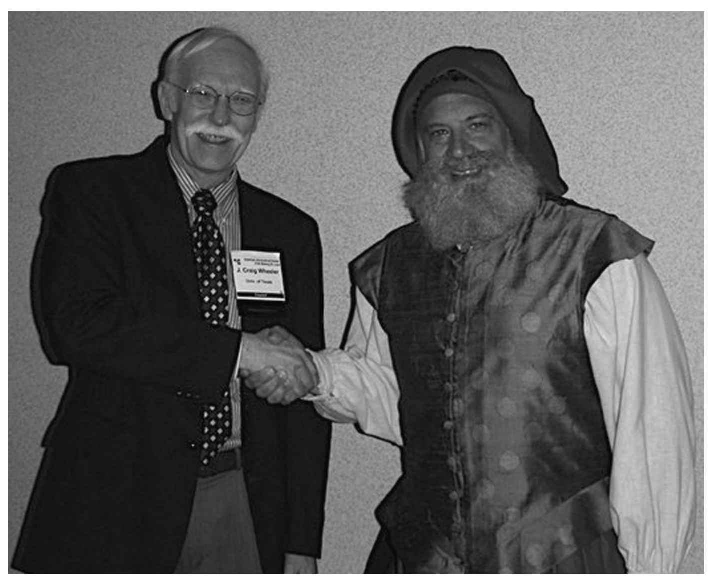
If you missed the IYA Symposium, all is not lost. The content of the event is preserved in a conference proceedings available from the ASP. The volume documents both workshops and symposium presentations in a series of written reports, and includes a supplementary resource section. The ASP's goal is to make this publication a useful reference for IYA—to serve all those involved in the effort in making professional connections, accessing resources, and maximizing their efforts to engage all of the world's citizens in a global celebration of astronomy—to get people to look up and rediscover the Universe. For information on how to obtain a copy of the proceedings, go to http://www.astrosociety.org/2008proceedings.html.

The ASP, founded in 1889 by a group professional and amateur astronomers following the observation of a total solar eclipse, is pleased to have conducted the Symposium as an expression of its support for IYA and bringing greater awareness and understanding of the cosmos through direct involvement. This is very much in keeping with its mission to advance science literacy through engagement in astronomy. The ASP thanks the AAS and meeting sponsors for their essential support.

To learn more about the ASP and its programs, visit http://www.astrosociety.org. To learn specifically about its IYA signature efforts, including teacher professional development, capacity-building for informal venues, resources for amateur astronomers, and plans for an education resource webpage, visit http://www.astrosociety.org/iya/index.html. Individuals and corporations wishing to assist the ASP in its work to improve science literacy through astronomy can find membership information at http://www.astrosociety.org/membership.html.

To be prepared is "half the victory," said Cervantes. Be sure to take advantage of all the resources available to help you prepare for and make 2009, and International Year of Astronomy, a year and an event to remember!

James G. Manning & Michael G. Gibbs
Astronomical Society of the Pacific



Left: Attendees of the ASP IYA Symposium check out their Galileoscopes.

Right: Craig Wheeler (former AAS President, Univ. of Texas) and Galileo (played by Mark Thomson) celebrate the International Year of Astronomy, also at the ASP IYA Symposium.

Innovations in Teaching Majors & Graduate Students

Part Two of a Series

With this issue of Spark, we present the second in a series of articles on innovations in teaching majors and graduate students. In our last issue, we heard from Jarita Holbrook at the University of Arizona and Nicholas Campion at the University of Wales, Lampeter, reflecting upon their graduate programs in cultural astronomy. As promised, in this issue we hear from Carl Heiles, at UC Berkeley, telling us about their innovative undergraduate laboratory courses.

When I (Gina) was an undergrad, I attended Berkeley, and I had the very fortunate experience of taking two of the lab courses Carl is going to tell us about. I asked Carl to write this article because of the profound effect these courses had on me and my fellow students—and we almost didn't get to take them! Dave Cudaback, at the time our undergraduate advisor, was retiring, and he was the only instructor who taught the optical lab, so the department wasn't going to be offering it anymore. A group of us had been really excited to take the class, and we asked Dave if he would teach it anyway. Of course he agreed to—Dave loved teaching, and it was through his instruction that I learned the importance of collaborative-learning and the role of "frustration" in the learning process (This latter lesson was hard-earned.). At least once a class, Dave would get this big smile on his face, while surveying his students, and say "Listen to all that learning!" Well, it took a student-petition, and quite a bit of pleading, but the department agreed. Dave coaxed Carl into teaching the lab class with him, and history was made. Thanks, Carl, both for continuing to teach these courses and for writing this article. Dave would be proud!

Gina Brissenden & Jake Noel-Storr
Editors

How *to Really* Help Our Undergrads Know what It's Like to Be an Astronomer: The UC Berkeley Advanced Undergraduate Labs

Carl Heiles, Univ. of California at Berkeley

The first time I taught the undergrad advanced optical lab class, way back when, we repeated the experiment of Eratosthenes to measure Earth's diameter. This experiment was the brainchild of David Cudaback, who started our advanced lab courses—and in our heavily research-oriented department, an undergrad lab with such "Mickey Mouse" experiments was regarded with not inconsiderable disdain.

Hold on! Dave's legacy is labs like this, and this one in particular was one of the best! It was about measuring Earth's diameter. But it wasn't really about that. Rather, it was an excuse to:

- Introduce the students to multivariate least squares.
- Get the students to write their own least-squares software using matrix techniques.
- Use propagation of errors.

All this within the first two weeks of the semester for students whose previous experience with computers was just game-playing and internet-surfing!
And there were ancillary goals:

- Get the students out under a dark, lonely sky. Most are city dwellers and the words "Milky Way" suggests a row of Tastee-Freezes along Main Street, USA.
- Work together in groups. Our experiments are difficult and require lots of analysis. The workload is high and working in groups is the way to make progress—just like in real life. It's social, and it's fun! One question industry asks: "Can you work with others in a group?"
- Promote group and one-on-one interaction by encouraging students to share their revelations and teach each other!
- Create the "show and tell" environment: a semi-

continued on next page

formal environment in which students and groups tell the others what they've been doing—and present their work, like a scientific paper—in the "formal" classroom setting. (It's hard to think of our class time as "formal").

- Live on the edge: be totally turned on to contribute to your group, contribute to the class, and make progress. Like, for a computer novice to write a multivariate matrix-based least-squares fitting program within two weeks requires hard work and a big time commitment. Accomplishing anything worthwhile is 90% perspiration, 10% inspiration, and this "Mickey-Mouse" lab threw them in the deep end with no apologies and no way out but up. A perfect introduction to the rest of the course, and to a successful professional career in any subject you choose, technical or not—indeed, to life itself.

- And, of course, a formal lab report due after four weeks—created using LaTeX. Products for the masses, like Microsoft Word, are great, but for us are forbidden territory because the students need to become comfortable with the many excellent scientific and mathematical features of LaTeX.

Yes, the lab was about astronomy, too—but the nominal astronomy goal is mainly a motivational tool. This overall philosophy and *modus operandi* defines our lab courses. At Berkeley, I'm closest to the radio lab, so let me focus on that. We do four experiments, each lasting 3 to 4 weeks:

1. Bench experiments: digitally sample sine waves and use discrete Fourier techniques to analyze them. Goals are digital sampling, Fourier transforms, power spectra, heterodyne systems in radio astronomy and real life.

2. Use our 10-m baseline, 10 GHz interferometer to accurately measure the declinations of Galactic sources (like Orion A, Cas A, accurate to 10 or 20 arcseconds); accurately measure the angular diameters of the Sun and Moon (why are they so different in the radio?). The real goals: apply discrete Fourier transforms to astronomical data, apply the "matched filter" to data (students write their own VLB fringe fitting software), coordinate systems, time systems and transformations.

3. More bench experiments: microwave devices and circuits, more on heterodyne systems, complex input to Fourier transforms, observe their first 21-cm line spectra with these techniques.

4. Use our 4-m dish to map the Galaxy and image the 21-cm line. The real goals include dealing with large data sets, Doppler corrections, image processing, analysis (interference, missing pixels, etc.) and presentation. There's a lot of published literature about the Galaxy and the 21-cm line, so this is an ideal venue for bibliographic databases like ADS.

Some details:

Class meets once per week for a minimum of three hours. This can be grueling, but it forces a long attention span, keeps them on their own for a full week (forcing them to confront their procrastination), and resonates with our "work hard" course ethic. Class begins with the previous week's progress, presented by one or more groups in a "show-and-tell" session where they display their results using their own analysis software on a computer projector. Not infrequently, they are showing results obtained just "ten minutes ago," which is ideal for uncovering mistakes and misconceptions; we look at their software in detail and suggest better approaches or techniques. It's fun to compare approaches, errors, and results of the different groups, who take different paths—some good, some not so good. Depending on circumstances, we might do a chalk-and-talk style lecture on theoretical or conceptual aspects of data or on the relevant astrophysics. Or we might do a demonstration of equipment, technique, or the next week's work. Or all of the above!

Properly staffing a course like this is essential. We are, in essence, running several observatories (radio interferometer, single dish, optical telescope with modern detectors, solar spectrometer) and to keep all this stuff working we have a full-time engineer. Professors spend lots of time on the course and on giving individual attention. All of this is a major commitment for the department, which embraces it because it has become the crown jewel of our undergraduate program.

But in some ways the key to the course is our teaching assistants. We have had great success using undergraduates as the TAs. Specifically, we pick the cream of the crop of those who have previously taken the course. These students are the *real* experts, not only in the intricacies of the course itself, but also the problems likely to be encountered by undergraduates both in the course and the physics and astronomy curriculum: after all, they've been in the course before and are going through the same stresses of undergraduate life. This helps the students; and the experience really helps those fortunate enough to serve as TAs!

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***Innovations in Teaching Major & Graduate Students** continued*

We use the IDL language: most students begin with zero programming experience, IDL is an interactive language with a relatively shallow learning curve, it has the Goddard library (we don't tell them about that—we want them to write their own), and it's heavily used in astronomy—students who learn it have a leg up on getting jobs in, and doing, real astronomical research, like REU programs. Other included essential computer basics are: technical writing and data presentation; computer device and telescope control; bits, bytes, floats, integers, structures.

We do a lot of astronomy and astrophysics, too. With the interferometer, we observe nonthermal radiation from supernova remnants like Cas A and thermal radiation from HII regions like Orion and, also, thermal radiation from the Sun and Moon. With the 4-m dish we see the Galaxy's flatness, measure its rotation curve, and see high-velocity gas at high latitudes. There's lots of opportunity to discuss astronomy! But when I teach the course, the astronomy takes second shrift to the "learn-how-to-do-things" aspects.

Knowledge is power; having these skills is power!

13th Issue of *Astronomy Education Review*

http://aer.noao.edu

Astronomy Education Review (AER), the web-based journal/magazine about astronomy education and outreach, has just completed the on-line publication of its 13th Issue (http://aer.noao.edu). There is no charge for reading or downloading the full articles in the journal.

When you go to the AER site, you will see that the 14th issue is already under way. It begins with descriptions of six demonstrations suitable for introductory astronomy classes. Special editors for this section were John Keller and Steve Pompea.

You can find the full 13th Issue by clicking on "back issues" and then on "Vol. 7, No. 1." Following are some of the articles you'll find in this Issue:

- The First Big Wave of Astronomy Education Research Dissertations and Some Directions for Future Research Efforts by Timothy Slater, University of Wyoming.
- Development and Implementation of a Lab Course for Introductory Astronomy by Nate McCrady, UCLA, and Emily Rice, UCLA.
- The Historical Evolution of Knowledge of the Universe: Errors in Secondary Education Textbooks in Spain by Uxío Pérez Rodríguez, University of Vigo, Spain, María Álvarez Lires, University of Vigo, Spain, and Jorge Prieto Soliño, English translator.
- What Are They Talking About? Lessons Learned from a Study of Peer Instruction by Mark C. James, Northern Arizona University, Federica Barbieri, Northern Arizona University, and Paula Garcia, Northern Arizona University.
- The Seasons Explained by Refutational Modeling Activities by Valérie Frede, OCTOGONE-ECCD Toulouse-Le Mirail University and UFE Paris Observatory.
- Students' Development of Astronomy Concepts across Time by Julia Plummer, Arcadia University.

We are also delighted to announce that, as of 2009, AER will become a journal of the American Astronomical Society. The transition should be seamless, and we continue to accept papers and announcements for publication in either the last issue of 2008 or the first issue of 2009. More information about the change of publishers will be available in the months to come.

Sidney Wolff & Andrew Fraknoi
Editors

The Hands-On Guide for Science Communicators: A Step-by-Step Approach to Public Outreach

by Lars Lindberg Christensen, Springer (2007), ISBN: 978-0-387-26324-3, $29.95

Stephen P. Maran (AAS Press Officer), Reviewer

Lars Lindberg Christensen (hereafter, "Lars"), Head of Communication at European Space Organization and Press Officer of the International Astronomical Union, has written a tour-de-force of practical information and advice for would-be science communicators.

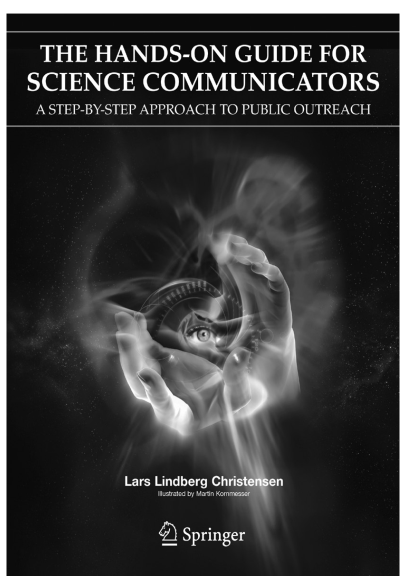
This softcover book offers a spectacular array of charts, tables, checklists, and case examples. There's a spectrum of communication types, from formal education (the cool end) to branding and VIP support (hot end), and a food-pyramid "skills triangle" with science, graphical, and technical skills at the vertices.

A section on Specific Advice for Science Writing offers step-by-step advice (per the subtitle). It won't make you a great writer, but it will get you started.

Numerous practitioners (full disclosure: including the reviewer) from the media, PIO profession and scholarly world are quoted; some contributed detailed materials that are beneficially reproduced.

A Press Release Visible Scale is contrary to usual astronomy practice, with mag 1 assigned to the least important release mechanism, said to be web posting, while mag 7 applies to a "Live televised press conference with presence of a high ranking political figure."

The nitty gritty of websites and video news release (VNR) development are presented, with a "Front-page significance matrix," used to plan the front page of a site, and a sample VNR story board, with script and thumbnails, and the corresponding Shotlist, with A- and B-roll time codes. If you don't know an "A-roll," (it's not sushi), from a B-roll, and you want to get into video, this book is for you.



A very important function of a press officer, however infrequent, is crisis communication—how your organization deals with the media when disaster strikes. This is an area where I differ with Lars. He stresses preparations, procedures, and staffing so you are ready when an accident occurs. That's OK, but I recommend that institutional personnel stay away from the press for as long as possible, allowing early media briefings to be conducted by disaster authorities—police, fire, emergency medical, local government. Then in a few days when the smoke clears (literally or figuratively) and the facts are better established, you offer press access to a well-prepared Director or other top manager. That way, there's no well-meant but wrong statement on videotape from a time when you were still subject to the fog of war, emerging again and again as time goes on.

A second area where I will add to Lars's comments is his section, Overcoming National Barriers. He's concerned with Europe where media often pay less attention to European science than equivalent findings streaming over newswires from the USA. Few have done more than Lars to reverse this tendency. But his analysis omits two factors. He emphasizes the problem of many different languages in Europe. But regardless of what language they use in reporting, most science journalists speak English. A more important factor limiting what they get into the newspaper or other media is the national identity of the scientists or project on which they are reporting. There's stress on one's own country, not one's continent, although there's much interest in news generated in the USA. A second unmentioned issue is that the reduced emphasis on science communications in many European institutions can sometimes be attributed to a political system in which institute directors feel that research projects may need only to be justified to a Research Minister who feeds into the preparation of the national budget, with no special need for public exposure.

This is a book where you find both philosophical justifications for science communications and the most detailed practical data, extending even to the standard deviations in shipping costs of press products among geographical zones. I highly recommend it.

Conducting Research in Astronomy Education

Columnist: Edward Prather, University of Arizona

Welcome to the first article in the new "Conducting Research in Astronomy Education" column. This column will highlight results from research that are important for the astronomical community to be aware of so that we might all advance our beliefs about how best to improve the understanding of our students and the general public. The systematic investigations done in this vital area of research provide robust results on the beliefs and reasoning difficulties of learners as well as key insights into the efficacy of different instructional strategies and professional development experiences.

In this installment Alexander L. Rudolph, Associate Professor in the Physics Department at California State Polytechnic University, Pomona, will describe results from a multi-institutional study recently conducted to access students' understanding of light and the use of interactive learning strategies.

Understanding of Light and the Use of Interactive Learning Strategies

Alexander Rudolph, Department of Physics, California State Polytechnic University

It is halfway through your Astro 101 class, and you have just finished lecturing on Kepler's 3rd Law. However, instead of going on to the next topic, you tell the students to take out their *Lecture-Tutorial* book and work in their groups on the tutorial on pages 25-27. Imagine your department chair or dean walks in at this point. Instead of finding your students attentively listening to you, she finds them with their chairs turned towards each other, creating a deafening clamor. When she asks you the meaning of this, you reply, "This is the sound of learning."

The above scenario is being played out in an increasing number of Astro 101 classes nationwide, and the evidence that interactive learning strategies, such as *Think-Pair-Share* questions, *Lecture-Tutorial* , and *Ranking Tasks*, are effective, is growing.[1,2,3] However, to date, a national study of the effectiveness of such techniques had not been done. This article is a report on such a study.[4]

The project was conducted, in collaboration with the Center for Astronomy Education,[5] from Fall 2006 to Fall 2007. The goal was to measure the effect of using interactive learning strategies on student understanding in Astro 101 courses. A total of 39 instructors from 31 institutions, from every part of the country, participated.

Each instructor was asked to give their students the "Light and Spectroscopy Concept Inventory" (LSCI) at the beginning and end of their course. The LSCI was developed to assess students' understanding of light and spectroscopy, two central topics of all Astro 101 classes[6]. Though there is no broad consensus on what should be taught in Astro 101[7], it is essential for any introductory astronomy class to teach the basics of light and spectroscopy. This is similar to the central role Newton's Laws play in introductory physics courses, which has led to the widespread use of the Force Concept Inventory (FCI) to study student learning in those courses[8].

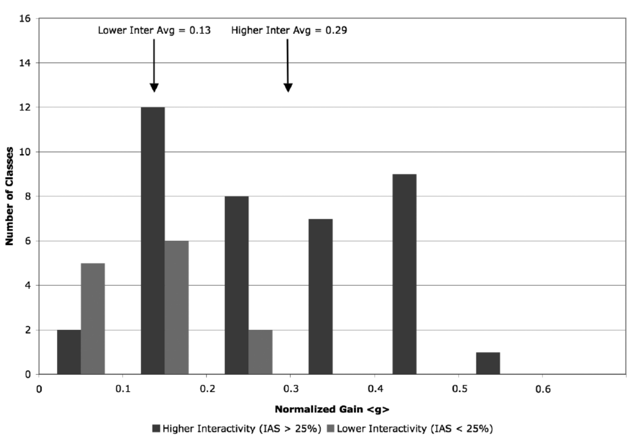
Altogether, nearly 4000 students took the LSCI pre-instruction (pre-test), and slightly more than 2500 took the post-instruction LSCI (post-test). For each pre-test and post-test, we calculated the percentage correct (of the 26 astronomy questions on the LSCI). Then, for each class section, we calculated an average pre-test and post-test percentage, from which we then were able to calculate a class-based normalized gain, $\langle g \rangle$,

$$\langle g \rangle = \frac{\langle \text{post\%} \rangle - \langle \text{pre\%} \rangle}{100 - \langle \text{pre\%} \rangle}$$

the ratio of the percentage gain achieved, to the possible improvement that could be achieved, as determined by the pre-test score. This measure of student learning has the advantage of removing any bias caused by differences in the starting ability of different students or classes.

Surprisingly, the range of class-averaged, pre-test percentages was *very* narrow, clustered around 25% (24±2%), suggesting that there is very little difference in background knowledge of light and spectroscopy in the various Astro 101 classes. This result is very different from what is found in introductory physics classes[6], where the range of pre-test scores can range from 30-70%. The normalized gain scores we calculated varied more widely, from 0-0.50, but were uncorrelated with either class size or institution type, suggesting that these two factors do not play any role in determining how much students learn. This argues that our results can apply to every Astro 101 class, regardless of size or type of institution where it is being taught.

To study how the instruction in different classrooms affected student learning, we developed and administered an Interactivity Assessment Instrument (IAI). This short survey, completed by instructors, allowed us to estimate the percent of classroom time spent on learner-centered, interactive learning strategies, which we called the Interactivity Assessment Score (IAS).



The figure shows a histogram of normalized gain broken into two groupings: classes with an IAS < 25% (lower interactivity) and those with an IAS > 25% (higher interactivity). Two things jump out when looking at this figure. First, none of the classes with an IAS < 25% have gains above 0.30, and the higher interactivity classes had an average gain more than twice as high as the lower interactivity classes, suggesting that interactive learning strategies can work. Second, there is a wide range of gains in both groups, suggesting that the use of interactive learning strategies is not enough by itself. One obvious possible cause for these two results is that the quality of an instructor's implementation of interactive learning strategies is critical, and that you as the instructor really do matter. This also argues for why continuing professional development that focuses on improving instructors' pedagogical content knowledge is so crucial if we expect to have a measurable effect on our students' learning as the result of trying innovative *and* research-validated teaching strategies in our classrooms.

(Endnotes)

[1] Prather, E.E. *et al.*, "Research on a Lecture-Tutorial Approach to Teaching Introductory Astronomy for Nonscience Majors," Astr. Ed. Rev. **3** (2), 122 (2004).

[2] D. W. Hudgins, E. E. Prather, D. J. Grayson, and D. P. Smits, "Effectiveness of Collaborative Ranking Tasks on Student Understanding of Key Astronomy Concepts" Astr. Ed. Rev. **5** (1), 1 (2006).

[3] E. M. Bardar, "First Results from the Light and Spectroscopy Concept Inventory," Astr. Ed. Rev. **6** (2), 75 (2008). http://aer.noao.edu/cgi-bin/article.pl?id=256

[4] Prather, E.E., Rudolph, A.L., Brissenden, G., & Schlingmann, W.M. 2008, "A national study assessing the teaching and learning of introductory astronomy, Part I: the effect of interactive instruction", submitted to American Journal of Physics

[5] The Center for Astronomy Education is funded by the JPL Exoplanet Exploration Public Engagement Program and an NSF CCLI Phase III center grant (NSF DUE 07-15517), entitled, "Community of Astronomy Teaching Scholars (CATS)-National Implementation Program for Learner-Centered Astronomy Teaching".

[6] 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. http://aer.noao.edu/cgi-bin/article.pl?id=225.

[7] Partridge, B., & Greenstein, G. 2003. "Goals for 'Astro 101': Report on Workshops for Department Leaders," Astronomy Education Review 2(2), 46. http://aer.noao.edu/cgi-bin/article.pl?id=64

[8] Richard R. Hake, "Interactive-Engagement versus Traditional Methods: A Six-Thousand-Student Survey of Mechanics Test Data for Introductory Physics Courses," Am. J. of Phys. **66** (1), 64 (1998).

Community Building

Columnist: Gina Brissenden, University of Arizona

With this issue of Spark, we debut our feature section on community building—a topic very near and dear to my heart. It is through community building that we decrease our sense of isolation, broaden our impact, deepen our bonds, increase our infrastructure, and expand our capabilities. Though I am sure we all feel like we belong to a personal community—our neighborhood, our family, a club—we may not realize the professional communities we belong to that make our work-efforts stronger and more enriched. The American Astronomical Society (AAS), itself, is such a community, and one that I am proud we are all members of. But other communities that we belong to, that we may not have thought of in this light, could be a national network of people working on the same project, a listserv that allows us to communicate with people of similar interests who we may have never met, an online discussion forum for people at similar points in their careers.

Building Community will regularly feature articles from people who are helping to create and expand these communities in astronomy education. Our first feature article comes to us from Jerry Dobek (Northwestern Mich. College), Andrew Fraknoi (Foothill College), and Connie Walker (NOAO) who are members of the Project ASTRO community. They'll tell us a bit about what Project Astro (and Family ASTRO) are, and how working as a community has helped them sustain and expand their program.

In the next issue of Spark, we'll be hearing from Paul Robinson (Westchester Community College) who is the guest moderator of Astrolrner@CAE, a listserv devoted to improving the teaching and learning of Astro 101. And in a future issue, we'll learn about the new AAS online Forum for Junior Members of our Society.

The Project ASTRO National Network: A Community That Can Help Your Education Programs Find a Wider Audience

Jerry Dobek (Northwestern Mich. College), Andrew Fraknoi (Foothill College), and Connie Walker (NOAO)

(Members on behalf of the Project ASTRO National Network)

As the U.S. Funding Agencies ask projects and programs to connect their work with the broader goals and needs of society, many astronomy groups are searching for meaningful ways to engage in education and outreach beyond their own campus or community. We want to tell you about a learning and teaching community, called the Project ASTRO National Network, which for more than a decade has been engaged in working with educators, volunteer astronomers, and students across the country for the betterment of science education. The National Network is always open to cooperation and interchange with other astronomy groups interested in the same goal.

Project ASTRO is an innovative, inquiry-based, science education program that links professional and amateur astronomers with 4th through 9th grade educators and their students. Its goals are to develop long-term partnerships between participating astronomers (professional or amateur) and educators, and to inspire students through the excitement of scientific discovery. Each volunteer astronomer adopts a classroom, or youth group, and typically visits them at least four times each year to co-lead hands-on astronomy lessons with their educator partner.

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Community Building *continued*

Begun as a pilot project of the Astronomical Society of the Pacific (ASP) in 1993, Project ASTRO has expanded to over a dozen regional sites around the country. Eight of the current sites have been disseminating Project ASTRO for ten years. With the support of local coalitions of educational organizations, scientific institutions, and businesses, these regional sites regularly recruit new and enthusiastic astronomers and educators, creating over 200 new partnerships annually. Nationwide, many thousands of active astronomer-educator partnerships have brought the excitement of astronomy to the classroom; we estimate that the project reaches over 20,000 students annually (see Fig. 1).

The Project ASTRO astronomers and educators are trained together during intensive workshops, with an emphasis on treating both as equal partners. Each volunteer astronomer establishes a good rapport with the students; often students brag about having their "own astronomer." The astronomer's multiple visits and work with the teacher focus on inquiry-based activities that put the students in the position of being the scientist: asking questions and finding their own answers. The educators and astronomers have access to a wide-ranging library of age-appropriate activities from various sources. Many come from the ASP's activity collections, The Universe at Your Fingertips and More Universe at Your Fingertips (see: http://www.astrosociety.org/education/astro/astropubs/astropubs.html).

To help each other, encourage the development of new sites, and foster cooperation with other astronomy education programs across the U.S., the regional sites' directors and coordinators formed a national Project ASTRO Network (See Fig. 2), which meets annually and keeps in close touch through email and teleconferences. Because the members of the Network have access to a national community of interested educators, students, and volunteer astronomers, the Network is an excellent partner for any project that is developing new educational materials, trying innovative approaches to astronomy teaching, or trying to get some training for its graduate students or educational staff on hands-on teaching techniques. People from many programs have observed Project ASTRO training workshops, and several astronomy education projects have put funding aside to use the Network to test and use their materials.

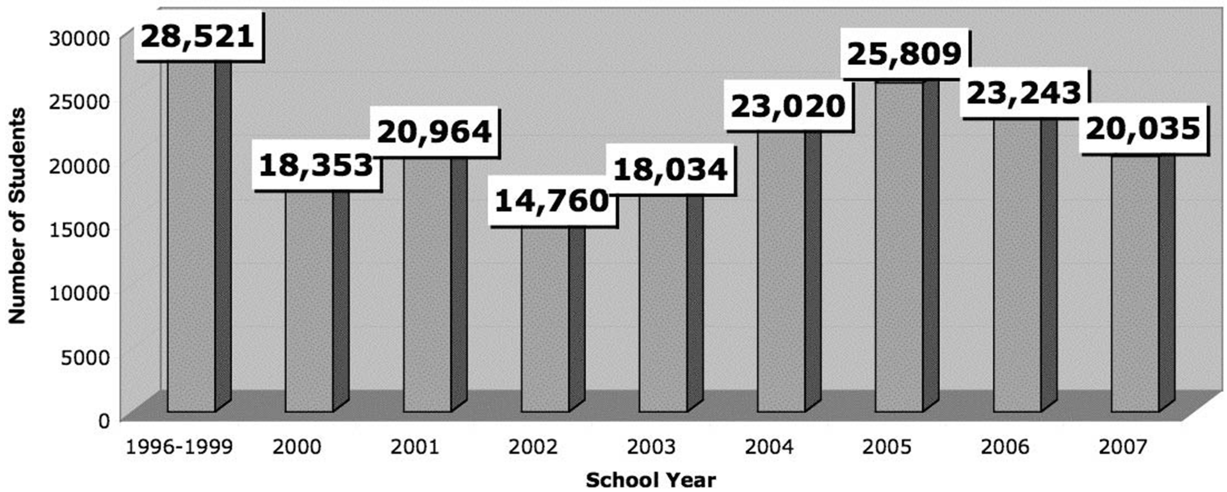
Project ASTRO is as diverse in its approach as the regions which it covers. Through multiple visits, each astronomer has the opportunity to share the enthusiasm and excitement of scientific research with tomorrow's scientists that goes beyond just a quick question and answer session or an awe inspiring PowerPoint™ presentation. The inquiry-based activities allow these students to be truly engaged and see that science is more than tables and bold words in a textbook. Partners often follow-up with "star-parties" or visits to an observatory or planetarium that engage families and the community at large. The regional sites are disseminating Project ASTRO to inner-city schools, urban and rural schools, as well as home-schools. Educators know what the goals and objectives are for their respective grade levels, but often do not have the resources or the expertise necessary to engage the students in the science process in general or astronomical inquiry in particular. Thus they are delighted to receive training and a volunteer astronomer to help them get over the "fear threshold" and make astronomy a regular part of their curriculum. These multi-visit partnerships have sustained Project ASTRO longer than most other Education and Public Outreach (EPO) programs.

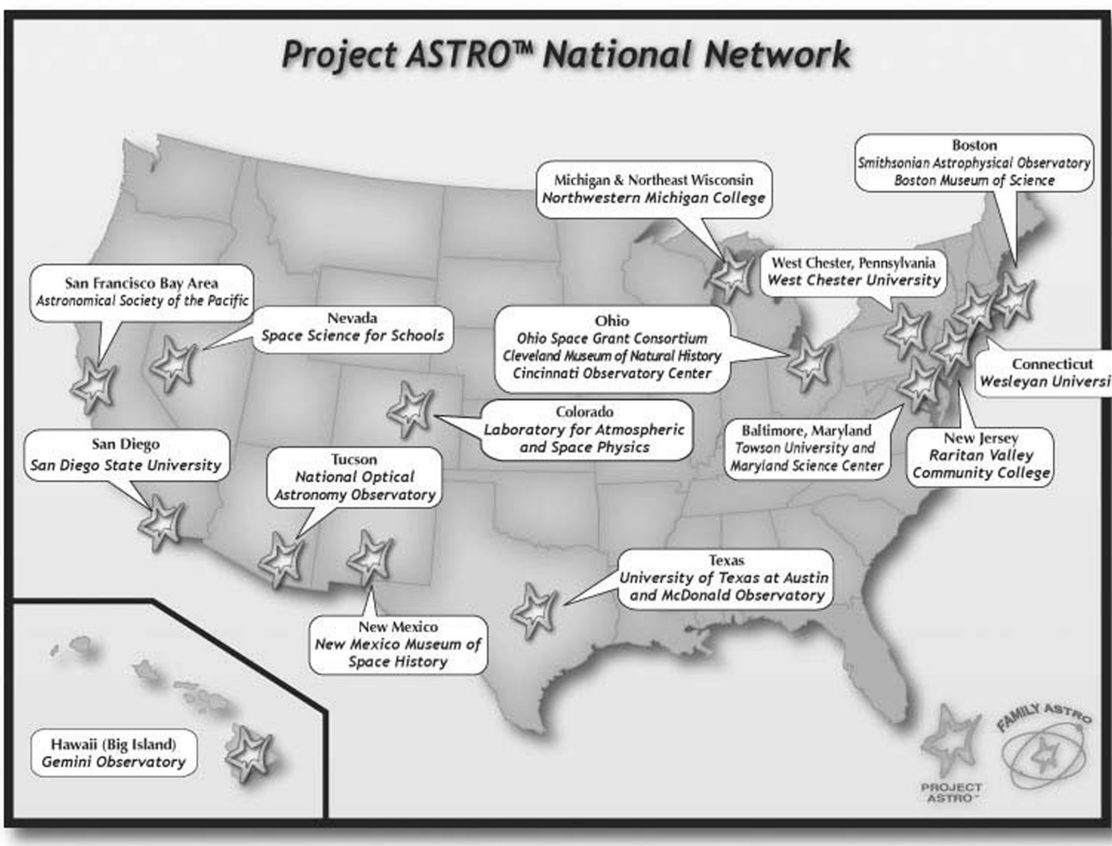
Working together, the ASP and the National Network found tremendous interest in what the astronomers and their educator partners were doing in the classroom among the families of their students. In 2000, the ASP received funding from the National Science Foundation (NSF) to develop a strategy and materials to bring astronomy in a more systematic way to families; a project that became known as Family ASTRO. Its key goal is to help families, youth groups, after-school clubs, and everyone else learn and enjoy some of the exciting ideas that underpin our understanding of the universe. To this end, the project developed some innovative kits, games, and training workshops on basic topics and ideas in astronomy, making them fun as well as educational. An important aim of the program is to help parents (and other caregivers) get more involved in their children's science education, and spend more family time together in active experiments, observations, and discussion. Eight years later, Family ASTRO is enjoying the same success as Project ASTRO. (See: http://www.astrosociety.org/education/family.html).

The sense of community that Project ASTRO and Family ASTRO provide extends to its National Network. It is analogous to the propagation of an electromagnetic field. Which one reinforces the existence of the other? The sense of community is embedded in both the National Network and the programs themselves, providing the success of the programs and the fodder to sustain the National Network.

So far, over 20 EPO proposals have leveraged the Project ASTRO/Family ASTRO Network. With active Network sites from Boston to Hawaii, it's generally easy to find a network member near you. If you want to get more involved with a successful EPO program—and become part of our community—we invite you to visit the Project ASTRO web site at: http://www.astrosociety.org/education/astro/project_astro.html.

Community Building continued





Top Figure 1: Number of students reached each year by ProjectAstro

Bottom Figure 2: A map of the ProjectAstro National Network sites

K-12 Astronomy Education

Columnist: Wil van der Veen, Raritan Valley Community College

Ten years ago, Project ASTRO (see article by Jerry Dobek, Andy Fraknoi, and Connie Walker in this issue of Spark) got me involved in K-12 education. In my first K-12 Astronomy Education Column, I would like to share with you some of my experiences as I transitioned from a career in astronomy research to science education.

Started as a desire to share my knowledge of astronomy with K-12 students, I assumed, like most scientists, that content was all I could contribute. Through my experiences with Project ASTRO and other exemplary programs I soon discovered a vast amount of research on student learning in science. Not only did it help me identify what I was already doing well, it focused me on what I could improve upon when working with K-12 teachers. It helped me model best practices deliberately and more consistently.

To my surprise I discovered that most science teachers and many of their supervisors are not familiar with the research either. If they are familiar with it, they often have trouble relating it directly to their classrooms. When doing professional development for teachers, I make sure I put the research to practice while making explicit references to it.

Becoming familiar with the science education research has helped me tremendously in my new career. If you like to like to learn more, these are four resources I recommend:

American Association for the Advancement of Science Project 2061. 2001, Atlas of Science Literacy, New York: Oxford University Press.

Astronomy Education Review: http://aer.noao.edu/

Michaels, S., Shouse, A., Schweingruber, H. 2008, Ready Set Science! Putting Research to Work in K-8 Classrooms, Washington, D.C.: National Academy Press.

National Research Council: 2005, How Students Learn – Science in the Classroom, Washington, D.C.: National Academy Press.

In future feature articles in this column, we'll hear other members' experiences in K-12 astronomy education.

Astronomy in Unexpected Places

Columnist: Sara Mitchell, SP Systems Inc. and NASA GSFC

One of the challenges of astronomy education is to make content relevant to our audiences – to connect the cosmos to everyday life. Astronomy can seem less tangible than other fields, such as physics or chemistry, as its applications aren't always obvious here on Earth. But we can make connections that move astronomy from elective to essential.

As we prepare for the International Year of Astronomy, we have to consider an inevitable audience question: "Why should I care?" While it is important to celebrate the history and spectrum of astronomical study, we also have to make it fit into our audiences' lives. We can make astronomy a part of everyday life by focusing on human connections and perspective – careers, applications, and our place in the universe. We can also depict astronomy as the work of many, rather than the work of few, emphasizing that anyone can be interested in the study of the universe around us.

Astronomy can easily stand alongside other subjects, such as mathematics, history, engineering, literature, and other sciences. Astronomy is part of the "big picture", an important part of human culture and achievement throughout history. While it may seem to some audiences that we already know everything, there are still boundless opportunities for anyone to engage in the exploration and discovery that has excited stargazers for millennia.

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Astronomy in Unexpected Places continued

The location of our offerings is equally important. By placing astronomy education in everyday places, we make it accessible and friendly. Instead of focusing efforts on museums, science centers, and other expected venues, we should also do education and outreach through places visited by those who wouldn't seek out astronomy. Shopping centers, libraries, and airports are venues that see millions of people each year – and excellent locations for innovative astronomy education. Bring astronomy to the people, and you'll engage new audiences. This is a first step toward drawing them to further involvement in astronomy. Through creative connections and contexts, we can tell the stories of astronomy and show that it is part of everyday – and everyone's – life.

In future features in this column we'll be hearing all about the creative and unexpected places members of our Society are sharing astronomy.

Astronomy in Out of School Time

Columnist: Jake Noel-Storr, Rochester Institute of Technology

I really hope that every astronomer around the world will choose, at least once during this International Year of Astronomy, to share their passion for astronomy with someone… and as most people, in most of their lives, spend most of their time out of school, I hope a lot of the outreach we do will be spent on "Out of School Time" activities.

I would like to challenge the whole astronomical community to think of novel ways of getting the excitement of astronomy to everyone. I will share some ideas here, but I'm much more excited to hear about what you are choosing to do. Please send us your ideas (spark@aas.org), and we will do our best to include them in an article on this topic in the summer issue.

Like to go night skiing after work? Would your slope like to give you free lift tickets for free astronomy in the parking lot?

When was the last time you went on a family picnic? Did you take a telescope and a solar filter along?

When and where is the county fair in your county? Do they have an astronomy table/tent/plaza/star party?

Education Policy

Columnist: Susana Deustua, Space Telescope Science Institute

Most of us have heard of No Child Left Behind (NCLB), signed into law by President George W. Bush in January 2002. NCLB is based on the expectation that setting measureable education goals results in improved outcomes. Individual states establish standards and develop assessment. The Act has been controversial—with disagreements on the basic philosophy, implementation, funding, and success, but nevertheless, has served to catalyze national attention onto K-12 education.

In 2006, focus on science and technology again became an issue of national attention, largely shaped by three initiatives. The National Academy of Science (NAS) report in 2005, "Rising Above the Gathering Storm," the Protecting America's Competitive Edge Acts proposed by Senator Pete Domenici (R-NM), and the President's American Competitiveness Initiative, presented in the 2006 State of the Union Address, all highlight the increasing urgency of not only maintaining, but also advancing America's interest in Research and Development (R&D) in order to maintain our competitive edge world-wide. In broad and general terms, the proposals specify the need for better science and math education, more research opportunities, and an environment which is more conducive to producing and retaining the

***Education Policy** continued*

researchers of tomorrow, through better immigration laws, better tax policies, and more financial incentives. The legislative result was the America COMPETES Act, which was signed into law by President Bush on 9 August 2007.

America COMPETES Act specifies legislative action in three areas a) increasing research investment in STEM disciplines through increasing funding for NSF, DOE, NIST, NOAA, NASA); b) developing an innovation infrastructure; and, most extensively, c) strengthening educational opportunities in science, technology, engineering, and mathematics from elementary through graduate school. The legislation emphasizes increasing participation in STEM and specifies the range of programs targeted at students and instructors (at all levels).

Although it is still early to assess the effect of the COMPETES Act, if Congress can fulfill its promise to fund the Act's programs, despite the current economic crisis, we could hope for a positive change in science education in the US. But not without our participation. So get to it!

If future features in this column we'll hear about other state and national education policy issues that affect us.

Engaging Students with Web 2.0

Pamela Gay, Southern Illinois University, Edwardsville

In today's digital world, educators are confronted with changed student expectations as well as with a new arsenal of tools. Learning how to effectively teach in this new digital environment requires a careful balancing act of real-world educational best-practices and integration of virtual content.

Many "millennial generation" students have had personal computers in their homes for their entire lives. They are used to fully rendered artificial realities and quickly updating simulations that mirror the real world. To them, digital line drawings are sometimes inexcusable, and two-dimensional simulations are "old school." While these students may have high expectations, they are easily able to interact with technology, and their willingness to engage in digital media and online communities can allow an astronomy instructor willing to embrace technology a variety of new ways to convey content.

Current students are constantly engaged (sometimes even during class!) in online media via their phones and laptops. Rather than confining ourselves to classic print media and CD/DVD/tape-based films, we can now branch out and point students to free online content, including YouTube videos, podcasts, and vodcasts. Podcasts in particular are easy for students to use because they are audio-only and can be listened to while on-the-go and while doing non-intellectual tasks. Many NASA missions have podcasts and videocasts and there are many popular astronomy podcasts and vodcasts available in iTunes.

Students can also interact with content through immersive environments such as Second Life. This particular virtual reality contains extensive educational content from NASA and other federally funded and non-profit programs, including an extensive rocket park, virtual solar system, and even an area of Mars Terrain.

While not as engaging as Second Life's full world experience, both Google Sky and Microsoft's World Wide Telescope offer different ways for individuals to explore the sky. Google Sky in particular has many educator tools and contains skins with text-based content from NASA missions, and non-profits such as Earth&Sky and Center for Backyard Astrophysics, and it allows people to view images in many wavelengths.

There is no substitute for good classroom instruction with minds-on social engagement, but online technology allows educators to provide a richer out-of-the-classroom experience for their students in a way that costs the students nothing. It can even increase office hour attendance—through chat software such as Skype and AOL Instant Messenger, it's possible for questions to be asked and answered from anywhere.

My take-home message is: Engage your students in class, but keep them engaged online through Web 2.0 technologies.

AAS Education Meeting Schedule - Long Beach, CA

SATURDAY, 3 JANUARY 2009
- CAE Astro 101 Teaching Excellence Workshop, Day 1 of 2
  Hyatt Regency Ballroom A
  9:00am-5:00pm

- NASA Faculty Institute on Preparing Future Teachers, Day 1 of 2
  Hyatt Harbor
  9:00am-5:00pm

- AstroZone: Long Beach
  Grand Ballroom
  12:00-4:00pm

- The Galileoscope & Hands-On Optics in the International Year of Astronomy
  Hyatt Shoreline
  1:00-5:00pm

SUNDAY, 4 JANUARY 2009
- CAE Astro 101 Teaching Excellence Workshop, Day 2 of 2
  Hyatt Regency Ballroom A
  9:00am-5:00pm

- NASA Faculty Institute on Preparing Future Teachers, Day 2 of 2
  Hyatt Harbor
  9:00am5:00pm

- IYA, Dark Skies Awareness Programs & You
  Hyatt Regency E-F
  9:00am-5:00pm

- CAE Active Questioning in the Classroom Workshop
  Hyatt Seaview Ballroom C
  2:00-5:00pm

- K-12 Educator Reception
  Hyatt Shoreline A
  5:00-7:00pm

- Undergraduate Orientation Reception
  Hyatt Pacific
  6:00-7:00pm

MONDAY, 5 JANUARY 2009
- The Center for Astronomy Education's (CAEs) Collaboration of Astronomy Teaching Scholars (CATS)
  Poster Session 429: Exhibit Hall A
  9:20am-6:30pm

- Education Research
  Poster Session 430: Exhibit Hall A
  9:20am-6:30pm

- Professional Development
  Poster Session 431: Exhibit Hall A
  9:20am-6:30pm

- Engaging Students: IYA2009 and Research
  Oral Session 311: Room 101B
  2:00-3:30pm

- Astronomy Teaching & Learning Reception
  Hyatt Harbor
  5:30-6:30pm

TUESDAY, 6 JANUARY 2009
- International Year of Astronomy Opening Reception
  Grand Ballroom 1
  6:30-7:30pm

- International Year of Astronomy Opening Event: 400 Years of Galileo's Telescope Movie Premiere
  General Session Hall
  7:45-9:00pm

WEDNESDAY, 7 JANUARY 20089
- Education - Practice Upper Level Undergraduate and Graduate
  Poster Session 461: Exhibit Hall A
  9:20am-6:30pm

- Education - Practice Undergrad Non-science Majors
  Poster Session 462: Exhibit Hall A
  9:20am-6:30pm

- Education - Practice K-12
  Poster Session 463: Exhibit Hall A
  9:20am-6:30pm

- Education Public Outreach
  Poster Session 464: Exhibit Hall A
  9:20am-6:30pm

- International Year of Astronomy 2009
  Poster Session 465: Exhibit Hall A
  9:20am-6:30pm

- International Year of Astronomy 2009 Overview
  Special Session 224: Grand Ballroom 1
  10:00-11:30: AM

- Education Research Brown Bag Lunch
  Hyatt Shoreline B
  12:45-1:45pm

- Astronomy Education Research
  Oral Session 353: Room 101B
  2:00-3:30pm

- International Year of Astronomy 2009 Programs
  Special Session 229: General Session Hall B
  2:00-3:30pm

- Astronomy Education Research
  Oral Session 353: Room 101B
  2:00-3:30

- Graduate Student Networking
  Location TBD
  6:00-7:00pm