The Universe at Your Fingertips 2.0 DVD-ROM
A Collection of Activities and Resources for Teaching Astronomy

ASP’s “greatest hits” of astronomy education, designed to help teachers, curriculum specialists, museum educators, and astronomers find the most effective way of teaching basic space science concepts!

This 2.0 DVD ROM includes:
• 133 field-tested hands-on activities
• 17 topic specific guides to information in print and on the web
• 52 background articles on astronomy and education
• 12 short videos with instructions.

Price: $29.95
Sold through the non-profit AstroShop on ASP’s website. Discounts are available for bulk orders and to catalogs, museum stores, and other resellers.

For more information and how to order, go to: www.astrosociety.org/uayf or call the ASP at 415-337-1100.

ASP • 390 Ashton Avenue • San Francisco, CA 94112

GIVE A STELLAR GIFT
Help foster scientific curiosity, science literacy, and the joy of exploration & discovery through astronomy … for tomorrow’s science, technology, and academic leaders! Share the gift of membership in the ASP!

astrosociety.org/membership
Give Yourself Tenure  
ANDREA SCHWEITZER

Following my PhD, I transitioned into an industry cubicle. Fifteen years later, I call myself a “scientist entrepreneur” having spent a decade working as a freelance project manager. I’ve got tenure; it’s just different from a tenured position at a university.

Restoring an Old Beauty  
MARY ANN UPTON

This is the story of how a century-old observatory was transformed into a modern teaching center while preserving its historical character.

Reflections: Science Fare  
PHIL PLAIT

The Bad Astronomer gives a short speech to students who participated in a science fair. “Welcome to science. You’re gonna like it here.”

Astronomy in the News

A volcanic history of Mars, changes in an exoplanet’s atmosphere, and an upcoming collision with the Andromeda Galaxy — these are some of the discoveries that recently made news in the astronomical community.

NAVIGATION TIPS

• To go directly to an article from here, click on its title.
• Within each article click on the underlined text for additional resources.
• Press [RETURN] to come back to this Contents page.
• To visit one of our advertisers, click on their website URL.

4 Editorial  
Paul Deans  
A Busy 18 Days

5 First Word  
James G. Manning  
In Transit

6 Echoes of the Past  
Katherine Bracher  
100 Years Ago: Cluster-type Variable Stars

7 Annals of Astronomy  
Clifford J. Cunningham  
Beyond Einstein

8 Astronomer’s Notebook  
Jennifer Birriel  
Exoplanets in the Habitable Zone

9 Planetary Perspectives  
Daniel D. Durda  
Scaling the Solar System

10 Armchair Astrophysics  
Christopher Wanjek  
Black Hole Roundup

11 Education Matters  
David Bruning  
The Future of Education and Digital Texts

12 Reaching Out  
Bethany Cobb  
A Transit of Clouds

13 Societal Impact  
Helen Barker and Jason Pittman  
Astronautical Engineering and Cyber Security: An Educational Partnership

30 Society Scope / ASP Supporters  
ASP Award Winners

34 Sky Sights  
Paul Deans  
Perseid Meteor Shower

37 Reflections  
Phil Plait  
Science Fare
A Busy 18 Days

If you love astronomy, you’ll long remember the 18-day period in May/June, 2012, as being pretty remarkable. From the annular eclipse on May 20 to the partial lunar eclipse on June 4 to the transit of Venus on June 5/6, it was a outstanding two-plus weeks that won’t soon be repeated. I hope you caught some of the action.

First up, the annular eclipse, visible as a partial across much of western North America (and eastern Asia). Annularity touched southeastern China, southern Japan, and a string of western US states. I watched the Moon encroach upon the solar disk from Chaco Canyon, New Mexico — a fascinating place even without the spectacle of an evening solar eclipse. Perhaps because it was near sunset, annularity brought darker skies than I expected.

But the best thing about this annular was seeing the partially eclipsed Sun setting behind some of Chaco’s ruins. While not quite as stunning as seeing the Sun set while in annular eclipse (here and here), it was, none-theless, a fascinating sight.

Next, a partial lunar eclipse swept across most of the Americas, the Pacific, Australia, and eastern Asia on June 4th. Unfortunately, my view of the eclipse was eclipsed by clouds.

Finally, the transit. To those of you who missed the passage of Venus across the solar face due to cloud, rain, or indifference… I’m sorry you didn’t see it. The images of the event are pretty good (start on this page in the Spaceweather.com Gallery and click “Previous” to advance through their submitted photos), as are some of the videos (a nice Earth-based view and an incredible view from space).

You might think that, unlike a total solar eclipse, the sight of the transit through a telescope would look about the same as a picture of the event. But you’d be wrong. There’s just

ON THE COVER

Front: The Hubble Space Telescope shows a rare view of a pair of overlapping galaxies. The two galaxies look as if they are colliding, but they are actually separated by tens of millions of light-years. The chance alignment of the two galaxies, as seen from Earth, gives a unique look at the silhouetted spiral arms in the closer face-on spiral. Courtesy NASA/ESA/ Hubble Heritage Team (STScI/ALMA)-ESA/Hubble Collaboration, and W. Keel (U. of Alabama)

Back: X-rays from Chandra (purple) show the hottest and most energetic areas of M101 (the Pinwheel Galaxy). Infrared data from Spitzer (red) and optical emission from Hubble (yellow) trace the dust and starlight respectively. Ultraviolet light from GALEX (blue) shows the output from young stars. Credits — X-ray: NASA/CXC/SAO; IR & UV: NASA/JPL-Caltech; Optical: NASA/STScI.
In Transit

Sic transit gloria mundi is, perhaps, an appropriate phrase when describing transits.

In a world full of fleeting moments, we often mark our days by the lingering legacies that singular moments create in our lives. And all through human history, many of those milestones have happened in the sky.

Consider, for example, the two glorious transits of the late spring of 2012.

The first occurred on May 20 — an annular solar eclipse (right), whose path of annularity sliced across northern California into the southwestern US. Officially, an "eclipse" — in the purest, most technical definition of that term — involves a body passing through the shadow of another. That's not what this event was. Technically, the May event was really a transit, the Moon being too small to completely cover the Sun (which would have been an occultation), and it thus passed across the face of another body, which is the definition of a transit.

And as a transit, it was fleeting indeed. From my observing site in Red Bluff, California, it took more than an hour for the Moon's silhouette to position itself squarely against the disk of the Sun. But once the curving horns of the solar crescent created by the obscuring Moon curled around to the Moon's trailing side to create the delicate, brilliant solar ring, it took a scant four minutes for the Moon to trundle across the Sun's disk and break through the solar limb on the far side. A close fit indeed.

The more classical (and much rarer) transit happened less than three weeks later — on June 5. In the mid-afternoon, as I watched from my perch on a bluff overlooking the sea, a much tinier black circle broached the solar limb and crawled onto the Sun's face: the silhouetted planet Venus. Its last such appearance against the solar disk had occurred eight years ago, but its next would be more than a century hence, so rarely does the precise line-up occur that affords such a view.

But this transit was more leisurely, lasting hours as distant Venus slowly made its way across the Sun. The (filtered) view was transfixing — the small, perfectly black, perfectly round planet visible against the perfectly round, perfectly bright disk of the Sun, passing fuzzier sunspots as it cut an angle across the solar disk. (See Paul's photo on the previous page). It was still transiting when the Sun striated in the atmosphere just above the horizon line and sank sizzling into the sea. Virtually no one on the Earth will see its like again, for the event will not repeat until 2117.

And this rare heavenly milestone will make 2012 "Transit Year" in our memories for many years to come.

To me transits — and they are all fleeting — are a celestial analog for our lives on Earth. In truth, we are all in transit in this world; we enter upon the stage, we make our brief mark against the face of the Sun, and we move on. And we hope that some lingering memory or legacy remains to note our passage.

The same is true of living entities like the ASP. In a year and a half, your Society will be 125 years old. And it still operates on a legacy built and nurtured by all of the founders, members, supporters, staff, and Board members who, during the decades long past, have striven mightily in a common cause. That cause? To promote astronomy, science, and science literacy; to seed understanding and appreciation of the universe around us; to use the sky we love to inspire tomorrow's scientists, science educators, and informed citizens; to help create the science-friendly future essential to addressing the great global challenges we face; and, in the process, to make life better for all.

These are noble goals, and worth spending time on during our own fleeting transit through the world. And I thank you, the reader, for your companionship and support in raising up the Society and making a difference for us all.

One hundred years from now and more, if the ASP continues to flourish and be vital and relevant to those who care about science and love the sky, it will be because of the legacy that you are helping us to build right now, every day, in countless ways. And what a milestone that would be: the Society still strong and thriving when next people on Earth raise their filtered eyes to watch Venus pass in its orbit across the face of the Sun! 

JAMES G. MANNING is the Executive Director of the Astronomical Society of the Pacific.
A century ago, the stars we now know as RR Lyrae variables were just being recognized as a separate class, as described in an article by C.C. Kiess in the August 1912 Publications of the ASP. Because most of these stars seemed to be in globular star clusters, he referred to them as cluster-type variables; this terminology lasted for quite some time.

But, Kiess wrote, “More surprising than the fact that variable stars are present in clusters, was the fact that in the great majority of instances the variation is of a new type.” These stars had short periods of variation, from 0.4 to 0.7 days, and “the rise from minimum to maximum light...is very rapid.” And they were all faint, with most of them being around 13th magnitude at maximum light. In these respects they differed from the Cepheid variables, which had longer periods and no uniformity in their maximum brightness. Kiess noted that a few isolated, non-cluster stars also showed this type of light variation, though without the uniformity in maximum light. He provided a list of 16 of these, of which the star RR Lyrae was the brightest.

He went on to note that: “Up to the present time no satisfactory theory has been advanced to explain the cluster type of variation.” Astronomers were divided on whether these stars were “a separate and distinct class, or are only an extreme type of the ordinary short-period [i.e. Cepheid] variation.” If the latter, then there should be one theory to explain both.

Kiess described the results of studying 11 Cepheids spectroscopically, which seemed to show that they were all binaries. This conclusion came from the variations observed in the radial velocities, suggesting a star orbiting a center of mass, and alternately approaching and receding from us. There were then three theories for the light variation: “the tidal theory, the resisting medium theory, and the variation-in-absorption theory.” Another theory had been proposed for the cluster variables, involving eclipses in a system with absorbing material between the two stars. Kiess thought this one was quite promising.

But he cautioned that before settling on a theory, one needed more information concerning the relationship of the light changes to the radial velocity changes. “We must have definite knowledge [about this] before we can decide in favor of one or the other of the above-mentioned classes, or must seek an altogether new explanation. We await the evidence which a star bright enough for spectroscopic study and analysis can give us.”

Such evidence was not long in coming. In 1914 Harlow Shapley showed definitively that Cepheids were pulsating stars, not binaries, and this was soon extended to the cluster-type variables as well. On this theory, the radial velocity variations come about as the star expands (and its surface moves away). Temperature changes also occur as the star expands and cools, and contracts and heats up. This pulsation idea soon supplanted the binary star theories.

The Cepheid variables had another useful property, first published by Henrietta Leavitt in 1912. This was a clear correlation between the mean luminosity of the star and its period of variation: the longer the period, the brighter the star. Leavitt discovered this for stars in the Small Magellanic Cloud, which were all about the same distance from us. In 1913 Ejnar Hertzsprung realized that this could provide a tool for finding distances, and he determined the zero-point for the period-luminosity relation. Then if one found a Cepheid, one had only to determine its period, and one would know its absolute magnitude; comparing this to its apparent magnitude would give its distance. Extending this to cluster variables, which were fainter than Cepheids, suggested that they would have absolute magnitudes of about 0.

The study of Cepheids and RR Lyrae stars (as they have come to be known) has provided us with much information. Edwin Hubble used Cepheids to find the distance to M31, the Andromeda galaxy. In 1952, Walter Baade’s failure to find RR Lyrae stars in M31 led to the realization that the period-luminosity distance scale was wrong by a factor of 2, and the galaxies were twice as far away as we had thought. It also led to the recognition of two major types of stars, Population I and Population II. So these variable stars have played a major role in cosmology in the past century and no doubt will continue to do so.

KATHERINE BRACHER taught astronomy at Whitman College in Walla Walla, WA, for 31 years. Retired in 1998, she currently lives in Brunswick, Maine. Her research focuses on eclipses and the astronomy of the ancient world; her other principal interest is early music.
Beyond Einstein

Physicists still struggle to explain how the universe really began.

“I wish my physics professor had been like that” said one member of the audience after listening to a presentation by Abhay Ashtekar. Few professors of physics have the ability to convey the complexities of cosmology to the public the way Ashtekar can, which is why he was chosen to deliver a Science Frontiers lecture at Boca Raton’s Florida Atlantic University. Ashtekar, who holds the formidable title of Director of the Institute for Gravitation and the Cosmos at Pennsylvania State University, took his audience on a journey beyond Einstein.

 Appropriately enough, just a few steps away from the lecture venue sat a ceramic vase depicting the great Einstein himself(right). The image is based on the famous photo of him sticking out his tongue like a little kid. It was part of a series of 12 ceramic vases done by Tabitha Pennekamp as her Master of Fine Arts thesis exhibition. There is a secret message encoded in the series — each vessel stands for a letter that spells out a phrase.

The exhibit was the perfect complement to Ashtekar’s lecture, which revealed how physicists during the past century have gradually pieced together clues from various celestial objects that are leading to an understanding of how our universe began. Ashtekar subtitled his talk “An Ode to the eternal themes of the Beginning and the End.” And it all began one hundred years ago when Albert Einstein ignored the advice of one of the world’s leading physicists.

Asked by Max Planck what he was working on, now that the theory of Special Relativity was behind him, Einstein replied he was working on a new theory of gravity. He felt it was needed because the results derived from Newton’s work did not agree with Special Relativity. Planck advised against such an endeavor, because “…even if you succeed, no one will believe you.” “Fortunately for us,” said Ashtekar, “Einstein did not take the advice seriously.” The result in 1915 was General Relativity, which “possessed both beauty and a compelling nature.”

Using a simile from the theatre, Ashtekar likened objects such as stars and planets to “actors in the eternal drama of the universe. Through General Relativity, space and time join the troupe of actors — they are no longer the stage.”

In a concept many people still have trouble comprehending a century later, Einstein realized that “gravity is geometry. The gravitation field is encoded in the very geometry of space-time.” Going back to Elizabethan writer Francis Bacon, Ashtekar said relativity displays Bacon’s idea of “strangeness in proportion. If something is very, very strange it is likely wrong, but relativity is strange in just the right proportion” to make it believable.

The most recent measurements by our most sophisticated space probes have confirmed the reality of relativity. Suppose you were just given a one-hour-old baby to examine, posited Ashtekar. From its appearance just after birth, show how it will appear as a 40-year-old. “That is the power of Einstein’s equations” when applied to the universe. We can now look back to when the universe was just 380,000 years old, where tiny fluctuations in matter led to the formation of the galaxies and planets that we see billions of years later.

“But we have to go beyond Einstein to understand the origin” of these fluctuations. Several decades ago a theory called inflation was developed, which can take physicists back to a point where all the matter in the universe appears to come together at a single point. But it is at this point that “inflationary physics throws up its hands and comes to a halt.” To find out how the universe really began, Ashtekar and others around the globe are working on a new theory called loop quantum gravity.

The most startling thing to emerge from this theory is that there was no Big Bang after all. “Quantum gravity creates a new repulsive force which overwhelms gravity. The Big Bang is replaced by the Big Bounce,” he said.

Instead of everything coming together at a singularity where numbers go to infinity and physics breaks down, this theory shows that there is a tiny bottleneck through which everything came from an earlier time. It’s not a different or parallel universe, but another aspect of our own universe that existed more than 13.7 billion years ago.

While the first paper on quantum gravity was published 25 years ago, it has really been just within the last five years that physicists have made this major breakthrough, and much work remains to be done. Ashtekar suggested that people interested in the subject should consult the non-technical articles listed on his semi-popular articles webpage.

CLIFFORD J. CUNNINGHAM was recently seen in London at the Diamond Jubilee celebrations of Queen Elizabeth II.
Exoplanets in the Habitable Zone

A new Web database provides habitable zone information for exoplanetary systems.

The existence of liquid water is considered an a priori requirement for life to exist on a planet. Of course, this assumes that we are talking about carbon-based life! Water exists in a liquid state between 273° and 373° Kelvin. Strictly speaking, then, the “habitable zone” around any star is the region in which the temperature falls in this range.

The number of known exoplanets increases each week and there are several online databases available to exoplanet enthusiasts: the JPL New Worlds Atlas, the NASA Exoplanet Archive, and the Extrasolar Planets Encyclopedia. These three include information on all the known exoplanets. However the Exoplanet Data Explorer is the only database limited to exoplanets with complete orbital solutions.

None of the aforementioned databases include information on the habitability of the known exoplanets. To fill this gap, Stephen Kane and Dawn Gelino of the NASA Exoplanet Science Institute at Caltech have developed an online resource called the Habitable Zone Gallery or HZG. As they explain in their paper “The Habitable Zone Gallery” Kane and Gelino utilized data from the Exoplanet Data Explorer (EDE). The EDE contains only data for exoplanets with complete orbital solutions, including the orbital inclination with respect to Earth, size of the semi-major axis, orbital eccentricity, and orbital velocity. Each exoplanet entry also contains information on the parent star of the exoplanet including its mass, radius, and effective temperature.

Kane and Gelino calculate the habitable zone assuming a runaway greenhouse effect at the inner radius and a maximum greenhouse effect at the outer radius. They assume that each exoplanet absorbs all incident infrared radiation, so that the exoplanet behaves like a blackbody. Assuming that the atmosphere of each exoplanet is 100% efficient at redistributing heat, Kane and Gelino calculate each planet’s temperature for a “well-mixed” case. They also calculate the planet’s temperature assuming that the planet has a “hot day side” by assuming that the atmosphere is completely inefficient at redistributing heat. Finally, they calculate the orbit of each exoplanet from EDE data, assuming a Keplerian orbit in which the exoplanet and parent star are treated as point masses.

So, what does the HZG offer? The home page of the HZG presents a plot of known exoplanets that enter their habitable zones. These are displayed on a plot of orbital eccentricity versus orbital period, and planets that spend more time in their star’s habitable zone are represented by successively larger dots. Beyond this, the three main parts of the HZG are a Table, a Gallery, and Movies.

The Table displays each exoplanet’s orbital parameters, the percentage of time the exoplanet spends in the habitable zone, and the exoplanet’s temperature in the well-mixed and hot-day side models for closest (periastron) and farthest (aphelion) approach to the parent star. The Gallery displays up to three columns per system. The second column is a representation of the habitable zone, the first column represents the outer region, and the third represents the inner region of the system. If there are no outer and/or inner planets, then the first and/or third column for that exoplanet is empty. Lastly, the Movies section of the HZG has MPEG-2 and MPEG-4 movies of the exoplanet orbits relative to their habitable zones.

The HZG is designed to automatically update without the need for data entry. If changes to the EDE database occur, whether these are additions of new exoplanets or changes in existing exoplanet data, the HZG code updates all portions of the HZG.

Now, “habitability” is not guaranteed simply because an exoplanet resides in the habitable zone. For example, a gas giant in the habitable zone is not likely to harbor carbon-based life. There is also the question of just what percentage of a terrestrial planet’s orbit must be within the habitable zone in order to ensure habitability? In an article accepted for publication in Astrobiology, Kane and Gelino explore the possibility that extremophiles might survive by hibernating during time periods in which an exoplanet spends time outside the habitable zone. Obviously, the development of the HZG is just one small step for astrobiologists.

JENNIFER BIRRIEL BIRRIEL is an Associate Professor of Physics in the Department of Mathematics, Computer Science, and Physics at Morehead State University in Morehead, KY. She and her husband have two teenagers and sometimes find themselves residing outside of the habitable zone.
Scaling the Solar System

Did you know there are as many inches in a mile as there are astronomical units in a light-year?

My friend Phil Plait (aka “The Bad Astronomer”) recently posted a fun entry on his blog, reminding me of something I ’discovered’ back about the time I was in eighth grade. I was tinkering around with various ways to get a better sense of the scale of the solar system and the relative sizes of the planets. One scale model system I like to use lets a standard 12-inch globe stand in for the Sun. When the (roughly) 1.4 million-kilometer-diameter Sun is shrunk down to 12 inches, our little Earth can be represented by a mere BB just one-tenth of an inch across located about 107 feet from the globe. The Moon is just a large grain of sand a little more than three inches away from BB Earth.

But I was thinking about yet larger scales, intrigued by the idea of planets orbiting other stars. I wanted to develop a better intuitive ‘feel’ for the sizes of planetary systems and the distances between the nearby stars. Picking a simple scale of one inch equaling one astronomical unit (AU — the average distance of Earth from the Sun, about 150 million kilometers), I found a pretty convenient way to shrink the solar system down a bit and picture the sizes of planetary orbits in simple units I could easily relate to. I then calculated the distance to Alpha Centauri on that scale, converting 4.3 light-years to kilometers and then scaling to my ‘one inch equals 150 million km’ model. Converting the resulting huge number of inches into something that might make some sense, the answer came out to about 4.3 miles.

But wait a minute — that was the same number I put in for the distance in light-years! Going back to the numbers, and looking for the most precise distances I could find, I double checked everything and stumbled upon a most amazing coincidence. To a precision of about 0.07%, there are as many inches in a mile as there are astronomical units in a light-year! That makes for a very convenient and easy-to-remember scale model of our planetary and near-stellar environment — measure AUs in inches and light-years in miles.

I’ve made an inner solar system scale model (right) to share with you — at one inch equals one AU, even the Sun is the right size! Just print this page to its exact actual dimensions and take it outside with you on your own mind’s-eye journey to the stars.

Daniel D. Durda is a Principal Scientist in the Department of Space Studies at the Southwest Research Institute in Boulder, CO.
Black Hole Roundup

Enigmatic black holes continue to reveal their secrets.

Despite the pervasive gloom enshrouding high-energy astronomy due to budget cuts and mission cancellations, major discoveries abound. These include exciting advances in our nascent understanding of dark matter, dark energy and, of course, black holes. What follows is a black hole “roundup” of news from recent months.

Near and fear. Think all black holes are in galaxies far, far way, churning and burning on timescales of millions of years? Well, we all might be in for a treat come 2013 as our Milky Way’s own central supermassive black hole, Sagittarius A*, prepares to swallow an unsuspecting gas cloud.

Stefan Gillessen, an astrophysicist at the Max Planck Institute for Extraterrestrial Physics in Munich, has calculated that a gas cloud is expected to pass in its vicinity at a distance of only 36 light-hours, which is much less than the radius of our solar system.

In his 20 years of studying objects around Sagittarius A*, Gillessen said only two stars have come that close. “They passed unharmed,” he said. “But this time will be different. The gas cloud will be completely ripped apart by the tidal forces of the black hole…. It will be elongated and stretched like spaghetti.”

Black holes can’t be seen, but the release of energy from this gas cloud falling in by the summer of 2013 will be detectable across much of the spectrum. Scientists can watch in real-time. Already the cloud is brightening and moving faster and faster, Gillessen said.

On the move. Black holes are menacing enough, but how about one on the move, punted from its host galaxy at a velocity exceeding three millions miles an hour? Astronomers using NASA’s Chandra X-ray Observatory have found one such black hole.

Astronomers think the black hole, a system called CID-42 in a galaxy four billion light-years away, attempted to merge with another supermassive black hole and got a powerful recoil kick from gravitational wave radiation.

“It’s hard to believe that a supermassive black hole weighing millions of times the mass of the Sun could be moved at all, let alone kicked out of a galaxy at enormous speed,” said Francesca Civano of the Harvard-Smithsonian Center for Astrophysics, who led the new study. “But these new data support the idea that gravitational waves — ripples in the fabric of space first predicted by Albert Einstein but never detected directly — can exert an extremely powerful force.”

Although a rare event, the observation implies that there are many other supermassive black holes whizzing through intergalactic space undetected.

Black hole glitterati. Somewhere between stellar-size black holes and the supermassive variety come so-called intermediate-mass black holes. This is a relatively recently discovered phenomenon — these black holes contain the mass of a few hundreds to thousands of suns.

Astronomers don’t know how they form, but now a new observation with the Hubble Space Telescope provides some insight. A team led by Sean Farrell of the Sydney Institute for Astronomy in Australia had discovered an intermediate-mass black hole called HLX-1 back in 2009 using the European Space Agency’s XMM-Newton X-ray space telescope. Farrell’s follow-up with Hubble reveals a cluster of young, blue stars encircling it.

The star cluster suggests that the black hole once was at the core of a now-disintegrated dwarf galaxy. This, in turn, implies that intermediate-mass black holes form at the center of small galaxies (and not from stellar-size black hole mergers, as hypothesized) and can merge with similar or larger black holes to create supermassive black holes.

New kid on the block. While time might slow around a black hole, the rate of discoveries about black holes surely will increase with the June 2012 launch of the NASA-led NuSTAR mission. The NuSTAR telescope is 100 times more sensitive than any previous high-energy X-ray telescope, and it will make images that are 10 times sharper than any that have been taken before at these energies.

Black holes are a major target for NuSTAR, as is any other high-energy phenomenon, such as supernovae or even certain solar activity from our own Sun. NuSTAR’s imaging ability means that it can complement the NASA Swift mission in conducting a census of all the black holes in the cosmic neighborhood but also measure how fast black holes spin.

Assuming all goes well with post-launch operations this summer, NuSTAR will give us a front-row seat for next year’s Sagittarius A* dinner of gas. [RETURN]

CHRISTOPHER WANJEK is the author of the new novel Hey, Einstein!, a nature vs. nurture tale about Albert Einstein clones, created by the CIA but raised in less-than-ideal settings, now being recruited to save the world from an evil genius.
Recent poll indicates that 20% of American adults now own or use e-readers or tablet computers; among students, the usage rate is slightly higher at 25%. Given the increasing usage, will we soon be at a crossroads where digital astronomy texts will replace printed books?

I predict that students will be using e-texts regularly in 10 years. The attractions of tablets are too many to not use them in our classrooms. But widespread adoption will take some time because student and faculty buy-in has been weak, and true digital textbooks remain largely unavailable. For example, Apple Inc’s Inkling textbook store currently lists only 10 science texts, none in astronomy or physics.

Buy-in has been slow because students have found many e-readers are not up to their standards. They demand glossaries, search functions, and annotation capability, and lose interest in reading if those features are unavailable. WiFi and Internet access remains a problem for retrieval of materials off-campus. While e-readers have the potential to lower student costs, the savings so far have been minimal. E-rentals cannot be resold, e-texts are hard to share, and some e-books cannot be returned if a student drops a course. For example, Apple Inc’s Inkling textbook store currently lists only 10 science texts, none in astronomy or physics.

Disappointingly, some surveys show that students read less and/or found reading digital material more difficult than with traditional textbooks. Students also mentioned that they “could not imagine e-text features and tools that would allow them to work mathematics problems with greater speed, efficiency, and convenience than old-fashioned paper and pencil.” Faculty found that they needed to spend considerable time training students to use e-readers and how to effectively read digital materials. Many e-books do not use page numbers, so assigning readings can be difficult. Dead batteries and insufficient power outlets in classrooms remain an issue.

In my opinion, these are short-term problems. The logistics of providing useful software, producing inexpensive tablets, and developing digital materials will be worked out and, most likely, quickly as publishers embrace the economic opportunities. Of bigger concern to me is the shape of digital books and how they will transform learning.

It is insufficient to merely recast a book into an electronic file format. Apple Inc’s Inkling software has the ability to embed audio, video, web links, links to glossaries, and more into digital textbooks. But this is not much different from having a companion website accessed from the tablet. Students may be more apt to click on a pop-up concept check on the companion website, but it certainly is not more innovative. Instead, I think we need to rethink the concept of the textbook and what it means to read.

Good printed texts have a narrative thread, a storyline that keeps the concepts working together. To read them requires an engagement that revolves around the deep thinking parts of the brain. But perhaps this is a skill that is fading away, much like slide rules gave way to calculators. David Ulin, in The Lost Art of Reading, writes that in the modern world, the result of reading: “is not contemplation…but an odd sort of distraction, distraction masquerading as being in the know.”

Should we retain the old sense of reading with e-textbooks, expecting students to think deeply about the material? Or because maintaining printed astronomy texts in digital form will not meaningfully exploit digital strengths, should digital texts usher in a new expectation of what reading means? We instructors, not multimedia artists, need to decide the direction of electronic texts.

Instead of being mesmerized by the novelty of embedded videos and digital devices, we should ask whether digital features engage student thinking or merely replace it. The discussion of what reading now means, and how it shapes our texts and student learning, should be central to the discussion about e-texts.

Most electronic textbooks are simply print editions reformatted.
On June 5, 2012, for the second and last time this century, Venus transited the Sun. It was a fantastic moment for astronomy, garnering the interests of the national press and news media, and reminding the world just how extraordinarily cool astronomy is.

My plan for the day was to hold a “sidewalk astronomy” event on the National Mall in front of the Smithsonian National Air and Space Museum. That way, I figured, I’d have wide-open skies to the west and could share the event with those who had specifically come to the Museum — and maybe even catch some DC tourists by surprise.

I had roped another professor and a physics graduate student into this adventure and, on the day, they expressed some skepticism about the sky conditions. But I insisted that we soldier on anyway — bolstered by weather reports that suggested at least partial sky clearing in the evening. In the morning, I clumsily painted a sign to advertise the event, and at the prearranged time I packed up the telescope and some eclipse-viewing glasses and headed to the National Mall.

Once there, I saw that the conditions were terrible — thick clouds everywhere with nary a break in between. I’d love to tell you that a miraculous wind blew in, clearing the skies and laying bare the Sun for all to behold the majestic beauty of Venus’s delicate form gracefully sailing across the face of the fiery ball of hydrogen that gives us life. Instead, it was solid clouds. The. Whole. Time.

Well, that’s observational astronomy for you.

Since I can’t tell you about the wonder on the faces of the little children as they beheld, with their own little eyes, this once-in-a-lifetime occurrence, I will instead share with you my “Top 10” list of lessons learned by this attempt at public outreach.

1) If you set up a telescope on the National Mall, people will flock to it.
2) The ASP is awesome. I built a Sun Funnel for the transit at the 2011 ASP meeting in Baltimore, the same meeting where I won my telescope in a raffle!
3) It’s a bad idea to wait until three weeks before possibly the biggest solar event of the century to buy a solar filter (seriously, even eBay was sold out.)
4) Weather reports lie. (Granted, I already knew this, but it was reaffirmed.)
5) Glitter paint may not dry as quickly as you believe it should. (Oops.)
6) People strongly believe that a telescope should be able to penetrate the clouds. (Sadly, our eyes are just sensitive to the wrong part of the electromagnetic spectrum.)
7) The Internet is awesome. (I was able to live-stream video of the event on my cell phone.)
8) People can be unwaveringly patient and optimistic. (Some waited well over an hour, crossing their fingers.) But…
9) No amount of wishful thinking will clear the sky of clouds. However…
10) Even when the observations fail, everyone still loves astronomy!

Seriously, even though the evening was a complete bust, I’m still glad I did it. I had the fortune to see the 2004 transit briefly as it peaked out between clouds, and so I just had to try. At least I was able to share the event in digital form. In the end, I had great conversations with an enthusiastic crowd. We talked about the history and the science of the transit, and how transits just like this were leading to the discovery of thousands of extrasolar planets thanks to the Kepler mission.

And thus the final lesson learned is that despite the conditions and the hassle, I’d do it all again. So, here’s looking forward to that next great astronomical event.

By Bethany Cobb

A Transit of Clouds

Clouds over Washington spoiled the show, but my outreach effort wasn’t in vain.

BETHANY COBB is an Assistant Professor of Honors and Physics at The George Washington University, where she studies gamma-ray bursts and teaches physics/astronomy to non-science majors.
Astronautical Engineering and Cyber Security: An Educational Partnership

The space industry is facing an increasing number of breaches in security.

In the information era, the need for secure channels of communication is critical to the success of an organization, whether it is the local bank or NASA. Nowhere is the reliance on secure information more evident than within the government and the contractors that support the government. This is not an agenda exclusive to the United States; it represents a worldwide problem. The literature base is growing with articles from around the world describing research results of new products/models for protecting our information. (For those interested, “Physical Layer Security in Multibeam Satellite Systems” is a PDF technical paper by Gan Zheng, Pantelis-Daniel Arapoglou, and Björn Ottersten that appeared in IEEE Wireless Communications, 2011, Vol. 18, No. 6.)

Cyber Security Extends to Space
The space industry is one arena that is facing an increasing number of breaches in security. Recent attacks on US aerospace companies have led to a demand for improved security (e.g. stronger encryption and authentication). One of the more recent cyber attacks on the RSA SecurID authentication system provided hackers access to the network of the largest weapons manufacturer in the US. While it is unclear to the general public what kind of data was compromised, we can be reasonably sure that there were negative consequences for multiple stakeholders.

The negative consequences of a breach like the RSA SecurID incident originate with the nature of the security product and the breadth of the product’s implementation. SecurID is a security product developed by RSA that provides dual-factor authentication. Dual-factor authentication pairs one type of authentication (something you know, such as a password) with a complimentary type (something you have, such as a hardware or software token). SecurID exists in both hardware and software versions. Banking institutions, aerospace and defense companies, and major corporations all use RSA SecurID. Although RSA ultimately resolved the security issue by issuing new SecurID tokens, imagine what might happen if such a breach in our satellite infrastructure went unnoticed even for a short period of time.

Communication satellites are an important component of the space infrastructure supporting the US. Any breach in any part of the satellite system (such as the control system) can have significant consequences. The victimization of two US government satellites by suspected Chinese hackers in 2007 and 2008 emphasizes our increasing vulnerability to attacks by a new generation of sophisticated hackers. The stakes are high for government projects such as NASA’s Dawn mission, which offers potential opportunities for paradigm shifting discoveries. Such missions are exposed to cyber attacks, further emphasizing the necessity for making security a high priority in the space industry.

This connection between space exploration and information assurance provides great opportunities. The results from this interdisciplinary arrangement will allow us to bridge the divide between these fields of study. As a result of these two industries coming together, we will be able to harness new ideas and ensure the security of current and future space technology. At the same time, students in both fields will benefit from the increased exposure to fresh ideas. Therefore, we need to create a new curriculum.

Joining Astronautical Engineering and Information Assurance
The creation of a joint curriculum between the astronautical and cyber security fits neatly under the auspices of the US National Science Board’s science, technology, engineering, and mathematics (STEM) program. STEM intends to foster creativity and advancement in the above-mentioned fields through education. There is active research under STEM in both astronautical engineering and information assurance. An immediate educational partnership between the two fields will effectively prepare future space professionals.

The education of a new generation of workers in space-associated
Addressing the 26th National Space Symposium, Secretary of the US Air Force Michael Donley indicated that future global initiatives depend heavily upon the security of space assets. In his 2010 master’s thesis, David Perez acknowledged a growing reliance on cyber space for astronautical operations yet concluded that there is a lack of focus on related cyber threats. Similarly, in the August 2010 issue of High Frontier, Josh Hartman indicated that providing cyber security for an expanding space infrastructure could be problematic given the current control theater. To counteract this trend, a multidisciplinary approach comprised of space industry professional and cyber security professionals is recommended.

Meeting the future needs beyond those of current civilian and military workforces likewise requires a multi-disciplinary educational approach. The fields of astronautical engineering and information assurance contain well-established educational criteria ripe for such a partnership. Both fields rely upon curricula comprised of multiple scientific disciplines — mathematics, computer science, and communications technology to name a few. It is not a stretch to image the future space professional being equally versed in numerous related subjects.

Adding cyber security after the fact is not a successful strategy. Many have analyzed and discussed the ill effects of attempting to do so. The success of melding information assurance topics into cross-discipline curricula is well established, as described by Glenda Rotvold and Sandy Braathen in their autumn 2007 article “Integrating Security Awareness Into Business and Information Systems Education” (Journal of Business and Training Education, Vol. 17). This topic was also discussed in 2009 during a panel on Integrating Disciplines: Cyber Security, Law, and Policy sponsored by the Georgetown Institute for Law, Science and Global Security, and Lawrence Livermore National Laboratory. Thus, partnering astronautical engineering and information assurance at an early educational juncture is critical.

The consequences of security vulnerabilities in the space industry could be catastrophic. Not only could adversaries attack space infrastructure such as satellites, mission delivery vehicles, and semi-permanent research facilities like the International Space Station. (One related 2007 article by Janie Hulse for the Strategic Studies Institute, U.S. Army War College, is titled “China’s Expansion into and U.S. Withdrawal from Argentina’s Telecommunications and Space Industries and the Implications for U.S. National Security”.) A successful attack on some of these infrastructure components could lead to economic collapse, breakdowns in national security initiatives, and interruption to global positioning services amongst others (see the paper by Charles Cynamon: “Protecting Commercial Space Systems: A Critical National Security Issue”). Likewise, the consequences of not integrating cyber security education and astronautical engineering education may open space infrastructure to unnecessary vulnerabilities.

The path to the future is clear. Technology is becoming more pervasive in our lives, and our presence in space is likewise expanding. Current information assurance professionals know how to secure terrestrial assets. Current astronautical engineering professionals know how to put assets into space. Tomorrow depends on students applying knowledge from both fields.

We challenge the American education system to develop interdisciplinary programs in information assurance and space related curriculum. We make this recommendation based on the belief that there is the need to support the ever-changing interrelated nature of the sciences.

HELEN G. BARKER is the Dean of Information and Business Sciences at Capitol College, Maryland. JASON M. PITTMAN is a faculty member in the Information Assurance Department, also at Capitol College.
The academic life, whether at prestigious Harvard or [Insert Name Here] University, may not be for you, the newly minted graduate student. Courtesy Paul Deans.

“Science is a wonderful thing if one does not have to earn one’s living at it.” — Albert Einstein

by Andrea Schweitzer
Fifteen years later, I call myself a “scientist entrepreneur,” having spent a decade working as a freelance project manager. During my eighth year freelancing, I was even able to give myself a sabbatical year off! The path I choose isn’t easy, but it’s an option to the equally challenging academic track.

Conventional Career Advice
Because tenure-track jobs are so competitive, you must stay on a focused career path within academia. If you don’t eventually land a tenure-track job, the conventional wisdom is to expand your job options by considering opportunities in industry, government, teaching at non-research institutions, science writing, etc. Often this takes place after the first or second postdoc position. This is an inefficient career path — not to mention very stressful, disheartening, and financially unwise for young scientists.

Paula Stephan wrote in her recent book, “How Economics Shapes Science”:

The market for scientists and engineers differs in many respects from that of other markets. The gestation period is extremely long, the cost of getting the degree is exceptionally high, and the job prospects at the time of graduation are difficult to predict. Moreover, aspirants often lack reliable information concerning the job outcomes of recent graduates. Somehow, in this era of information technology and social networking, the young still make career decisions, especially with regard to science and engineering careers, in the dark.

The Odds Are Not In Your Favor
Oftentimes, young scientists have not been encouraged to think objectively and cautiously about their career plans, and many people (myself included!) over-estimate the likelihood of landing a permanent academic position. Consider these odds:


“One must conclude that there is considerable disparity between the aspirations of young scientists and engineers and the reality that, depending upon the field, at most 25 percent will get a permanent position in academia.” How Economics Shapes Science, Paula Stephan, Harvard University Press, 2012, page 170.

I would like to present another option for consideration — the career path of the scientist entrepreneur who is deeply committed to his or her interest in science, but who may find a more efficient way of earning a living while still maintaining the most important aspects of an academic life.

As a recent PhD on the job market for the past two years, I know my experience is pretty average. I’m not holding out for a tenure-track professorship in a research university, but willing to take anything that involved teaching — and unable to get it... we’re in our 30s applying for food stamps and trying to figure out how to start over. We don’t need options outside the research university — we need options outside academia. Posted on a career discussion board on the Chronicle of Higher Education, January 12, 2011, at 09:14 am.

Many young scientists who do land a coveted tenure-track job speak (off the record) of their exhaustion and of the lack of time for starting a family. I have also heard from some full professors (even further off the record) that they, too, can become disillusioned with academia, get burned out from grant writing and university committee work, and toy with the idea of leaving it all behind and making a fresh career start.

Academia: Idealism vs. Reality
When I made my decision to go to graduate school and get a PhD in astronomy, I began with the expectation that the sacrifices and hard work would pay off with a secure position as a professor. Even though I was told that there were no guarantees, I presumed that since I had won awards in college, was a good teacher, and had authored research papers as an undergrad, I had a good shot at a tenured position. (I think this is like the Lake Wobegon effect: every new grad student believes that they are at least a bit above average.)

I arrived at graduate school with the hope that I would pursue interesting research, teach astronomy to inquisitive undergrads, and engage in an exciting and challenging community of like-minded academics. I pictured contributing to both my scientific field and to the broader university community. (And I did do all of this — albeit with a much heavier workload than I expected!)
I think this idealized view of academia grew out of the 1960s when US investment in the sciences greatly expanded, when academic jobs and grants were easier to find, and science was the place to be. I believe most people who choose to become scientists have some version of this dream, though some may emphasize research, others teaching.

While our ideals of academia may come from the science expansion of the 1960s, the university world no longer works that way, and there have been significant governmental budget changes. For example, during the Apollo era NASA was supported by more than 4% of the US budget; NASA now receives about 0.5%.

Midway through graduate school I began asking some of the hard questions about continuing in an academic career. Discussions with early-career scientists who were a few years to a decade ahead of me brought an unwelcome dose of reality. Applying for jobs, chasing grants, moving frequently, living on a shoestring budget, and placating unhappy spouses were concerns of many postdocs.

As reported in “The PhD Now Comes With Food Stamps” in the Chronicle of Higher Education (May 6, 2012): [There is] an often overlooked, and growing, subgroup of PhD recipients, adjunct professors, and other Americans with advanced degrees who have had to apply for food stamps or some other form of government aid since late 2007. …Others are trying to raise families or pay for their children’s college expenses on the low and fluctuating pay they receive as professors off the tenure track, a group that now makes up 70 percent of faculties. “It’s the dirty little secret of higher education,” says Matthew Williams, cofounder of the New Faculty Majority, an advocacy group for nontenure-track faculty. “…all it takes is for somebody to run the numbers to see that their faculty is eligible for welfare assistance.”

The Great Grant Funding Game

Even professors find their extended responsibilities and the endless quest for funding to be very stressful. One blogger wrote: “My money fears aren’t just about getting tenure. There’s actually a deeper worry, and one that will still be with me even if I do get tenure, That’s funding graduate students…. This is a Sword of Damocles that will be hanging over me for the rest of my life.”

This is not an isolated fear. The American Academy of Arts and Sciences wrote in their 2008 ARISE report:

Young scientists today face much greater burdens than in the past. They experience lengthening training periods in the form of multiple postdoctoral fellowships, limited pay, and greater hurdles to receiving federal funding. …[NSF] funding rates decreased from 30 percent in 2000 to 21 percent in 2006. …One-half of new investigators never again receive NSF funding after their initial award. …Too much time is being spent preparing and resubmitting grant applications. Productivity is being compromised and morale is suffering.

The Young Scientist’s Dilemma

Given the disillusionment many scientists have found with their academic lives, and that roughly two-thirds of young scientists are unlikely to land a long-term university position anyway, and those who do get an academic position are faced with ongoing grant funding hurdles, perhaps it is time to re-think academic career planning.

Dan Pink, author of Drive and Free Agent Nation, wrote: “The old social contract didn’t have a clause for introspection. It was much simpler than that. You gave loyalty. You got security. But now that the old contract has been repealed, people are examining both its basic terms and its implicit conditions.” He added: “Just as sensible investors would never sink all their financial capital into one stock, free agents…are questioning the wisdom of investing all their human capital in a single employer.”

Sensible young scientists are doubting the wisdom of investing a decade of graduate school and postdoc work in a single academic system that provides only a one-third chance of a permanent academic position, followed by a less than one-quarter funding rate of NSF research grant proposals.

Yet no one wants to give up his or her opportunity to do science. So as one way to reconcile this dilemma, I would like to propose a new career option, that of a scientist entrepreneur.

As a scientist entrepreneur, I retain the most important parts of my identity as a scientist, and I make time for doing the activities that I love most. However, while I define my life and myself by those things, I rarely get paid for my time as astronomer. I “fund myself” via other higher-paying work in industry.

Okay I admit it: most weeks I put in 40 hours on a job before I get to do the astronomy activities that are
meaningful to me. However, I know that nearly all professors in my age group also put in 40 hours per week (doing grading, grants, and grunt work) before they get to focus on their own science.

What I hold in common with all scientists is that I define myself by the activities that give me the most meaning, not by the grunt work inherent in virtually all jobs. (As my mother would say, “If a job is only fun, they wouldn’t have to pay you to do it.”)

So it is important to define for yourself: What is it that makes you a scientist?

What Makes You a Scientist?
First, identify what you like best about being a scientist, and also observe what you dislike about how you spend your work time. Refer to the chart “Work Activities in Science” (below) — or draw up your own — to compare an academic track to a scientist entrepreneur track.

Second, describe and quantify your job: roughly how many hours are spent on what type of tasks? Then talk to colleagues who are ahead of you on the career path (in a moment of privacy when they can speak freely) and ask how they actually spend their work hours.

The final step is to analyze this information and apply the results back to yourself and your career goals. For example: How much time can you realistically expect to spend on the research that interests you vs. applying for grants?

Before making career decisions, it is important to understand how many actual job hours are spent doing what you enjoy most as a scientist. If those fun and meaningful hours come only on top of 40 hours of the grading, grants, and grunt work that you wouldn’t enjoy, then this is important information to consider.

One of the main trade-offs of being a scientist entrepreneur is quality vs. quantity. You will spend fewer hours engaged as a scientist, but you can retain the best aspects (for you) of being a scientist. For example, I enjoy being connected with colleagues in my field. When I was a graduate student, I was surrounded by a whole department of astronomers, and yet I had scientific discussions about my research for only a few hours a week. Some of the colloquium talks were terrific, and yet many were uninteresting to me.

Now that I live as a scientist entrepreneur I see my colleagues less frequently, but I am still in touch via e-mail and attending conferences. I go to only a couple of colloquia per semester, but I attend

### Work Activities in Science

<table>
<thead>
<tr>
<th>Scientist Work Activity</th>
<th>Academic Track (Greater quantity of time, but not always quality time)</th>
<th>Scientist Entrepreneur Track (Less time for these activities, but higher quality; ability to make choices with less or no regard for pay/grant funding)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>Build your research program based primarily upon what is competitive for funding</td>
<td>Focus on your interests (not what will get funded) • collaborate with colleagues at a lab/university, volunteer your time • read journal articles, attend conferences • offer to take notes at important teleconferences • make small donations, such as a modest student research prize</td>
</tr>
<tr>
<td>Teaching</td>
<td>Teaching load and course topics mostly set by department, significant “overhead” time spent on grading, “Will this be on the final?”</td>
<td>Teach your topics of interest to a more engaged audience: • colloquium speaker • guest lecturer or fill in for professors on travel • science center supporter (public talks, train staff and volunteers) • featured speaker at teacher training workshops • science cafe speaker • adjunct professor, sabbatical replacement, or at a community college</td>
</tr>
<tr>
<td>Scientific/University Community Service</td>
<td>Dept. and campus committees, review panels, service to your research community</td>
<td>Volunteer for review panels, provide input to reports, serve on national committees, join board of directors of local science center</td>
</tr>
<tr>
<td>Mentoring Students</td>
<td>Office hours, in the lab, informally, at conferences</td>
<td>Mentor in a broad way, or forge a close connection with one student: • mentor via a local university (clubs, organizations, students of colleagues), long-distance (e-mail and telephone), at conferences • give talks on careers and skills development • sponsor internships, cover travel for a student to attend a conference • post to online discussion boards • serve on national employment committee in your field • join formal mentoring programs, local or online</td>
</tr>
<tr>
<td>Education and Public Outreach</td>
<td>Rarely counts much toward tenure, usually must be squeezed in</td>
<td>Ask and find E/PO opportunities; publicize science via local media • local schools, clubs, science centers, news/radio • most groups are in need of speakers, writers, and volunteers</td>
</tr>
<tr>
<td>Personal Scientific Growth</td>
<td>Often funding influenced</td>
<td>Follow your interests; attend talks/conferences; be a confidante and/or mentor to colleagues and they will usually keep you in the loop</td>
</tr>
</tbody>
</table>
the ones that capture my interest. I miss the spontaneous connections that happened in the hallways of the department, but I don’t miss how many of the conversations were about the long hours of stress from the grading, grants, and grunt work.

A Plan to Give Yourself Tenure

By definition, “entrepreneur” means uncharted territory. If being one were clear and easy to do, everyone would already be doing it!

While there are many ways to earn a living, and at times your “paying career path” may zigzag, it is possible to have a North Star to guide you. This is the knowledge of what defines you as a scientist and what academic activities are the most important to maintain. Always ensure that you develop the skills and contacts to participate in the scientific activities that are the most meaningful to you.

The academic career track feels reassuring because there is a clearly marked path with specific goals. Look at to the career stages and goals in the first two columns of the chart “Tracking Your Goals” (above). An academic career seems very straightforward, as long as you don’t let your gaze drift over the cliff of inconvenient statistics on faculty positions and competitive grant funding.

The scientist entrepreneur career track does not specify a particular job, and it allows for flexibility as hiring and job markets change. In column three I list specific goals for each timeframe. While this entrepreneur career track may appear vague, in many ways it is more solid than the academic track because there is a broader range of opportunities available.

The Difficulties and Risks

To simply state “get a job in industry” overlooks how difficult and complex this can be! But there are many resources, career counselors, and alumni available to help navigate.

Another critical step is to “save towards financial freedom,” which sounds vague but can have specific steps and goals. For example, I was able to fund my own year’s sabbatical at roughly the

<table>
<thead>
<tr>
<th>Career Stages</th>
<th>Academic Track Goals</th>
<th>Scientist Entrepreneur Track Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate Student</td>
<td>Prepare for grad school: do well in coursework and on GREs, get introductory research experience</td>
<td>Prepare for grad school while substituting a couple of narrow-focus courses for broader skills (such as oral and written communication, computer programming, economics, business, interdisciplinary courses)</td>
</tr>
<tr>
<td>Graduate Student</td>
<td>Prepare for a postdoc position: conduct research, publish, network</td>
<td>At approx. year three, assess odds of a permanent job; while learning science/research skills, cultivate skills highlighted in PhD+8y survey (top five: critical thinking, speaking, data analysis, writing, interdisciplinary work)</td>
</tr>
<tr>
<td>Receive PhD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postdoc</td>
<td>Prepare for a professorship position: establish yourself in your field, win funding resources and instrument time, publish (or perish)</td>
<td>• get a job in industry, with some time for academic life</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>Prepare for tenure: build research program, win funding to support lab and students, do enough teaching and service to qualify for tenure</td>
<td>• establish yourself in your field</td>
</tr>
<tr>
<td>Tenure Review</td>
<td>Tenure from your academic institution</td>
<td>Hold a “tenure review” on your terms with family, mentors, and financial planner</td>
</tr>
<tr>
<td>Sabbatical</td>
<td>Plan next stage of academic career: expand research goals, travel, collaborate, write grants/journal articles/book</td>
<td>Plan next stage of career: rebalance your goals vs. work, time vs. earnings, make more time for your academic interests, maybe combined with a job layoff</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>Enjoy the security of tenure, but have the worry of keeping students/lab funded</td>
<td>Seek to have flexible hours at a high-paying job with as much independent academic time as an associate professor</td>
</tr>
<tr>
<td>Full Professor</td>
<td>Have greater academic flexibility, higher earnings, but still have the worry of keeping students/lab funded</td>
<td>Aim to reach financial independence and thus have complete academic freedom</td>
</tr>
<tr>
<td>Retirement</td>
<td>Attain complete academic freedom: university pension + your investments</td>
<td>Attain complete academic freedom: your investments + perhaps a company retirement plan</td>
</tr>
</tbody>
</table>
same time that my graduate school cohort received tenure and took their sabbaticals.

There are important disadvantages to consider, as well: time spent being unemployed, no paid sick leave, no paid vacations, and no time off for a serious family crisis — unless you can save an “emergency fund” by yourself. Financial planning and cash flow management is critical. You must qualify for health insurance coverage. (I recommend starting with an insurance broker.)

Of course you need to weigh these negatives against the advantages: higher earnings when you are employed, and flexibility in choosing your location.

Other aspects such as a home office and a less-structured work day could be considered as either positive or negative, depending upon your work style. It is important to enjoy being self-motivated and to have discipline for both time and money management. If you lack these traits, academia may be your best option.

Being a scientist entrepreneur is not an easier path than academia, but it is a viable one for scientists to consider. And it is possible to address many of the risks with advanced planning (such as saving for times of unemployment or sick leave).

My Career Continues

As I publish this article I am, like many people, affected by the recession. My usual clients would be happy to hire me but have had their budgets cut. I have chosen a modest lifestyle, so my savings will tide me over for quite some time.

I try to appreciate my free time even in the midst of employment uncertainty. If I were working now on a well-paying project-management contract, I would not have much time to be writing! Thus goes the ebb and flow of being a scientist entrepreneur.

I make the most of my open time by catching up with colleagues and volunteering at the educational observatory I help run. I have time to mentor students and to help organize a National Park Service initiative in which citizen scientists will collect light pollution information. A regional construction company has invited me to give a lunch talk on outdoor lighting design so that future development can be dark-sky friendly.

One thing I have found to be true: There is never a dull moment as a scientist entrepreneur!

— A. S.
How an old observatory was transformed into a modern teaching center while preserving its historical character.

by Mary Ann Upton
Whitin Observatory has served the students of Wellesley College (Wellesley, Massachusetts) for more than 100 years. In 2010, after years of planning, it received a much needed renovation and expansion, reinforcing its reputation as a teaching observatory of unsurpassed quality. This is the story of its legacy and transformation.

**A Marvelous Donation**

The first astronomy course — Applied Physics — was offered to the women of Wellesley in 1879. Twenty years later, a fortunate opportunity propelled it from a single class to a formidable astronomy program. A Fitz/Clark 12-inch refractor, in use in Brooklyn at the time, became available for purchase at a bargain price. Inspired by her friend, Professor Sarah Whiting, the newly elected trustee Mrs. J. C. Whitin gave the gift of the powerful telescope and a modest, neoclassical building clad in white marble to house the instrument. According to college historians:

"This work was done in the spirit of the founder of the College, who believed that beauty is essential to the highest development of the student.... Mrs. Whitin expressed the same idea when she said, in answer to a remark that a rug would not be necessary in a laboratory: "You and Miss Hayes can attend to the science; it will be good for the girls to put their feet on an India rug."

By 1900 the Whitin Observatory was complete, proudly perched on a hill in the lush arboretum at the northern edge of the campus. Delicate details in stone and copper gave it an elegance and charm unmatched on campus. It was as beautifully calibrated to its purpose as the refractor it housed.

Since its opening, the Observatory has not been a static place, but one of change, keeping up with advances in science and education. A mere six years after it opened, the first addition appeared. A 6-inch Clark companion was added to the original telescope, as well as a transit dome and an astronomy library. Between 1962 and 1988 several more additions were built to meet immediate demands but without regard for the facility's overall composition. Cheaply made classrooms and offices of cinder block and stucco were annexed. Layers of architecture and artifacts burdened the modest observatory on the hill.

**Time for a Change**

By the time of the Observatory's centennial celebration in 2000, Dean Richard French was keenly aware of the need to reinvigorate the facility. In his words:

"Our goal is to make the Wellesley College Astronomy Department a model for liberal arts science education in the 21st century. To achieve this goal, we need to transform the venerable Whitin Observatory into a modern center for scientific teaching and learning, while restoring and preserving its historical character. As much as we love the Observatory, it is not adequate for our present or future needs.

At that time the building had no central circulation routes and no shop for equipment repairs. Restrooms were hidden away in a dark basement, the library was compromised, and it lacked sufficient office, study, and teaching space.

In short, the challenge facing planners was to execute a faithful restoration of the beloved Observatory despite the necessity to expand and improve it.

**The Restoration**

In the completed project, old and new found a balance. The addition was located so the historic parts of the building remained predominant. While the later additions were stripped of their stucco and re-clad in glass, the classical style was preserved on the oldest wings, including the original observatory. The contemporary architecture celebrates and liberates the classical.

As part of the restoration, a great deal of attention was paid to the aging exterior. Over time the copper gutters bled, darkly staining the marble facade below. Cracks in the blocks and failing mortar threatened the integrity of the walls. To restore the walls, masons delicately cut out all the 1/8-inch mortar joints (in some cases the mortar simply fell out) and replaced them. This process is called repointing and is crucial in preventing water from infiltrating the walls, which would cause

One of the display cases, created using the opening for a former window, offers a view into the Astronomy Library.

Whitin Observatory has served the students of Wellesley College (Wellesley, Massachusetts) for more than 100 years. In 2010, after years of planning, it received a much needed renovation and expansion, reinforcing its reputation as a teaching observatory of unsurpassed quality. This is the story of its legacy and transformation.
deterioration. It also improves their appearance. The yellow discol-
oration of the white stone was lifted with an application of warm
water under low pressure, restoring the building's
brilliance.

Although the original copper roof was still
intact, 50 years worth of layers and layers of white
paint on top did more than the metal to keep the
interior dry. So the entire dome (paint layers and
copper roof) was removed. The architect selected
zinc-coated copper as the new roof covering
because of its light color and similarity to the origi-
nal material. The silver patina reflects enough energy
to keep dome temperatures down during the day.
This prevents heat waves from rising in the dome
during the evening, which can distort the tele-
scopes' views of celestial sights.

The new roof work necessitated the removal of
the old copper ornaments (right), but these were
replicated in new material where possible. (Two
original ornaments were sent out-of-state to have a
mold and custom stamp made.) It is these details that give Whitin
Observatory its charm.

Insulated replica windows replaced the drafty originals in all the
heated spaces. Where heat loss was not a concern, namely in the
two older telescope rooms, expert woodworkers restored the origi-
nal windows. They are a complement to the other antiquities and
help give the rooms the feeling of a bygone age.

In the interior, an abatement team pulled out and safely dis-
posed of tiles contaminated with asbestos (commonly found in
buildings constructed during the 1960s). The demolition crew tore
down plaster walls to reveal hidden marble and forgotten rafter
ceilings. Old, buried window openings were opened up and trans-
formed into display cases for the astronomy memorabilia collected
through the years.

Two of these openings are dedicated to a display of stained glass
panels designed by Lady Margaret Huggins, an astronomer and
eyear supporter of the observatory. In disrepair, the panels had been
stored away for many years. As part of the renovation, the panels
were restored and now prominently flank the fireplace in the
Library. Also contributing to the Library's charm is the reintroduc-
tion of an antique rug even Mrs. Whitin could be proud of!

A new corridor now cuts through the buildings to improve
circulation, relieving the Research Project Room and Astronomy
Library of the burden. The college took the oppor-
tunity to upgrade the entire utility infrastructure
while the interior was reassembled. Energy-efficient
lighting, a new fire sprinkler system, and updated
heating and cooling equipment now serve the spaces.

**Modernizing a Century-old Facility**

A challenge of any major restoration is the require-
ment to bring historic conditions up to modern
code compliance. To address the requirements of
the Americans with Disabilities Act, many changes
were adopted. Bathrooms, formerly in the base-
ment, were relocated to the ground floor and are
now accessible without the impediment of a stair.
New door levers were installed on existing doors
because the original knobs were not compliant.

The biggest challenge, however, was to make the
observing experience available to students who are

The new Research Project Room/computer lab. During the renovation the
room was opened up, exposing the wood roof framing and uncovering an
old fireplace. The remote-control computer station for the 24-inch reflector
is set up here, for students unable to climb the stairs to the telescope.

Acanthus leaf detail (it's a rain
diverter along the gutter line),
replicated from zinc to match
new batten seam roof material.
unable to ascend the narrow stairs and climb the ladders to reach the telescopes. In lieu of expensive lifts, which would have compromised the historic charm of the rooms, technology was used to create an alternate viewing experience. Students are able to remotely control the 24-inch Boller and Chivens reflector from a computer station in the Research Project Room. From there they can even use the telescope’s powerful CCD camera to capture high-resolution images.

Most restoration projects require such modifications, but some challenges were specific to the observatory. Before work began, special care was taken to protect the two oldest telescopes. A large plywood box was built around each one to keep them free of debris and protected from equipment and traffic. Because each scope is mounted on its own granite base separate from the building foundation, no additional measures were taken to provide vibration isolation. Part of the new roof was installed a bit too close to the largest dome, restricting its rotation. Needless to say, the mistake was quickly spotted and remedied!

The new lighting system includes a set of fixtures designed to throw red light. The ‘in use’ lights are intended to replace bright lights at night so observers can navigate without losing their night vision. The observatory engineer had previously used red bulbs to achieve the effect, but the new system called for red lenses so that standard white bulbs could be used (which are cheaper and easier to replace). The lights are tied to a central control system so that the brightness levels throughout the entire building can be choreographed from a single location. This allows the observatory to easily adapt to changing requirements each night of the school week, depending on which courses are meeting.

As part of the expansion, a new Specialty Classroom was added to house astronomy classes and to welcome the geoscience and earth science programs. After 110 years as home to the astronomy department, the observatory is now a hub for many sciences, a place for collaboration across disciplines.

A Successful Renewal
With all these improvements, the Whitin Observatory is as bustling as ever. The faculty reports that the renewed Astronomy Library is “a favorite camping ground for students and faculty to work together, have discussion classes, and think deeply about the universe.” Professor French would agree that the architect, designLAB architects of Boston, succeeded in preserving and restoring the 19th-century character of the building, while “turning [it] into a real 21st-century place to do science.” It is his hope that this intervention will bolster the Whitin Observatory for the next 100 years.

Even a century later, the words of Ellen Hayes, a Professor of Mathematics at Wellesley College, still seem relevant:

One’s imagination is taxed in trying to picture the long procession of young women whose lives are going to be made richer and nobler by this far-reaching benefaction due to Mrs. Whitin. We shall one by one close our eyes to the stars, but the beautiful observatory will remain. Those who come after us will take up the work, watch the skies, and go on with the records in our stead, for the astronomer never dies.

MARY ANN UPTON is an architect & project manager at designLAB architects in Boston. She worked closely with the astronomy faculty at Wellesley College during the renovation and addition to their century-old observatory.
First Mars Express Gravity Results Plot Volcanic History

European Space Agency

Five years of Mars Express gravity mapping data are providing unique insights into what lies beneath the Red Planet’s largest volcanoes. The results show that the lava grew denser over time and that the thickness of the planet’s rigid outer layers varies across the Tharsis region.

The measurements were made while Mars Express was at altitudes between 275 and 330 km above the Tharsis volcanic ‘bulge’ during the closest points of its eccentric orbit, and were combined with data from NASA’s Mars Reconnaissance Orbiter.

The Tharsis bulge includes Olympus Mons, the tallest volcano in the solar system, at 21 km, and the three smaller Tharsis Montes that are evenly spaced in a row.

The region is thought to have been volcanically active until 100-250 million years ago, relatively recent on a geological timescale.

The large mass of the volcanoes caused tiny ‘wobbles’ in the trajectory of Mars Express as it flew overhead; these were measured from Earth via radio tracking and translated into measurements of density variations below the surface.

The new data also reveal how the lava density changed during the construction of the three Tharsis Montes volcanoes. They started with a lighter andesitic lava that can form in the presence of water, and were then overlaid with heavier basaltic lava that makes up the visible surface of the Martian crust.

“Combined with the varying height of the volcanoes, we can say that Arsia Mons is the oldest, then Pavonis Mons formed and finally Ascraeus Mons,” says Mikael Beuthe of the Royal Observatory of Belgium.

Geological Map of Io

Arizona State University

More than 400 years after Galileo’s discovery of Io, the innermost of Jupiter’s largest moons, a team of scientists led by Arizona State University has produced the first complete global geologic map of the Jovian satellite. The map, published by the US Geological Survey, depicts the characteristics and relative ages of some of the most geologically unique and active volcanoes and lava flows ever documented in the solar system.

Following its discovery by Galileo in January 1610, Io has been the focus of repeated telescopic and satellite scientific observation. These studies have shown that the orbital and gravitational relationships between Io, its sister moons Europa and Ganymede, and Jupiter cause massive, rapid flexing of its rocky crust. These tidal flexures generate tremendous heat within Io’s interior, which is released through the many surface volcanoes observed.

“One of the reasons for making this map was to create a tool for continuing scientific studies of Io, and a tool for target planning of Io observations on future missions to the Jupiter system,” says David Williams, a faculty research associate in the School of Earth and Space Exploration at ASU, who led the six-year research project to produce the geologic map.

The highly detailed, colorful map reveals a number of volcanic features, including: paterae (caldera-like depressions), lava flow fields, tholi (volcanic domes), and plume deposits, in various shapes, sizes and colors, as well as high mountains and large expanses of sulfur- and sulfur dioxide-rich plains. One feature you will not see on the geologic map is impact craters.

“Io has no impact craters; it is the only object in the solar system where we have not seen any impact craters,” says Williams.
Cassini Sees Tropical Lakes on Saturn Moon

**NASA / JPL**

NASA’s Cassini spacecraft has spied long-standing methane lakes, or puddles, in the “tropics” of Saturn’s moon Titan. One of the tropical lakes appears to be about half the size of Utah’s Great Salt Lake, with a depth of at least 3 feet (1 meter).

The result, which is a new analysis of Cassini data, is unexpected because models had assumed the long-standing bodies of liquid would only exist at the poles.

Where could the liquid for these lakes come from? “A likely supplier is an underground aquifer,” said Caitlin Griffith, a Cassini team associate at the University of Arizona, Tucson. “In essence, Titan may have oases.”

Understanding how lakes or wetlands form on Titan helps scientists learn about the moon’s weather. Like Earth’s hydrological cycle, Titan has a “methane” cycle, with methane rather than water circulating. In Titan’s atmosphere, ultraviolet light breaks apart methane, initiating a chain of complicated organic chemical reactions. But existing models haven’t been able to account for the abundant supply of methane.

“An aquifer could explain one of the puzzling questions about the existence of methane, which is continually depleted,” Griffith said. “Methane is a progenitor of Titan’s organic chemistry, which likely produces interesting molecules like amino acids, the building blocks of life.”

The latest results come from Cassini’s visual and infrared mapping spectrometer, which detected the dark areas in the tropical region known as Shangri-La, near the spot where the European Space Agency’s Huygens probe landed in 2005.

WISE Finds Few Brown Dwarfs Close to Home

**Jet Propulsion Laboratory**

Astronomers are getting to know the neighbors better. Our Sun resides within a spiral arm of our Milky Way galaxy about two-thirds of the way out from the center. It lives in a fairly calm, suburb-like area with an average number of stellar residents. Recently, NASA’s Wide-field Infrared Survey Explorer, or WISE, has been turning up a new crowd of stars close to home: the coldest of the brown dwarf family of “failed” stars.

Now, just as scientists are “meeting and greeting” the new neighbors, WISE has a surprise in store: there are far fewer brown dwarfs around us than predicted.

“This is a really illuminating result,” said Davy Kirkpatrick of the WISE science team at NASA’s Infrared Processing and Analysis Center at the California Institute of Technology in Pasadena. “Now that we’re finally seeing the solar neighborhood with keener, infrared vision, the little guys aren’t as prevalent as we once thought.”

Previous estimates had predicted as many brown dwarfs as typical stars, but the new initial tally from WISE shows just one brown dwarf for every six stars. It’s the cosmic equivalent to finally being able to see down a mysterious, gated block and finding only a few homes.

“WISE is finding new, cold worlds that are ripe for exploration in their own right. We think they can form by several different mechanisms, including having their growth stunted by a variety of factors that prevent them from becoming full-blown stars. Still, we don’t know exactly how this process works,” said Kirkpatrick.

Improvements in WISE’s infrared vision over past missions have allowed it to pick up the faint glow of many of these hidden objects. In August 2011, the mission announced the discovery of the coolest brown dwarfs spotted yet, a new class of stars called Y dwarfs. One of the Y dwarfs is less than 80 degrees Fahrenheit (25 degrees Celsius), or about room temperature, making it the coldest star-like body known.
New Way of Probing Exoplanet Atmospheres
European Southern Observatory

For the first time a clever new technique has allowed astronomers to study the atmosphere of an exoplanet in detail — even though it does not pass in front of its parent star. An international team has used ESO’s Very Large Telescope to directly catch the faint glow from the planet Tau Boötis b. They have studied the planet’s atmosphere and measured its orbit and mass precisely for the first time — in the process solving a 15-year old problem.

The planet Tau Boötis b was one of the first exoplanets to be discovered back in 1996, and it is still one of the closest exoplanets known. Although its parent star is easily visible with the naked eye, the planet itself certainly is not, and up to now it could only be detected by its gravitational effects on the star. Tau Boötis b is a large “hot Jupiter” planet orbiting very close to its parent star.

Like most exoplanets, this planet does not transit the disc of its star. Up to now such transits were essential to allow the study of hot Jupiter atmospheres: when a planet passes in front of its star it imprints the properties of the atmosphere onto the starlight. As no starlight shines through Tau Boötis b’s atmosphere towards us, this means the planet’s atmosphere could not be studied before.

But now, after 15 years of attempting to study the faint glow that is emitted from hot Jupiter exoplanets, astronomers have finally succeeded in reliably probing the structure of the atmosphere of Tau Boötis b and deducing its mass accurately for the first time.

Dramatic Change Spotted on a Faraway Planet
Hubble ESA

Astronomers using the NASA/ESA Hubble Space Telescope have seen dramatic changes in the upper atmosphere of a faraway planet. Just after a violent flare on its parent star bathed it in intense X-ray radiation, the planet’s atmosphere gave off a powerful burst of evaporation. The observations give a tantalising glimpse of the changing climates and weather on planets outside our solar system.

Astronomer Alain Lecavelier des Etangs (CNRS-UPMC, France) and his team used Hubble to observe the atmosphere of exoplanet HD 189733b during two periods in early 2010 and late 2011, as it was silhouetted against its parent star. While backlit in this way, the planet’s atmosphere imprints its chemical signature on the starlight, allowing astronomers to decode what is happening on scales that are too tiny to image directly. The observations were carried out in order to confirm what the team had previously seen once before in a different planetary system: the evaporation of an exoplanet’s atmosphere.

“The first set of observations were actually disappointing,” Lecavelier says, “since they showed no trace of the planet’s atmosphere at all. We only realised we had chanced upon something more interesting when the second set of observations came in.”

The team’s follow-up observations, made in 2011, showed a dramatic change, with clear signs of a plume of gas being blown from the planet at a rate of at least 1000 tonnes per second. “We hadn’t just confirmed that some planets’ atmospheres evaporate,” Lecavelier explains, “we had watched the physical conditions in the evaporating atmosphere vary over time. Nobody had done that before.”

The next question was: why the change? Despite the extreme temperature of the planet, the atmosphere is not hot enough to evaporate at the rate seen in 2011. Instead the evaporation is thought to be driven by the intense X-ray and extreme-ultraviolet radiation from the parent star, HD 189733A, which is about 20 times more powerful than that of our own Sun.
1000 Days of Infrared Wonders
Harvard-Smithsonian Center for Astrophysics

[In a release dated April 16, 2012, the CfA noted that] for the last 1000 days the Infrared Array Camera (IRAC), aboard NASA’s Spitzer Space Telescope, has been operating continuously to probe the universe from its most distant regions to our local solar neighborhood. The IRAC “warm” program began once Spitzer used up its liquid helium coolant, thus completing its “cold” mission. To commemorate 1000 days of infrared wonders, the program is releasing a gallery of the 10 best IRAC images.

“IRAC continues to be an amazing camera, still producing important discoveries and spectacular new images of the infrared universe,” said principal investigator Giovanni Fazio of the Harvard-Smithsonian Center for Astrophysics.

The warm-mission images particularly highlight the continuing capabilities of Spitzer. Indeed, NASA’s Senior Review Panel has recommended extending the Spitzer warm mission through 2015. They specifically commended the Spitzer team for telescope improvements that have made it a powerful instrument for science, especially in exoplanet studies.

IRAC is sensitive to infrared light — light beyond the red end of the visible spectrum. It can image nebulae of cold dust, peer inside obscured dust clouds where new stars are forming, and detect faint emissions from very distant galaxies.

During its 1000-day undertaking, IRAC used its two shortest-wavelength infrared sensors. Some of the top 10 IRAC images the team selected include a “space tornado,” the Orion Nebula, the Helix Nebula, the Trifid Nebula, the “Mountains of Creation,” a young star cluster, our Milky Way galaxy, and the Whirlpool and Sombrero galaxies.

One Supernova Type, Two Different Sources
Harvard-Smithsonian Center for Astrophysics

The exploding stars known as Type Ia supernovae serve an important role in measuring the universe, and were used to discover the existence of dark energy. They’re bright enough to see across large distances, and similar enough to act as a “standard candle” — an object of known luminosity. The 2011 Nobel Prize in Physics was awarded for the discovery of the accelerating universe using Type Ia supernovae. However, an embarrassing fact is that astronomers still don’t know what star systems make Type Ia supernovae.

Two very different models explain the possible origin of Type Ia supernovae, and different studies support each model. New evidence shows that both models are correct — some of these supernovae are created one way and some the other.

“Previous studies have produced conflicting results. The conflict disappears if both types of explosion are happening,” explained Smithsonian astronomer and Clay Fellow Ryan Foley (Harvard-Smithsonian Center for Astrophysics).

Type Ia supernovae are known to originate from white dwarfs — the dense cores of dead stars. White dwarfs are also called degenerate stars because they’re supported by quantum degeneracy pressure.

In the single-degenerate model for a supernova, a white dwarf gathers material from a companion star until it reaches a tipping point where a runaway nuclear reaction begins and the star explodes. In the double-degenerate model, two white dwarfs merge and explode. Single-degenerate systems should have gas from the companion star around the supernova, while the double-degenerate systems will lack that gas.

Foley and his colleagues studied 23 Type Ia supernovae to look for signatures of gas around the supernovae, which should be present only in single-degenerate systems.
Black Hole Caught Red-handed in Stellar Homicide
STScI / Johns Hopkins University

Astronomers have gathered the most direct evidence yet of a supermassive black hole shredding a star that wandered too close. NASA's Galaxy Evolution Explorer, a space-based observatory, and the Pan-STARRS1 telescope on the summit of Haleakala in Hawaii were among the first to the scene, helping to identify the stellar remains.

Astronomers have spotted these stellar homicides before, but this is the first time they identified the victim. Using several ground- and space-based telescopes, a team of astronomers led by Suvi Gezari of the Johns Hopkins University in Baltimore identified the victim as a star rich in helium gas. The star resides in a galaxy 2.7 billion light-years away.

“When the star is ripped apart by the gravitational forces of the black hole, some part of the star's remains falls into the black hole while the rest is ejected at high speeds,” Gezari said. “We are seeing the glow from the stellar gas falling into the black hole over time. We're also witnessing the spectral signature of the ejected gas, which we find to be mostly helium. It is like we are gathering evidence from a crime scene. Because there is very little hydrogen and mostly helium in the gas, we detect from the carnage that the slaughtered star had to have been the helium-rich core of a stripped star.”

Milky Way is Destined for Head-on Collision with Andromeda Galaxy
Space Telescope Science Institute

NASA astronomers announced they can now predict with certainty the next major cosmic event to affect our galaxy, Sun, and solar system: the titanic collision of our Milky Way galaxy with the neighboring Andromeda galaxy. The Milky Way is destined to get a major makeover during the encounter, which is predicted to happen four billion years from now. It is likely the Sun will be flung into a new region of our galaxy, but our Earth and solar system are in no danger of being destroyed.

“Our findings are statistically consistent with a head-on collision between the Andromeda galaxy and our Milky Way galaxy,” said Roeland van der Marel of the Space Telescope Science Institute (STScI) in Baltimore.

The solution came through painstaking NASA Hubble Space Telescope measurements of the motion of Andromeda, which also is known as M31. The galaxy is now 2.5 million light-years away, but it is inexorably falling toward the Milky Way under the mutual pull of gravity between the two galaxies and the invisible dark matter that surrounds them both.

“After nearly a century of speculation about the future destiny of Andromeda and our Milky Way, we at last have a clear picture of how events will unfold over the coming billions of years,” said Sangmo Tony Sohn of STScI.

Black Hole Caught Red-handed in Stellar Homicide

NASA's Galaxy Evolution Explorer, a space-based observatory, and the Pan-STARRS1 telescope on the summit of Haleakala in Hawaii were among the first to the scene, helping to identify the stellar remains.

Astronomers have spotted these stellar homicides before, but this is the first time they identified the victim. Using several ground- and space-based telescopes, a team of astronomers led by Suvi Gezari of the Johns Hopkins University in Baltimore identified the victim as a star rich in helium gas. The star resides in a galaxy 2.7 billion light-years away.

“When the star is ripped apart by the gravitational forces of the black hole, some part of the star's remains falls into the black hole while the rest is ejected at high speeds,” Gezari said. “We are seeing the glow from the stellar gas falling into the black hole over time. We're also witnessing the spectral signature of the ejected gas, which we find to be mostly helium. It is like we are gathering evidence from a crime scene. Because there is very little hydrogen and mostly helium in the gas, we detect from the carnage that the slaughtered star had to have been the helium-rich core of a stripped star.”

Milky Way is Destined for Head-on Collision with Andromeda Galaxy

NASA astronomers announced they can now predict with certainty the next major cosmic event to affect our galaxy, Sun, and solar system: the titanic collision of our Milky Way galaxy with the neighboring Andromeda galaxy. The Milky Way is destined to get a major makeover during the encounter, which is predicted to happen four billion years from now. It is likely the Sun will be flung into a new region of our galaxy, but our Earth and solar system are in no danger of being destroyed.

“Our findings are statistically consistent with a head-on collision between the Andromeda galaxy and our Milky Way galaxy,” said Roeland van der Marel of the Space Telescope Science Institute (STScI) in Baltimore.

The solution came through painstaking NASA Hubble Space Telescope measurements of the motion of Andromeda, which also is known as M31. The galaxy is now 2.5 million light-years away, but it is inexorably falling toward the Milky Way under the mutual pull of gravity between the two galaxies and the invisible dark matter that surrounds them both.

“After nearly a century of speculation about the future destiny of Andromeda and our Milky Way, we at last have a clear picture of how events will unfold over the coming billions of years,” said Sangmo Tony Sohn of STScI.
2012 ASP Award Recipients

Catherine Wolfe Bruce Gold Medal established by Catherine Wolfe Bruce and first awarded in 1898.

Dr. Sandra Moore Faber, University Professor of Astronomy and Astrophysics, University of California Santa Cruz (UCSC), CA.

Dr. Faber earned her bachelor’s degree in physics at Swarthmore College in 1966 and her PhD in astronomy at Harvard University in 1972. Since 1972, she has worked at UCSC and with the University of California Observatories/Lick Observatory, contributing fundamental advances in the understanding of dark matter, the formation of galaxies and black holes in galactic cores, and the large-scale structure of the universe.

With colleague Robert E. Jackson, she discovered the “Faber-Jackson relation,” which related the orbital velocities of stars in galactic centers to their luminosities, providing a means for estimating distances to galaxies. Faber and collaborators discovered “The Great Attractor,” a localized concentration of mass toward which the Milky Way and neighboring galaxies are being pulled, and conducted ground-breaking research on super-massive black holes in the centers of nearly all nearby galaxies.

In 1979, she wrote a review establishing the notion that galaxies must be surrounded by invisible halos of “dark matter,” and subsequently worked with several colleagues to develop a comprehensive picture of galaxy evolution in which the gravitational pull of dark matter is essential to the formation of galaxies and in shaping the large-scale structure of the universe.

“Sandy Faber’s pioneering research has had enormous influence on our understanding of the universe,” said UCSC Chancellor George Blumenthal who also serves as professor of astronomy and astrophysics. “In addition to making important discoveries on the formation of galaxies and the evolution of the universe, she has been a leader in the development of new telescopes and astronomical instruments that continue to yield new insights.”

Thomas Brennan Award for exceptional achievement related to the teaching of astronomy at the high school level.

Mr. Philip Deutschle, co-Chair of the Science Department and instructor of Astronomy, Physics, and Earth Science at Salinas High School in Salinas, CA.

Philip sponsors both the Astronomy Club and Scientists of the Future Club (supporting English Language Learners). Using funds they raised themselves, he and students built and equipped the Salinas Observatory, which students use for studies in astrophotography, star cluster photometry, and stellar spectroscopy. Daytime solar studies include sunspot tracking, H-alpha observations, and plotting of drift scans using a mobile Ku-band radio telescope. An on-going project is the study of solar flare activity by monitoring Sudden Ionospheric Disturbances detected with a VLF radio receiver. Student outreach activities include free public viewings at the Salinas Observatory on Thursday nights, off-site star parties, “Astronomy in the Streets” in Oldtown Salinas, and presentation of hands-on astronomy activities at special events such as Hartnell College’s “Family Science Day” and Salinas High’s “Astronomy Expo.”

Richard H. Emmons Award for excellence in college astronomy teaching.

Dr. Terry A. Matlisky, Faculty, Department of Physics and Astronomy, Rutgers, NJ.

Terry has served as an enthusiastic and energetic astronomy teacher at Rutgers, The State University of New Jersey, for nearly 35 years. After inheriting a two-semester introductory astronomy class of 10-20 students, he revamped the curriculum and teaching methodology, raised funds for a 24-inch telescope, and oversaw the growth of enrollment to more than 1000 students. He has developed and taught courses for non-science majors ranging from basic astronomy to an online introduction to research methods in X-ray astrophysics. He also spearheaded the development of the Rutgers Astrophysics Institute, a four-week astrophysics research program in summer with a yearlong follow up in which New Jersey high school physics teachers and students (and pre-service teachers) are exposed to cutting-edge research in X-ray astrophysics.

Amateur Achievement Award for significant observational or technical achievements by an amateur astronomer.

Mr. Jeffrey L. Hopkins, Hopkins Phoenix Observatory, Phoenix, AZ.

Jeffery exemplifies a level of long-term dedication and commitment...
in the very best tradition of amateur astronomers contributing to professional science. He has a long record of achievement in precision photometric photometry and recently in high-resolution spectroscopy. He has co-authored dozens of research papers that have appeared in such publications as *Astronomy and Astrophysics*, *the Astrophysical Journal*, *Astrophysics and Space Science*, and the *Publications of the Astronomical Society of the Pacific*, and has published five astronomically related books, the most recent being *Small Telescope Astronomical Spectroscopy*. He has participated in numerous observing campaigns, including studies of Epsilon Aurigae, comets, eclipsing binaries, and RS CVn stars. Amateur photometry and spectroscopy requires a high level of precision, often without access to professional resources, and Hopkins’ work, going back several decades, has significantly helped to lower the barriers between amateur and professional astronomers.

**Klumpke-Roberts Award for outstanding contributions to the public understanding and appreciation of astronomy.**

Ian Ridpath, writer, editor, and broadcaster, Brentford, west London, UK.

For three decades, Ian has been one of the most respected and widely published authors in the popularization of astronomy. His contributions to astronomy education comprise a rich, wide-field catalog of luminous and accessible books, articles, television and radio appearances, and lectures. His work is routinely authoritative, accurate, and valuable. Ian’s many popular sky atlases and guides, including the *Collins Stars and Planets*, *The Monthly Sky Guide*, and *Gem Stars* (a pocket guide to the constellations), have gone through a number of editions and are models of clarity and facility of use. Ian was also responsible for the first major overhaul (in 79 years) of the extremely popular *Norton’s Star Atlas*. He is a Fellow of the Royal Astronomical Society, as well as a member of the Society of Authors and of the Association of British Science Writers. According to Professor Sir Martin Rees, Britain’s Astronomer Royal, “His works all have clarity and authority.”

**Las Cumbres Amateur Outreach Award for outstanding outreach by an amateur astronomer to children and the public.**

Chuck McPartlin, Santa Barbara, CA.

Chuck is the current Outreach Coordinator of the Santa Barbara Astronomical Unit (SBAU), which won *Astronomy* magazine’s “Out-of-This-World” award for 2010. This selection can be directly attributed to Chuck’s dedicated outreach activities and programming spanning two decades. He routinely takes groups of amateur astronomers with him to events at campsites, school science nights, and Telescope Tuesdays. He also travels to other counties to show the sky to people in small communities and to campers in the outlying sites. In addition, Chuck coordinates the monthly public observing nights at Westmont College Observatory and presents regular shows at the Museum’s planetarium. According to SBAU President Rubin Gutierrez: “Chuck is the Heart, Soul, and Backbone of the SBAU and has spearheaded the nationally acclaimed outreach efforts of the SBAU for years.”

**Maria and Eric Muhlmann Award for important research results based upon the development of groundbreaking instruments and techniques.**

Kepler Science Team, led by Mr. William Borucki (Science Principal Investigator for the Kepler Mission) and Dr. David Koch (Deputy Principal Investigator for the Kepler Mission).

The Kepler mission has revolutionized the fields of observational discovery of exoplanets and planetary systems as well as the field of asteroseismology. Through continuous monitoring of approximately 150,000 stars, and thanks to clever innovations in space-based precision photometry, Kepler has detected more than 2,300 exoplanet candidates with 72 planets subsequently confirmed by ground-based observations. Kepler has found a number of “super-Earths,” at least one of which resides in the habitable zone of its parent star. Hundreds of Kepler candidates are in multiple-planet systems. The same precision photometry used to find planets...
enables the detection of subtle, periodic variations in stellar brightness (asteroseismology), useful for studying the interior structure of stars and the determination of stellar masses and radii.

As Principal Investigator of the Kepler Mission, William Borucki (previous page) skillfully assembled a team of scientists and engineers to design, construct, launch, and utilize the results from this NASA Discovery mission. David Koch (above) has been working on the Kepler Mission since 1992, before it was known as “Kepler.” The legacy of the mission is remarkable because follow-up observations of the candidates can be performed from small as well as large telescopes around the world.

Robert J. Trumpler Award for a recent Ph.D. thesis considered unusually important to astronomy.

Shared: Dr. Charles Conroy (Assistant Professor, University of California, Santa Cruz, CA.) and Dr. Emily Levesque (Einstein Postdoctoral Fellow at the University of Colorado at Boulder’s Department of Astrophysical and Planetary Sciences, Boulder, CO.).

Charlie Conroy has published influential papers covering a wide range of topics including galaxy evolution, stellar populations, globular cluster formation, Active Galactic Nuclei feedback, and the evolution of large-scale structure in the universe. His forefront observations have had a large impact on the study of stellar populations in galaxies over a large look-back time. His innovations include new spectral synthesis code and two novel techniques for measuring the effects of dust of galaxy spectra. Documenting his tremendous productivity, 29 of his papers have received more than 1,300 citations.

Emily Levesque studied the environmental properties of long-duration gamma-ray bursts (LGRBs) from the different perspectives of theoretical studies of the interstellar medium, observations of local host galaxies, and observations of massive stars in similar environments. She was quick to point out that the standard model had a significant problem as there appeared to be a bias for LGRBs to be found in galaxies of low metallicity. Through Keck observations, she measured metallicity in a large number of LGRB host galaxies and confirmed that such a bias does exist. It seems then that many (but not all) of these enigmatic LGRBs must be the result of binary, rather than single-star, evolution. This result opens the way for a comprehensive understanding of LGRBs and, ultimately, what they tell us about stellar evolution, star-formation rates, and stellar populations at large look-back times.

Priscilla and Bart Bok Award Winners

Two high school students from Texas and Louisiana are the winners of the 2012 Priscilla and Bart Bok Awards for their astronomy projects presented at the Intel Science and Engineering Fair in Pittsburgh, Pennsylvania in May. The awards were presented on May 18 by the Astronomical Society of the Pacific (ASP) in partnership with the American Astronomical Society (AAS), supported by funding from the National Science Foundation (NSF).

The first prize of $1,000 went to Piper Michelle Reid of Dripping Springs High School, Dripping Springs, Texas, for her project, “Photometric and Spectroscopic Analysis for the Determination of Physical Parameters of an Eclipsing Binary Star System.” The project explores how, with careful use of consumer-grade astronomical equipment, it is possible for an amateur astronomer to determine an array of physical characteristics of a distant binary star system from a suburban setting.

The second prize of $500 went to Henry Wanjune Lin of Caddo Parish Magnet High School, Shreveport, Louisiana, for his project, “A Generalized Holographic Model of Cosmic Accelerated Expansion,” which explores how holographic models naturally account for the observed cosmic accelerated expansion. Henry’s project is an attempt to model the possible ways that dark energy can be represented to explain the observed acceleration of the universe.

The Priscilla and Bart Bok Awards are given jointly by the ASP and the AAS. The main criterion for selecting the two annual Bok Award winners is scientific merit. The Bok prize is named for Bart
LEGACY GIVING

Astronomy compels the soul to look upwards and leads us from this world to another.

— Plato

Leave a universal legacy...

Astronomy shows us that we are part of something much greater than ourselves, and that our actions on Earth have a lasting impact. A legacy gift to the ASP as part of your estate plan reflects this understanding, and will support future generations as they reach for the stars.

astrosociety.org/support.html or (415) 337-1100 x106

NEW MEMBERS — The ASP welcomes new members who joined between April 1 and June 30, 2012.

Technical Membership
Terry S. Arnold, San Diego, CA
Malika D. Carter, San Jose, CA
Edward L. Fitzpatrick, Villanova, PA
Christine A. Jones, Cambridge, MA
Annette S. Lee, St. Cloud, MN
William J. Mullin, Doylestown, PA
George H. Rieke, Tucson, AZ
Donn R. Starky, Auburn, IN
Alan L. Strauss, Tucson, AZ
Kylah M. Thiel, Phoenix, AZ
Morgan S. Wilson, San Luis Obispo, CA
Alex Woronow, Pearland, TX

General Membership
Alexander K. Antunes, Laurel, MD
Mary Helen Armour, Georgetown, ON, Canada
Amada E. Bauer, Milsons Pt, NSW, Australia
Richard Baum, Chester, England
Bruce Bayly, Tucson, AZ
Kayla Berry, Washington, DC
Donald W. Boonstra, Chandler, AZ
Jillian E. Bornak, Las Cruces, NM
Tabitha C. Buehler, Salt Lake City, UT
Coral Clark, Sunnyvale, CA
Debra C. Colodner, Tucson, AZ
Bradford T. Davey, North Kingstown, RI
Craig De Voto, Chicago, IL
Alyssa M. Gilbert, London, ON, Canada
Sarah K. Guffey, Spindale, NC
Nicole E. Gugliucci, Edwardsville, IL
Kevin K. Hardegree-Ullman, Tucson, AZ
John M. Heasley, Lone Rock, WI
Michelle L. Higgins, Tucson, AZ
Carmen Jimenez, Concepcion, Chile
Robin E. Johnson, Paradise Valley, AZ
Sadie Jones, Southampton, United Kingdom
Charles Kerton, Ames, IA
Allison M. McGraw, Tucson, AZ
Peter D. McLoughlin, Stratford, CT
Paul Morgan, Roseburg, OR
Mark A. Newhouse, Tucson, AZ
Michelle Pausen, Evanston, IL
William D. Rosner, Tarzana, CA
Kevin Schindler, Flagstaff, AZ
Wouter C. Schrier, Leiden, Netherlands
Jennifer Stalls, Williamston, NC
Patricia S. Udomprasert, Cambridge, MA
Tom Viron, Flagstaff, AZ
Charles Wendt, Flagstaff, AZ
Katherine R. White, East Bunn, NC
Laura Whyte, Chicago, IL
Jeremy Wood, Hazard, KY

Supporter’s Circle Membership
Billy J. Collins, Exeter, CA

Family Membership
Robert Geiter, Vista, CA

Friend of the ASP
Brian Biviano, Apopka, FL

Life Membership (Bruce Medal)
Sandra M. Faber, Santa Cruz, CA

HELP EVERYONE REACH FOR THE STARS!

Books, Posters, Slide Sets
Family ASTRO Games
Special Order Items
ASP Conference Series

AstroShop
www.astrosociety.org

All proceeds from product sales support the mission and education programs of the ASP
The Skies of August

Every evening it’s possible to see the occasional streak of light in the sky. These are meteors, little bits of space rock that blaze a bright trail through the heavens as they are heated to incandescence by the friction of Earth's atmosphere. (For clarity, a meteoroid is the name of that chunk of rock drifting through space; a meteorite is that same piece of rock that has survived its plunge through the atmosphere and landed on the ground. Same rock, three different names depending on its location.)

Several times a year, Earth passes through a stream of debris left by a passing comet. The result is a meteor shower. During a shower you’ll see more meteors per hour than usual, and all of them will appear to fall from the same spot in the sky — a point called the radiant. The shower gets its name from the constellation in which the radiant lies. One of the most popular meteor displays is the Perseids, because it’s visible during the warm summer months (in the Northern Hemisphere), and because observers can see up to 60 meteors per hour (at its peak) pouring out of the constellation Perseus.

After last year’s full Moon washout of the Perseids, meteor watchers have been eagerly awaiting this year’s event. In 2012 the Perseid meteor shower peaks during the early morning hours of Sunday, August 12, though meteors will be visible from dusk on the 11th to dawn on the 12th. However the show improves after 11:00 pm, once the sunset glow fades and the radiant clears the horizon.

Unlike last year when the Moon was visible all night, this year the Moon doesn’t rise until after 1:00 am on the 12th, and even then it’s a thin waning crescent whose light won't hide many meteors. As a bonus, the Moon will be flanked by two bright planets: Jupiter to its upper right and Venus (once it rises about an hour later) to its lower left. All in all, it should be a lovely night of meteor watching.

As revealed in the previous paragraph, Jupiter and Venus are in the morning sky this month. Jupiter rises after midnight and is well up in the east before sunrise. Venus rises about 3:30 am all month. At the start of August, these two bright planets are close to each other (their closest approach was in early July), but as the month progresses Jupiter pulls higher into the sky. The crescent Moon sits to the upper right of Jupiter on the morning of the 11th and Venus on the 13th.

As an added bonus, the Moon occults Venus on the 13th. Although it’s an afternoon event for almost all of North America, if you can find the 26-day-old crescent Moon in the daytime sky, you can find Venus and watch the Moon pass in front of the planet. (You’ll need at least binoculars to see the event unfold.) Here is an extensive list of disappearance and reappearance times. Keep in mind the times listed are Universal Time, so you’ll have to convert to your local time. Because Venus is not a point source, it’ll take upwards of 30 seconds to vanish (and later reappear from) behind the Moon.

Mercury is barely visible low in the east-northeast at dawn during the second half of the month, rising between 60 and 90 minutes before the Sun. If you have a flat eastern horizon, you might spot it to the lower left of the very thin crescent Moon on the 15th.

Saturn and Mars are together, low in the southwest after sunset. They form an ever-changing triangle with Spica most of the month, but you’ll need a low, clear horizon to find them in the twilight glow. Saturn is the brightest (barely) of the three; Mars the reddest. On the 21st the crescent Moon joins them: Spica will be to the Moon’s right, Saturn to the upper right, and Mars above and slightly behind the lunar crescent.
The Skies of September

In late August or early September, stand outside around 10:00 pm, face south (in other words, put your back to Polaris, the Pole star) and look up...look way up. Even in a city, from your balcony or back yard or nearby park, you should have no trouble spotting three bright stars in the shape of a large triangle that points down. Congratulations, you have just found the Summer Triangle. As you can see in our chart (right), the three bright stars that form this triangle are Deneb, Vega, and Altair (in the constellations Cygnus, Lyra, and Aquila respectively). If you’re observing from a dark site, you’ll see many more stars within and around the Triangle. In our chart, only the brightest stars that are likely visible to viewers in most cities are shown.

The Summer Triangle isn’t a constellation. Rather, it’s an asterism, a simple pattern that contains stars from one or more constellations. The Big Dipper is one of the most famous asterisms.

If you seek the Summer Triangle in July or early August, look for it rising out of the southeast as twilight fades. After sunset during autumn, you can spot it sliding down toward the western horizon.

For much of the month Mars and Saturn race to stay ahead of the Sun in the west at dusk. Mars is successful; it sets two hours after the Sun at both the start and end of the month. But Saturn gradually sinks into the sunset twilight as the month progresses. On the 18th look for Saturn to the right of the crescent Moon; Mars is to the Moon’s upper left. The next night Mars hovers immediately to the right of the lunar crescent.

While Mercury is hidden by the solar glare all month, Venus and Jupiter continue to dominate the dawn sky. As with Mars at sunset, Venus stays well ahead of the Sun, rising 3.5 hours ahead of Sol all month long. On the 12th the crescent Moon sits just to the right of brilliant Venus — a beautiful sight. On that morning use your binoculars to look to the left of Venus. That small gathering of stars you see is M44, the Beehive star cluster.

Meanwhile Jupiter continues to climb away from dawn’s glow. By the end of the month, the giant planet is very high in the south at the start of twilight. The last quarter Moon and Jupiter, rising together just after midnight on the 8th, make a pretty sight.

The Skies of October

During the first week of the month, Mercury peeks out from the glow of sunset and joins Saturn, but that’s not saying much. Both are very low in the west, and a clear, flat horizon will be necessary to spot them. By the time the very thin crescent Moon stands to the right of Mercury on the 16th, Saturn is lost to the solar glare.

The next evening, the lunar crescent sits roughly half way between Mercury (to its lower right) and Mars (to its upper left). At dusk on the 18th, Mars is to the crescent’s lower right. Perhaps surprisingly, Mars continues to stay ahead of the Sun, setting some two hours after the Sun right through to the end of the year.

Meanwhile, Jupiter now rises before midnight and is high in the south well before dawn. The giant planet is currently in Taurus, surrounded by all the glorious sights of the winter sky. But don’t overlook this belted, moon-encircled world, especially since it’s now very high in the sky at dawn. And even though Jupiter is a morning sight, October is a fine month to explore the planet’s lighter-hued zones, darker belts, and its Great Red Spot, because it’s still reasonably warm during the night. On the 4th, Jupiter rises with the Moon (just past full) to its upper right. (The Moon revisits Jupiter at the end of the month, and rises just beneath it on November 1st.)

Finally, Venus continues to hang out at dawn, rising some three hours before the Sun. On the 3rd, the brilliant planet is a mere ¾° from Regulus, but you’ll need binoculars to see this dim star beside the much brighter planet. On the 12th there is another lovely pairing of Venus and the crescent Moon.

In badly light-polluted skies, you might spot little more than the stars that help create the three blue constellation outlines.
Thanks to Sky & Telescope magazine, Mercury readers have direct access to S&T’s online Interactive Sky Chart. While anyone can go to it on Sky’s website, registration is required to load and use the charts. Registration is free and has some advantages, but it’s not necessary for ASP members who just want to retrieve the monthly star chart.

Please note that the S&T Interactive Sky Chart does not work on the iPad.

Sky & Telescope’s Interactive Sky Chart is a Java applet that simulates a naked-eye view of the sky from any location on Earth at any time of night. Charted stars and planets are the ones typically visible without optical aid under clear suburban skies. Some deep-sky objects that can be seen in binoculars are plotted too.

Using the Chart: The Basics

When you launch Sky & Telescope’s Interactive Sky Chart applet in your Web browser, you should get a rectangular view of the sky in the upper left and a large circular all-sky chart on the right. If the star charts do not appear, refer to the “Tech Talk” section at the end of this article.

For instance, when you click on the link for the August Sky Chart, you should see, in a new window, a screen that looks like the image above. Each of the monthly links in Sky Sights will take you to a chart set for 40° north latitude and 100° west longitude (so it’s useful throughout the continental US) at 10:00 pm local time at midmonth in August and September, and 9:00 pm local time in October. The chart can be used one hour later at the start of each month and one hour earlier at month-end.

If all you want is a copy of the circular All-Sky Chart to take outside, press the “Create PDF” button, and then print the result. You’ll find the easy-to-use instructions included on the chart.

But Sky’s Interactive Chart offers much more. Click on any area of the circular All-Sky Chart that you’d like to see in more detail. The green frame will jump to where your cursor is pointing, and the scene in the Selected View window will now show this area. Or click and hold down your mouse button within the green frame on the All-Sky Chart, then drag the frame around the sky. The scene in the Selected View window will change as the location of the green rectangle on the All-Sky Chart changes. Finally, click and hold down your mouse button in the Selected View window, then drag the cursor to move to another part of the sky. The green frame in the All-Sky Chart will follow your movements.

Changing the Chart

Below the Selected View window you’ll find the latitude and longitude the chart is set for, as well as the date and time. These can all be changed.

To alter the date and time, click on the month, day, hour, or minute in the display at lower left, which will become highlighted. (You can change only one parameter at a time.) Then use the + or – button to increase or decrease the value you’ve selected. Each time you change a quantity, both the Selected View and All-Sky Chart will be updated instantly. If you’d rather do a wholesale change, click the large “Change” button in the Date & Time display area. A pop-up window will appear. Here you can choose any date between January 1, 1600, and December 31, 2400, using the day and month pull-down lists and the year text-entry box.

To alter the location, you’ll need to click the large “Change” button in the Location display area. A pop-up window will appear that will let you select a new location. Use either the “USA or Canada” or the “World by City” box and your time zone will be automatically selected, but don’t forget to check the Daylight Saving Time box if appropriate. Do not use the “Worldwide by Latitude & Longitude” option — there are problems with its functionality (among other things; here’s an update from S&T).

You’ll find more detailed instructions and hints for using the chart on the Help page. To really become familiar with this program, see the article: Fun with S&T’s Interactive Sky Chart.

Tech Talk

The applet should work properly in most Java-enabled Web browsers. For best results on a PC, use Internet Explorer 6 or Netscape 7; on a Mac, use OS X 10.3 (or higher) with Safari. If you’ve installed a “pop-up stopper” to block advertisements that automatically open in new browser windows, you’ll probably have to turn it off, as the Interactive Sky Chart needs to open in a new browser window.

If you have trouble getting the Sky Chart to open on your computer, please review Sky’s detailed system requirements to check whether you’re using a supported operating system. And don’t forget to also review the Help page.
Science Fare

Science: Just you, your brain, and your ability to think.

In April 2012, I was asked to give a short speech to a group of local students who participated in a science fair. I wasn't sure what to say to them, until I saw a newscast the night before the fair. The story was some typically inaccurate fluff piece giving antiscience boneheads “equal time” with science, as if any ridiculous theory should have equal time against the truth.

I sat down with a pad of paper and a pencil and scribbled down this speech. I gave it almost exactly as I wrote it.

I know a place where the Sun never sets. It's a mountain, and it's on the Moon. It sticks up so high that even as the Moon spins, it's in perpetual daylight. Radiation from the Sun pours down on there day and night, 24 hours a day — well, the Moon's day is actually about 4 weeks long, so the sunlight pours down there 708 hours a day.

I know a place where the Sun never shines. It's at the bottom of the ocean. A crack in the crust there exudes nasty chemicals and heats the water to the boiling point. This would kill a human instantly, but there are creatures there, bacteria, that thrive. They eat the sulfur from the vent, and excrete sulfuric acid.

I know a place where the temperature is 15 million degrees, and the pressure would crush you to a microscopic dot. That place is the core of the Sun.

I know a place where the magnetic fields would rip you apart, atom by atom: the surface of a neutron star, a magnetar.

I know a place where life began billions of years ago. That place is here, the Earth.

I know these places because I’m a scientist.

Science is a way of finding things out. It's a way of testing what's real. It's what Richard Feynman called: “A way of not fooling ourselves.”

No astrologer ever predicted the existence of Uranus, Neptune, or Pluto. No modern astrologer had a clue about Sedna, a ball of ice half the size of Pluto that orbits even farther out. No astrologer predicted the more than 150 planets now known to orbit other suns.

But scientists did.

No psychic, despite their claims, has ever helped the police solve a crime. But forensic scientists have, all the time.

It wasn't someone who practices homeopathy who was able to stop smallpox or polio. Scientists did, medical scientists.

No creationist ever cracked the genetic code. Chemists did. Molecular biologists did. They used physics. They used math. They used chemistry, biology, astronomy, engineering.

Unknown to astrologers prior to its discovery by astronomers in 1846, Neptune is seen here by the Voyager 2 spacecraft.

They used science.

These are all the things you discovered doing your projects. All the things that brought you here today.

Computers? Cell phones? Rockets to Saturn, probes to the ocean floor, PlayStations, GameCubes, Game Boys, Xboxes? All by scientists.

Those places I talked about before? You can get to know them too. You can experience the wonder of seeing them for the first time, the thrill of discovery, the incredible, visceral feeling of doing something no one has ever done before, seen things no one has seen before, know something no one else has ever known.

No crystal balls, no tarot cards, no horoscopes. Just you, your brain, and your ability to think.

Welcome to science. You're gonna like it here.

PHIL PLAIT, the creator of Bad Astronomy, is an astronomer, lecturer, and author. After 10 years working on Hubble Space Telescope and six more working on astronomy education, he struck out on his own as a writer. He's written two books, dozens of magazine articles, and 12 bazillion blog articles. He is a skeptic and fights the abuse of science, but his true love is praising the wonders of real science.

Editor’s Note: “A Moment of Science,” a Slate magazine article also written by Phil (Bad Astronomer) Plait, nicely summarizes what many of the ASP’s programs strive for. [RETURN]