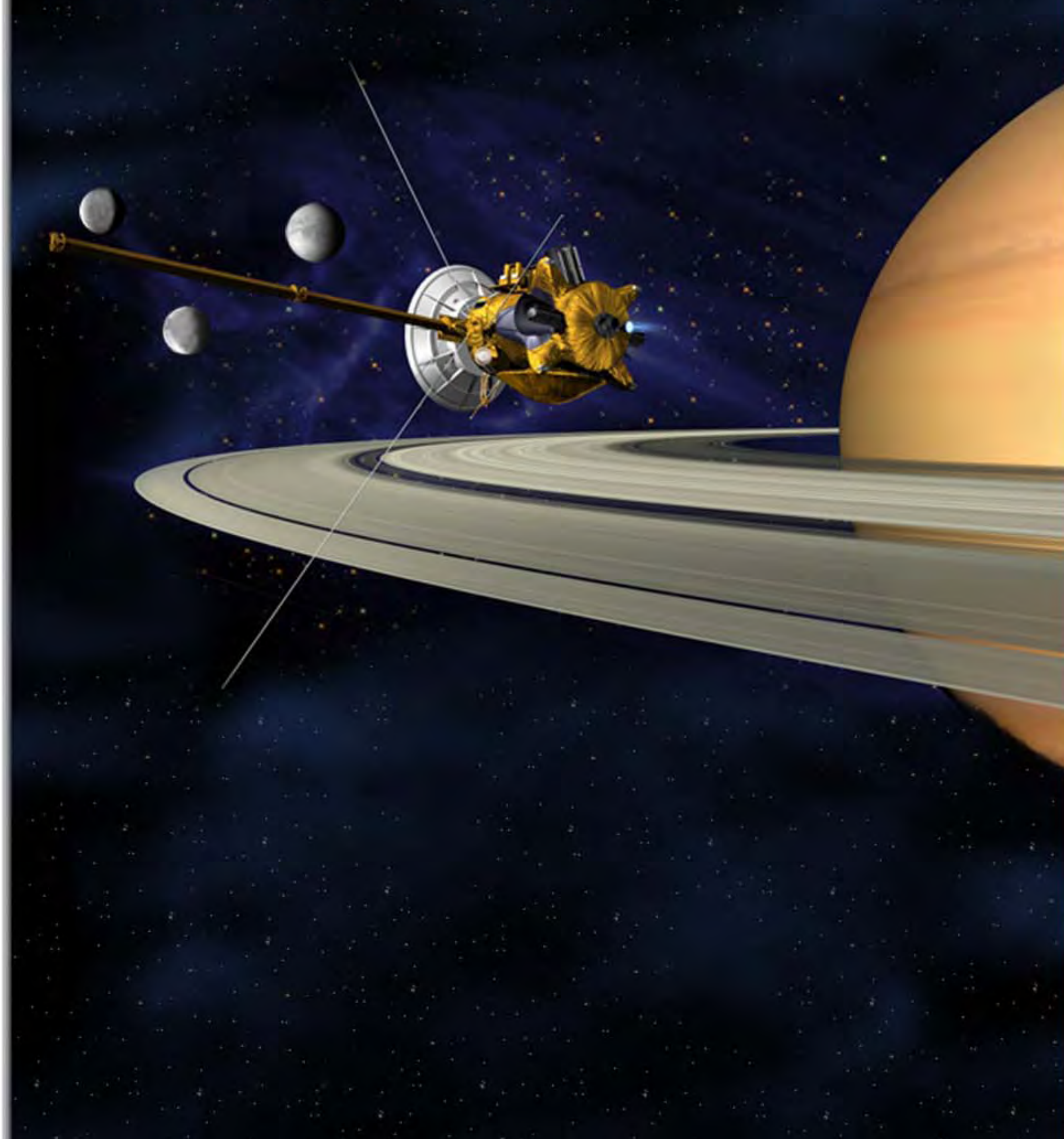
# Saturn and its Moons — A Photo Essay



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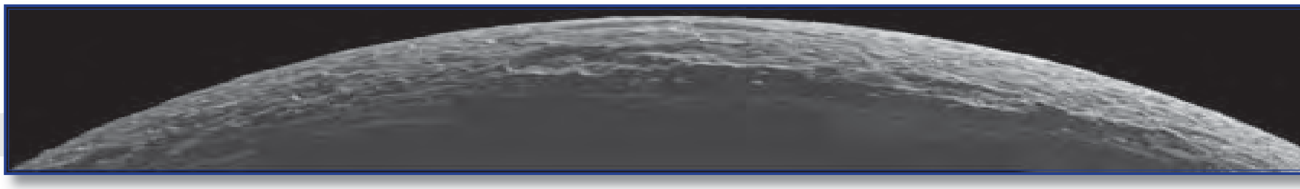
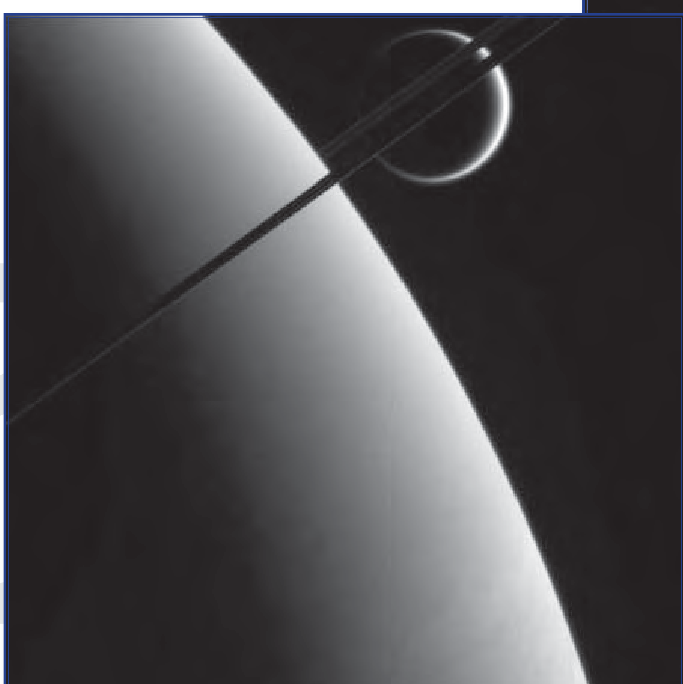
# Saturn and its Moons — A Photo Essay

To paraphrase Astronaut Buzz Aldrin, the solar system has a stark beauty all its own. Every planet we have visited has borne this out, but none so much as Saturn with its rich variety of moons and rings. The orbiting Cassini spacecraft has provided breathtaking views that are otherwise impossible for us Earth-bound humans to witness directly. In recent months Cassini has spent a great deal of time orbiting behind the planet while it observes the planet and its many moons. It has shown us ghost-like moons shining in Saturn's glow, moons partly obscured by diffuse rings of icy debris, and turbulent maelstroms in the giant planet's atmosphere. This photo essay provides just a small sample of these unique perspectives gathered from the raw image archives.

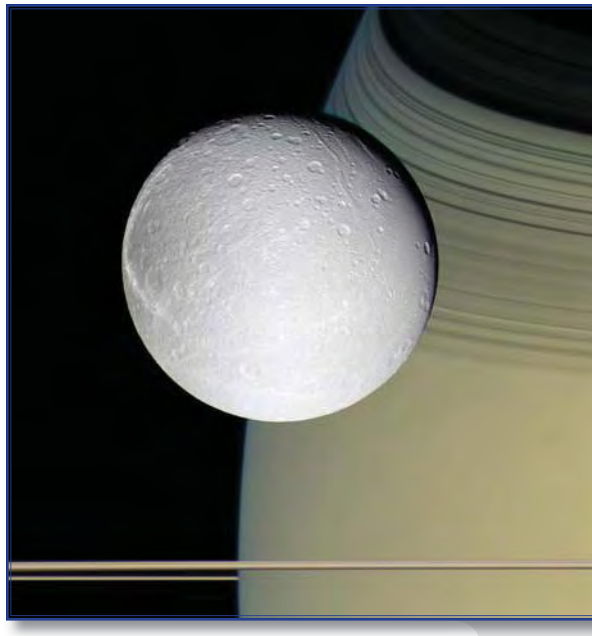


*Dione*

*Mimas ("The Death Star") hovers menacingly outside Saturn's rings.*

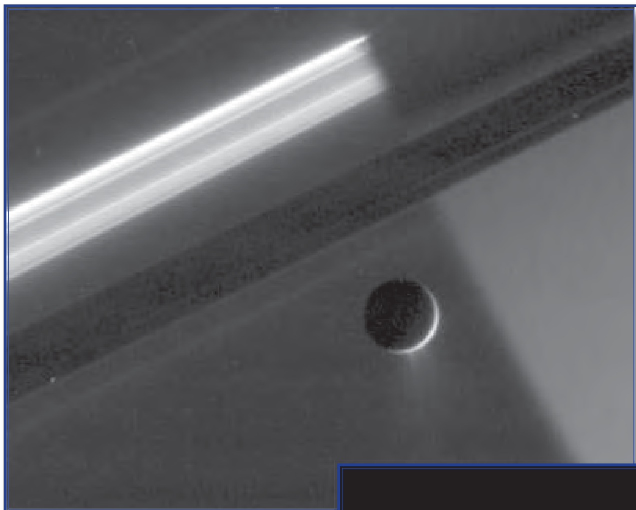


*Rings pierce crescent Titan and Saturn.*

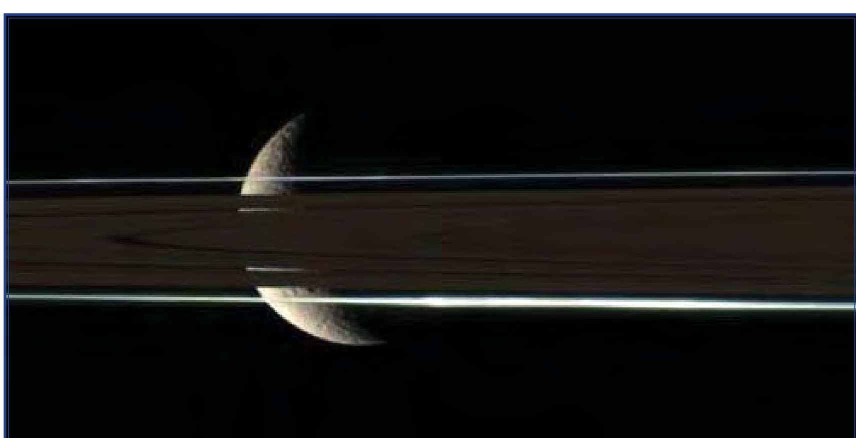


*Dione above Saturn.*

*Icy eruptions from Enceladus.*

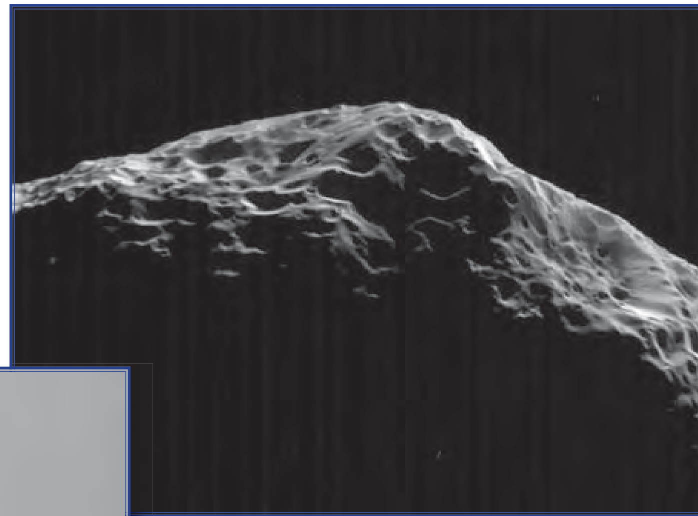


*Tiny Enceladus and Saturn's rings transit across the dark side of Titan.*

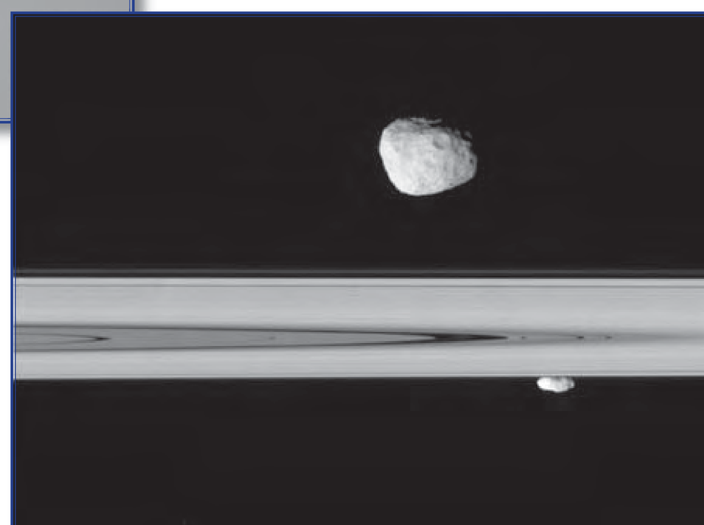


*Rhea looms behind Saturn's rings.*

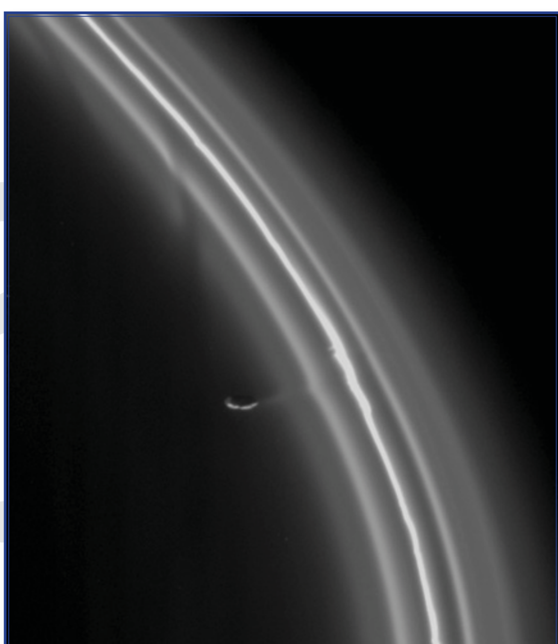
*Battered Hyperion.*



*Mimas floats above Saturn's chilly cloud deck.*



*Shepherd moons Janus and Prometheus hover on the edge of Saturn's rings.*



*A small moon disturbs the F-ring.*

## Pluto Demoted Back to Dog-Star Status

The vote of the International Astronomical Union (IAU) on August 24 to redefine the term "planet" changed our solar system . . . Or did it? The only real casualty of the decision is Pluto. Discovered in 1930 during the Great Depression, this small but fascinating body is no longer a planet, made familiar by school verse, but rather a "dwarf planet." The word "planet" is derived from the ancient Greek term *planetai*, which meant "wanderer" and referred to the known objects that moved in the sky against the apparently fixed stars. In modern times, the term planets has come to include three Sun-orbiting objects discovered by telescope: Uranus, Neptune, and Pluto. Starting in 1801, again in 1992, and now, this simplistic view has been challenged.

The IAU redefined the term planet to refer to any Sun-orbiting object whose internal gravity is sufficient to make it squeeze into a "round" form, rather than into an irregular lump, and has gravitationally cleared out the neighborhood around it. Pluto disqualifies on the third count. As a refinement, Pluto was designated one of the "dwarf planets," a new classification to account for objects that fill most but not all of the above requirements. Xena, which is further out and slightly larger than Pluto, has also been designated a dwarf planet, as has the classical asteroid Ceres.

On the face of it, the new definition seems reasonable, but the decision to demote Pluto has caused considerable controversy, not least among Plutophiles worldwide. On one side are those supporting the IAU, or at least preferring to let the vote stand for now. Others disagree and seek to challenge the definition as too rigid, and should be made more inclusive. After all, there are plenty of small objects orbiting in the vicinity of Jupiter, so does Jupiter really clear out its neighborhood of lesser miscreants and ne'er-do-wells? Others have criticized the complainers, characterizing them as troublemakers that will make scientists look foolish and self-centered. Well, why should scientists be any different? Working in ivory towers does not require leaving passion behind. Passion for truth and knowledge are at the heart of science. Why not let the Plutophiles state their case? If enough people get behind it, perhaps the decision can be reconsidered.

There is considerable emotion behind some of these sentiments. Pluto has been a planet for 76 years, so why change it now? It has been a familiar, albeit small and lonely, outpost on our solar system for a long time; a strange interloper that occasionally sneaks inside Neptune's orbit but spends most of its time in the frigid dim outskirts of our planetary nest. School children somehow identify with this tiny relict, in part because it is one of the few remaining outposts not yet visited by spacecraft. Or perhaps they know all too well what it's like to be small objects pushed around and dwarfed by the bigger bullies in the celestial neighborhood. Indeed, the support of school children nationwide helped sustain the New Horizons project, now on its way to Pluto. But science does not always recognize personal preference. The IAU voted for the simplest definition. Implementation may not be so simple.

*Artist's view of the Pluto system. Image courtesy of NASA, ESA, and G. Bacon.*

In 1969, when man first walked on the Moon and I was still in grade school, the solar system, and the galaxy for that matter, were rather straightforward static places. Nine well-ordered and well-behaved planets and a few hundred asteroids quietly and eternally orbited the Sun, perturbed only occasionally by passing comets. Since then, we have discovered that some planets have moved outward in their orbits (Neptune and Uranus may have even traded places long, long ago!); comets are sometimes captured or break up when they encounter planets; protoplanets and moons have collided with each other many times, forming new moons or large ring systems; and large impact events have repeatedly reset the biology of otherwise hospitable planets such as our own. Small asteroids are now discovered at such a rate that record-keeping may not be able to keep pace, and several dozen objects are known to lurk between Jupiter and Neptune. The moons of the outer planets, once thought to be frozen relicts of creation, have proved to be complex and diverse. Some have atmospheres or magnetic fields and several are liquid inside and could contain biologic materials or living specimens. Moons act like planets, gravitational clearing is not absolute, and size and shape do matter.

Pluto's problems began in earnest in 1992. That year marked a colossal expansion of the known limits of our solar sytem with the formal discovery of the so-called Kuiper belt, a region of space beyond Neptune filled with thousands of icy bodies. The belt was really discovered in 1930 along with Pluto and postulated by Gerard Kuiper in the 1940s, but it was not recognized as such until the first additional bodies were discovered in 1992. People began to see Pluto as a large representative of a whole class of previously unknown bodies. Indeed, the argument that Pluto is just a large Kuiper belt object was reinforced by the discovery that Sedna, which orbits further out from Pluto, is at least as large. But perhaps a planet can be something more. Pluto has its own atmosphere, one very large moon, and several smaller moons of its own. It also has history, and science is not just about nature, but about people and how they relate to nature. Science can and has recognized historical precedence.

Confused yet? We can look back on the events of 1801 for guidance. January 1 of that first year of a new century saw the discovery of the first asteroid. Astronomers had wondered about the large gap between Mars and Jupiter. Ceres seemed to fill that gap and was referred to as "the new planet" until its puny diameter of only 950 kilometers, far smaller than the other known planets, became apparent. The discovery the very next year of Pallas, the second such object, also gave pause. By 1807 there were four of these bodies, and starting in 1845, discoveries of asteroids increased almost exponentially. The region between Mars and Jupiter was filled with thousands of bit of planetary debris. Were any of them worthy of the term planet? Astronomers declared "No!" and reclassified them as asteroids. By direct analogy, Pluto, Xena, Sedna, and several thousand similar objects, including many comets, are part of a belt of icy objects beyond Neptune called the Kuiper belt. And there is probably another such zone even farther out, from which many other comets originate:  the Oort cloud. On August 24, Ceres was partially reinstated, but was forced to settle for dwarf planet status along with Pluto. Let's hope Cerians are not miffed at the snub. My vote? Let the new definition stand for now. It is certain to change in a few years anyway.

The prime lesson of Pluto, with its exotic atmosphere, icy composition, and three moons, is that the solar system is a complex, dynamic place. The diversity of objects and their dynamical behavior is becoming increasing difficult to label and compartmentalize. Finding clean definitions for its components is not as simple as it used to be, and that is a sure sign of progress. Perhaps we shouldn't complain too much about a matter of mere words. A dwarf planet is still a planet after all. And perhaps a few folks on this chaotic immature planet will remember to look up in the sky every so often and marvel.

*— Paul Schenk*

# Spotlight on Education

*"Spotlight on Education" highlights events and programs that provide opportunities for space scientists to become involved in education and public outreach and to engage science educators and the community. If you know of space science educational programs or events that should be included, please contact the South Central Organization of Researchers and Educators at score@lpi.usra.edu.*

## Pre-LPSC Workshop on Public Understanding of Planetary Science

The 2006 pre-Lunar and Planetary Science Conference Education and Public Outreach workshop examined the "Public Understanding of Planetary Science." Fifty-two participants, including scientists and formal and informal science educators, came together to explore commonly held Earth and planetary science misconceptions. Teachers, students, and the general public often hold deeply rooted misconceptions about Earth and space science — and the nature of science — that preclude them from understanding and appreciating the role of science in their lives. Once aware of audience misconceptions, scientists and educators are in stronger positions to build a more accurate understanding of scientific concepts and the process of science.

Dr. Phil Plait, author of *Bad Astronomy*, and Research Manager for the Gamma-ray Large Area Space Telescope (GLAST) education and public outreach team at Sonoma State University, began the workshop with "The Moon Hoax Hoax." Plait explored common misconceptions about the lunar environment and the belief that the evidence of human exploration of the Moon was faked as part of a large conspiracy. His presentation expounded the scientific evidence counter to the misconceptions. Misconceptions commonly are shared — or exploited — through the media. It is important to understand the power of the media in delivering science information; in 2004, 41% of the general public indicated that their leading source of current science and technology news came from television. The Internet is a smaller, but increasingly used, source of information (18%), with 14% each for newspapers and magazines.

Dr. Phil Sadler, Director of the Science Education Department of the Harvard-Smithsonian Center for Astrophysics, presented "Mining the Data — Student and Teacher Results on a Space Science Concept Inventory," long-term research into student and teacher misconceptions. Sadler's data underscored the fact that student and teacher knowledge does increase with increasing instruction, but that the gains, perhaps, are not as large as anticipated. Educators often overestimate student gains in knowledge over the course of a class. Nor are the gains in student understanding of astronomy concepts significant as they are exposed to content in subsequent grades. There is a strong correlation between student learning and teacher understanding.

Finally, Ms. Claudine Kavanagh, doctoral candidate in the School of Education at Tufts University, and author of research articles about common Earth and space science misconceptions held by children and adults, presented "The Research Perspective on Teaching and Learning Science." She explored what research identifies as the most effective ways to share science information with the public, how to address misconceptions, and the scientist's role in doing so. For learners, their initial knowledge is based solely on their concrete experiences. Misconceptions are transient; they form as learners strive to incorporate new information into their existing knowledge. Audiences are likely to develop a "hybrid idea" that is a blend of their own understanding and what the scientist or educator is sharing. To help audiences move forward, presenters need to provide sufficient reasons for the audience to examine critically their experiential beliefs and to alter their perceptions. Kavanagh recommended that scientists and educators explore their audiences' misconceptions through questions and respond to these by providing multiple paths, such as active presentations, demonstrations, visualizations, and activities, in which the audience can access the new information.

Throughout the day, participants identified specific Earth and space science misconceptions about the Moon, lunar exploration, the scale of the solar system, and other topics. During the afternoon session small groups collaborated to develop strategies to address these misconceptions; these are available on line at www.lpi.usra.edu/education/score/public_understanding/misconceptions.shtml.

> *"I work a lot with introducing astronomy, physics and geology courses. I also teach future elementary teachers and do lots of outreach. In all of these, I will be keeping my eyes open for misconceptions and using the info from this workshop."*
>
> *— Workshop Participant*

Participants received two highly recommended resources, developed by the Harvard-Smithsonian Center for Astrophysics, that investigate student misconceptions. *A Private Universe/Minds of Our Own* (www.learner.org/resources/series29.html) is a collection of video clips that examines students' astronomical ideas (seasons and Moon phases) and how these ideas change (or don't) with classroom instruction. The newly released *Beyond the Solar System:*

*Expanding the Universe in the Classroom* (*www.cfa.harvard.edu/seuforum/btss/*) is a video exploration of the structure and evolution of the universe and the nature of science. *Beyond the Solar System* includes clips of students' preconceived ideas about stars, galaxies, and the Big Bang; exploration of science concepts; classroom strategies; and extensive resources for further exploration.

Presentations, recommended resources, and specific strategies for accessing audience understanding can be found on the *Public Understanding of Planetary Science* Web pages (*www.lpi.usra.edu/education/score/public_understanding/index.shtml*). The workshop was co-hosted by the South Central Organization of Researchers and Educators (SCORE) and the Structure and Evolution of the Universe Education Forum (SEU-EF) (*cfa-www.harvard.edu/seuforum/*) of NASA's Science Mission Directorate's Space Science Education and Public Outreach Support Network.

## *Annual LPI Field Experience for Educators*

Twenty-six K–12 classroom teachers and planetarium, science center, and library educators met in Eugene, Oregon, in July for the week-long "Heat From Within: Earthly Insights into Planetary Volcanism" field experience. Participants joined with planetary scientists Dr. Allan Treiman and Dr. Walter Kiefer of the Lunar and Planetary Institute to investigate local volcanic features and to compare and contrast volcanism on Earth with volcanism on other planets and moons in our solar system. These field experiences are one venue for continued professional development for science educators.

> *"Most people learn best by actually doing things hands on. For geology, that means going out into the field, looking at the rocks, and examining the processes that shaped the landscape. Once the teachers have done this for a few days, the process becomes less abstract and they more readily understand how scientists interpret pictures of the planets obtained by NASA's planetary probes."*
>
> *— Dr. Walter Kiefer, LPI Staff Scientist*

The week began with classroom discussion of volcanic rocks and features aimed, in part, at dispelling the common misconception that there are three kinds of volcanos: shield volcanos, stratovolcanos, and cinder cones. Instead, the participants were asked to consider the characteristics of the magma and the resulting type of volcanic activity — either effusive or explosive. The educators were challenged to place the many different volcanic features they observed in Central Oregon in the context of eruptive style, magma composition, and geologic environment. Three-and-a-half days subsequently were spent in the field, exploring volcanic rocks, flows, and characteristics associated with the Cascades volcanos, Newberry Caldera, Crater Lake, and landforms in the Fort Rock Basin. Attendees examined first hand stratovolcanos, cinder cones, shield volcanos, tuff rings, and flood basalts, and developed an understanding of the complexity of flows and features that contribute to volcanic landforms. At each field stop, participants made their observations and then participated in a group discussion of the interpretation of the site and placement in the broader geologic context.

Following the field days, participants worked in small teams to describe the volcanic features they observed, interpret the processes that formed them, and make connections to volcanic activity on other bodies in the solar system. These reports, which will be posted on the workshop Web page, will provide an avenue for the educators to reflect on their own learning and permit the facilitators to assess participant understanding and provide additional instruction.

Hands-on activities, selected to enhance field explorations and classroom discussion, were conducted by the participants and followed by group analysis of classroom implementation. Attendees also shared ideas for dissemination of content and activities to colleagues; several plan to conduct in-service workshops within their schools or districts, and to present at state science conferences. Presentations, resources, activities, and other information about the field experience can be found at *www.lpi.usra.edu/education/fieldtrips/2006/*.

## *Astronomical Society of the Pacific's 118th Annual Meeting: Engaging the Education and Public Outreach Community: Best Practices, New Approaches*

Scientists, educators, writers, webmasters, and journalists working in the field of astronomy and space science education and outreach are invited to this three-day conference September 16–18, 2006, in Baltimore, Maryland. The conference will highlight the best practices in the field and facilitate sharing of new approaches to serving students, teachers, and the public. If you are engaged in EPO activities, or are thinking of getting involved, this will be an ideal conference for learning from and networking with your peers. Conference and registration information can be found at *www.astrosociety.org/events/meeting.html*. Online registration closes September 5.

## American Geophysical Union Fall Meeting

Abstracts are due on September 7 for the Fall 2006 AGU! Consider submitting to one of the Education and Human Resources Sessions (*www.agu.org/meetings/fm06/content=search&show=session&section=18&cosection=0&category=&keysearch=&title=1&desc=1&searchBy=sponsor*). First authors can submit a contribution to an Education or Public Affairs session in addition to their abstract for a scientific session. Session topics include Education and Outreach Activities in support of the International Geophysical Year; Space Physics in the Undergraduate Curriculum; Using Earth and Planetary Data in Educational Settings; and Teacher Professional Development Programs. There will also be numerous Earth Systems Science and Geoscience sessions.

## Earth Science Week


"Be a Citizen Scientist!" is the theme of Earth Science Week 2006 on October 8–14. The week is intended to engage students and the public in conducting authentic "citizen science" research and help to spread science literacy. During Earth Science Week scientists, educators, local organizations, and interested individuals organize community activities to discover the Earth sciences and promote responsible stewardship of the Earth. The American Geological Institute will coordinate national essay, photography, and visual arts contests related to citizen science. Supporting educational packets, available on line, include a calendar, posters, CDs of information and activities, and more. Consider hosting an Earth Science Week Event at your institution, or partner with local schools! Earth Science Week is sponsored by the American Geological Institute, NASA, the U.S. Geological Survey, and other partners. Learn more at *www.earthsciweek.org*.

## The Universe in the Classroom


*www.astrosociety.org/education/publications/tnl/tnl.html*

The Astronomical Society of the Pacific offers an online newsletter for educators who want to bring astronomy into their learning environment. Prepared for those who may not have much background in astronomy, each issue focuses on a topic of current astronomical interest and is complemented by hands-on classroom activities and resource links to help children — and adults — explore further. The current issue spotlights Mercury, with tips for viewing the planet in the night sky and during its November 8 transit, an overview of the MESSENGER mission, and hands-on activities to explore Mercury's orbit and the reason transits are so rare.

## NASA's Earth Observatory

earth observatory

Earth Observatory provides current, online satellite imagery and scientific information, presented for the general public and educators, about Earth's climate and environmental change. The "Features" articles explore ongoing research about Earth's oceans, land, atmosphere, and biosphere. The site also shares Earth data and images, current Earth events, and has experiments for children. Great for the inquisitive adult or high-school student. Visit *earthobservatory.nasa.gov*.

## Small E/PO Workshop and Project Grants Available

The SCORE Broker Facilitator program offers small grants up to $4000 to assist in the development and implementation of local professional development workshops for classroom educators in the SCORE six-state region of Arizona, Kansas, Louisiana, New Mexico, Oklahoma, and Texas. Workshops are intended to initiate new partnerships between NASA's Science Mission Directorate scientists and K–12 formal educators. The workshops are designed and implemented by the scientist-educator team and should meet the needs of the local community. Interested researchers and educators can find more information at *www.lpi.usra.edu/education/score/collaborativeworkshops.shtml*.

The SCORE program also offers grants of up to $1000 to collaborative teams of educators and Science Mission Directorate researchers in the SCORE six-state region. The grants are intended to help initiate new partnerships between educators and researchers. Funds can be used to purchase materials and resources to increase student or public understanding of space science content. For more information, visit *www.lpi.usra.edu/education/score/collaborativeprojects.shtml*.

*Interested in becoming more involved in space science education and public outreach? NASA's Science Mission Directorate's Space Science Education and Public Outreach Support Network encompasses a nationwide network of Broker/Facilitators and Education Forums that are prepared to assist space science investigators in developing high-quality, high-impact E/PO programs. For more information about the network, or to contact the Broker/Facilitator in your region, please visit science.hq.nasa.gov/research/ecosystem.htm.*

## Solicitation for Contributions

Contributions to the Lunar and Planetary Information Bulletin (LPIB) are solicited from the planetary community and beyond. Articles exploring issues related to planetary science and exploration are welcome. Of special interest are articles describing Web-based research and educational tools, meeting highlights and summaries, and descriptions of new space missions that may be of interest to our readers. Peer-reviewed research articles, however, are not appropriate for publication in the LPIB. The LPIB is published quarterly and serves the planetary research community, science libraries, educators, students, and lay readers interested in space-science-related research. Suggested topics can be e-mailed to the editors, who will provide guidelines for formatting and content.

Dr. Paul Schenk,
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Renée Dotson,
Production Editor (***dotson@lpi.usra.edu***)

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The Bulletin welcomes articles dealing with issues related to planetary science and exploration. The copy deadline for the next issue is October 13, 2006. Articles or announcements should be submitted via e-mail to ***lpibed@lpi.usra.edu***.

To be added to the list to receive notification by e-mail of future issues, please send your e-mail address to ***lpibed@lpi.usra.edu***.

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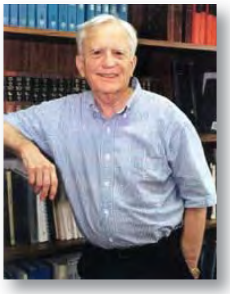
# In Memoriam



## George Wetherill

Carnegie Institution planetary formation theorist and 1997 National Medal of Science recipient, George Wetherill, died from heart failure on July 19, 2006, at his Washington, DC, home. Wetherill revolutionized our understanding of how our planets and solar system formed through his theoretical models.

Born in Philadelphia on August 12, 1925, Wetherill served in the U.S. Navy during World War II, teaching radar at the Naval Research Laboratory in the District. He graduated from the University of Chicago in 1953 after a succession of degrees, Ph.B., S.B., S.M., and Ph.D. After receiving his doctorate, he joined Carnegie's Department of Terrestrial Magnetism as a member of the scientific staff. Between 1960 and 1975 he was a professor and department chairman at the University of California, Los Angeles. He came back to Carnegie in 1975 as director of the department, a position he held until 1991. After he stepped down, he continued his research as director emeritus.

In the 1950s, Wetherill was among a group of scientists who developed geochemical methods involving natural radioactive decay to date Earth's rocks. Later, his interests in age-dating techniques expanded to include extraterrestrial materials, including meteorites and rock samples from the Moon. In the 1970s, he began theoretical explorations into the origins of meteorites and the terrestrial planets, developing a technique to calculate the orbital evolution and accumulation of swarms of small bodies as they coalesce into planets.

Wetherill's computations also revealed how important Jupiter may be in protecting Earth and other inner planets from bombardment via its enormous gravitational field. He showed that Jupiter provides a shield from orbiting asteroids and comets, scattering most of them out of the solar system. The discoveries of planets orbiting other stars provided him with further theoretical challenges in his final years of research.

In 1997 George Wetherill received the highest scientific award in the nation — the National Medal of Science. He was elected to the American Academy of Arts and Sciences in 1971 and to the National Academy of Sciences in 1974. He received the 1981 F. C. Leonard Medal of the Meteoritical Society, the 1984 G. K. Gilbert Award of the Geological Society of America, the 1986 G. P. Kuiper Prize of the Division for Planetary Sciences of the American Astronomical Society, and the 1991 Harry H. Hess Medal of the American Geophysical Union. In 2003 Wetherill was awarded the Henry Norris Russell Lectureship, the highest honor bestowed by the American Astronomical Society.

## Books

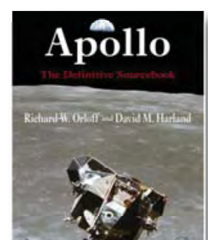
***Meteorites and the Early Solar System II***. Edited by Dante S. Lauretta and Harry Y. McSween. University of Arizona Press, 2006. 942 pp., Hardcover, $90.00. *www.uapress.arizona.edu*


They range in size from microscopic particles to masses of many tons. The geologic diversity of asteroids and other rocky bodies of the solar system are displayed in the enormous variety of textures and mineralogies observed in meteorites. The composition, chemistry, and mineralogy of primitive meteorites collectively provide evidence for a wide variety of chemical and physical processes. This book synthesizes our current understanding of the early solar system, summarizing information about processes that occurred before its formation. It will be valuable as a textbook for graduate education in planetary science and as a reference for meteoriticists and researchers in allied fields worldwide.

***The Last of the Great Observatories: Spitzer and the Era of Faster, Better, Cheaper at NASA***. George H. Rieke. University of Arizona Press, 2006. 264 pp., Hardcover, $40.00. *www.uapress.arizona.edu*

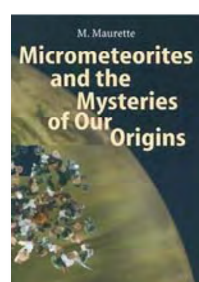

The Spitzer Space Observatory, originally known as the Space Infrared Telescope Facility (SIRTF), is the last of the four "Great Observatories," which also include the Hubble Space Telescope, the Chandra X-Ray Observatory, and the Compton Gamma Ray Observatory. Developed over 20 years and dubbed the "Infrared Hubble," Spitzer was launched in the summer of 2003 and has since contributed significantly to our understanding of the universe. Rieke played a key role in Spitzer and now relates the story of how that observatory was built and launched into space. Up to its official start and even afterward, Spitzer was significant not merely in terms of its scientific value but because it stood at the center of major changes in space science policy and politics. Through interviews with many of the project participants, Rieke reconstructs the political and managerial process by which space missions are conceived, approved, and developed. Rieke's participant's perspective takes readers inside Congress and NASA to trace the progress of missions prior to the excitement of the launch, revealing the enormously complex and often disheartening political process that needs to be negotiated. He also shares some of the new observations and discoveries made by Spitzer in just its first year of operation. As the only book devoted to the Spitzer mission, *The Last of the Great Observatories* is a story at the nexus of politics and science, shedding new light on both spheres as it contemplates the future of mankind's exploration of the universe.

***Apollo: The Definitive Sourcebook.*** Richard W. Orloff and David M. Harland. Springer, 2006. 633 pp., Paperback, $49.95. *www.springer.com*

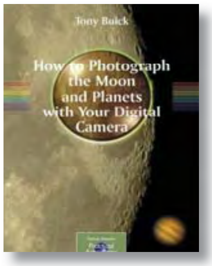



On May 25, 1961, John F. Kennedy announced the goal of landing an American man on the Moon by the end of the decade. This challenge forced NASA to plan the lunar landing of a three-man spaceship named Apollo in the mid-1970s. In 1962, it was decided that a specialized vehicle would accompany the main spacecraft, to make the lunar landing while the mothership remained in lunar orbit. To send these vehicles to the Moon would require the development of an enormous rocket. Development was protracted, but in December 1968 Apollo 8 was launched on a pioneering mission to perform an initial reconnaissance in lunar orbit. When Apollo 17 lifted off from the Moon in December 1972, the program was concluded. Now, at long last, there is a real prospect of a resumption of human exploration of the Moon. This book provides an overview of the origins of the Apollo program and descriptions of the ground facilities, launch vehicles, and spacecraft that will serve as an invaluable single-volume sourcebook for space enthusiasts, space historians, journalists, and producers of radio and TV programs. It supplements the other books that have focused on the politics and management of the Apollo program, the astronauts, and their training and exploits.

***Micrometeorites and the Mysteries of Our Origin.*** M. Maurette. Springer, 2006. 330 pp., Hardcover, $59.95. *www.springer.com*




Micrometeorites played an essential role in the formation of the atmosphere of the early Earth and also served as a significant source of activation for organic prebiotic chemistry on mineral surfaces. The present book gives a coherent account of this scenario, embedding the more specific results within a broader framework that considers the creation and evolution of the early Earth. It thus addresses students and nonspecialist researchers in the fields of planetary atmospheres, biogeophysics, and astrobiology. The experienced researcher will find this volume to be a modern and compact reference, as well as a source of material for lectures in this field.

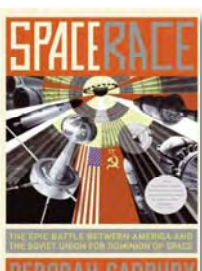



***How to Photograph the Moon and Planets with Your Digital Camera.*** Tony Buick. Springer, 2006. 274 pp., Paperback, $50.00. *www.springer.com*

Since the advent of astronomical charge-coupled device (CCD) imaging it has been possible for amateurs to produce images of a quality that was attainable only by universities and professional observatories just a decade ago. However, astronomical CCD cameras are still very expensive, and technology has now progressed so that digital cameras — the kind you use on vacation — are more than capable of photographing the brighter astronomical objects, notably the Moon and major planets. Buick has worked for two years on the techniques involved, and has written this illustrated step-by-step manual for anyone who has a telescope (of any size) and a digital camera. The color images he has produced — there are over 300 of them in the book — are of breathtaking quality. His book is more than a manual of techniques (including details of how to make a low-cost do-it-yourself camera mount) and examples; it also provides a concise photographic atlas of the whole of the nearside of the Moon — with every image taken using a standard digital camera — and describes the various lunar features, including the sites of manned and robotic landings.


***The Man Who Ran the Moon: James E. Webb, NASA, and the Secret History of Project Apollo.*** Piers Bizony. Thunder's Mouth Press, 2006. 256 pp., Hardcover, $24.95. *www.thundersmouth.com*

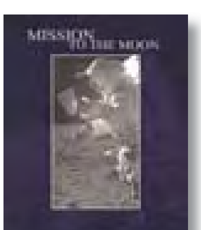
One man, more than any other, created the giant space agency we know today as NASA: James E. Webb. *The Man Who Ran the Moon* explores a time when Webb and an elite group of charismatic business associates took control of America's Apollo moon project, sometimes with disturbing results. In 1967, NASA was rocked by disaster and Apollo was grounded. Webb was savaged in a Congressional investigation. Not just a matter of broken hardware, there were accusations of corruption at the heart of America's space effort. Some of Webb's political allies had been caught up in the biggest scandal ever to hit Washington prior to Watergate. The backwash unfairly tainted NASA's chief. By the time of the first triumphant lunar landing, Webb had resigned and his name had all but been forgotten. But he's the man who got us to the Moon, and the power base he forged in the 1960s has kept NASA on a solid footing to this day. Washington insiders now acknowledge Webb as one of the greatest leaders in modern American history. No space boss since his time has wielded so much power and such a powerful story.




***Space Race: The Epic Battle Between America and the Soviet Union for Dominion of Space.*** Deborah Cadbury. HarperCollins, 2006. 384 pp., Hardcover, $24.95. *www.harpercollins.com*

The story of the race into space is marked by the greatest superpower rivalries, political paranoia, and technological feats of the twentieth century. At the center of this fast-paced account are Wernher von Braun, the former Nazi scientist who led the American rocket design team, and Sergei Korolev, the chief Soviet designer and former political prisoner whose identity was a closely guarded state secret. These rivals were opposite in every way, save one: each was obsessed by the idea of launching a man to the Moon. In attempting to fulfill this dream, Korolev was initially hampered by a budget so small that his engineers were forced to repurpose cardboard boxes as drafting tables. Von Braun, meanwhile, was eventually granted almost limitless access to funds by an American government panicked at the thought that their Cold War enemy might take the lead in the exploration of space. Cadbury combines adventure and suspense with a moving portrayal of the space race's human dimension. Using source materials never before seen, she reveals that the essential story of the cold war is a mind-bending voyage beyond the bounds of Earth, one marked by espionage, ambition, ingenuity, and passion.

## DVD



***Mission to the Moon.*** Produced by Mark Gray. Spacecraft Films, 2005. $34.99. *www.spacecraftfilms.com*

Man's first steps on the Moon took an incredible effort by thousands of dedicated workers. In this two-DVD set you'll see how the Apollo program took men to the Moon through in-depth programs created for NASA in conjunction with the Massachusetts Institute of Technology. Each of them focuses on a specific topic presenting in-depth information and hands-on demonstrations of how hardware was built and operated. Most of the programs are in black and white but are some of the most informative pieces on Apollo hardware and procedures we've ever seen. This set contains over five hours of material and is hosted by John Fitch.

## KIDS !!!

***Al Espacio: La Carrera la Luna.*** Philip Wilkinson. Dorling Kindersley Publishing Inc., 2006. 48 pp., Paperback, $3.99. us.dk.com


This is a new translation of a bestselling DK Reader from the *Spacebusters* series. This book describes the voyage of Apollo 11, its three astronauts, and details of the mission that put the first man on the Moon in 1969. This version is designed to introduce children to the Spanish language and encourage fluency and literacy. The exciting storyline will inspire children to try out new vocabulary and develop their reading skills as they learn about favorite subjects. For ages 4–8.

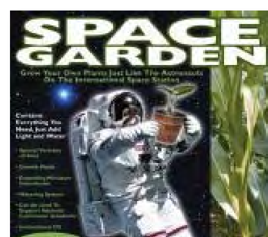
***NASA STS-121 Comic Book Poster.*** Matt Melis. NASA, 2006. 17-inch × 22-inch poster, $4.50. www.countdowncreations.com

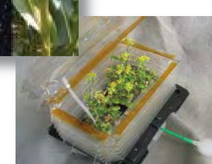

Look! Up in the sky! It's a bird! It's a plane! It's the space shuttle! On July 4, NASA successfully launched its second shuttle "return to flight" since the loss of space shuttle Columbia in February 2003. Now, NASA Glenn Research Center aerospace engineer Matt Melis has drawn for the space agency an STS-121 mission poster that captures the excitement of the launch in the style of a classic comic book cover. The thirteen-day STS-121 mission tested new techniques for improving shuttle safety and delivered both supplies and another crewmate to the orbiting outpost.

***Tektites: Rocks from Space.*** Available from Physlink.com Science eStore. $3.99. www.physlink.com


Tektites are amazing little rocks thought by scientists to have formed when rocks from space impact Earth. Currently the most popular theories speculate that tektites have an extraterrestrial origin, either directly from the Moon or from the effects of large meteorites hitting Earth. Ages range from 800,000 to 35 million years old! Tektites are typically black or darkly colored and have rounded shapes, generally pitted on the outside and glassy on the inside. Each package includes one 1" to 1.25" tektite and a card with educational information on the back. Great for science projects or classroom collection. For ages 7 and up.

***Space Garden.*** Planet LLC, 2006. $49.99. www.spacegarden.net



Start to discover the many uses of plants in space with Space Garden — the most realistic and educational growth system available today. Space Garden's unique growth chamber is a groundbased version of an actual vegetable growth system designed for the International Space Station. Space Garden comes with all the materials needed to conduct biological, agricultural, and life science investigations just like the astronauts. Each kit includes an expandable growth chamber, seeds, watering syringe, growth medium, and educational activities to introduce the science of plants in space in a fun — and even edible — way!

# Calendar 2006

## September

4–7 **Remote Sensing Applications for a Sustainable Future**, Haifa, Israel.
*http://geo.haifa.ac.il/~isprs/comm8-symposium/*

11–15 **Workshop "From Dust to Planetesimals,"** Ringberg Castle, Germany. *http://www.mpia.de/homes/fdtp/*

11–15 **Precision Spectroscopy in Astrophysics**, Aveiro, Portugal. *http://www.oal.ul.pt/psa2006/*

13–16 **The Second International Symposium on Space Climate**, Sinaia, Romania. *http://www.issc2.ro/*

14–15 **Beyond Pluto: The Discovery of the "10th Planet,"** Pasadena, California.
*http://www.jpl.nasa.gov/events/lectures/sep06.cfm*

16–18 **118th Annual Meeting of the Astronomical Society of the Pacific, Engaging the Education and Outreach Community: Best Practices, New Approaches**, Baltimore, Maryland.
*http://www.astrosociety.org/events/meeting.html*

17–20 **Pale Blue Dot III**, Chicago, Illinois.
*http://www.adlerplanetarium.org/pale_blue_dot/*

17–21 **Extremophiles 2006 Conference**, Brittany, France.
*http://www.extremophiles2006.org/*

17–22 **International Symposium on Recent Observations and Simulations of the Sun-Earth System**, Varna, Bulgaria.
*http://www.isroses.org*

18–22 **Europlanet #1: European Planetary Science Congress**, Berlin, Germany.
*http://meetings.copernicus.org/epsc2006/index.html*

19–21 **Space 2006**, San Jose, California.
*http://www.aiaa.org/content.cfm?pageid=230&lumeetingid=1393*

24–27 **7th International Symposium on Environmental Geochemistry**, Beijing, China.
*http://www.iseg2006.com/2001_welcome.htm*

24–29 **VIIIth Hvar Astrophysical Colloquium Dynamical Processes in the Solar Atmosphere**, Hvar, Croatia.
*http://www.geof.hr/oh/meetings/*

25–28 **Transiting Extra-Solar Planets Workshop**, Heidelberg, Germany. *http://www.mpia-hd.mpg.de/transits/wk/*

## October

2–6 **4th International Conference on Mars Polar Science and Exploration**, Davos, Switzerland.
*http://www.lpi.usra.edu/meetings/polar2006/*

2–6 **57th International Astronautical Congress**, Valencia, Spain. *http://www.iac2006.com/principal.asp?sm=0*

4–7 **High Energy Astrophysics Division 2006**, San Francisco, California.
*http://www.confcon.com/head2006/head06.php*

5–6 **Workshop on Spacecraft Reconnaisance of Asteroid and Comet Interiors**, Santa Cruz, California.
*http://www.lpi.usra.edu/meetings/recon2006/*

8–13 **38th Annual Meeting of the Division of Planetary Sciences of the American Astronomical Society**, Pasadena, California.
*http://www.aas.org/dps/dps.html*

9–11 **Radiation Backgrounds from the First Stars, Galaxies and Black Holes**, College Park, Maryland.
*http://www.astro.umd.edu/october/2006/2006.html*

10–12 **Strategic Space 2006**, Omaha, Nebraska.
*http://www.stratspace.org/*

12–13 **Advanced Technology for Life Detection and Biology**, Pasadena, California.
*http://www.jpl.nasa.gov/events/lectures/oct06.cfm*

16–17 **LCROSS Workshop**, Moffet Field, California.
*http://www.lpi.usra.edu/meetings/lcross2006*

16–18 **European Workshop on Astrobiology 2006**, Lyon, France. *http://eana06.univ-lyon1.fr*

22–24 **Workshop on Martian Sulfates as Recorders of Atmospheric-Fluid-Rock Interactions**, Houston, Texas.
*http://www.lpi.usra.edu/meetings/sulfates2006/*

22–25 **GSA 2006 Annual Meeting and Exposition**, Philadelphia, Pennsylvania.
*http://www.geosociety.org/meetings/2006/index.htm*

31–Nov 2 **Space Resources Roundtable VIII**, Golden, Colorado.
*http://www.lpi.usra.edu/meetings/roundtable2006/*

## November

2–5 **American Society for Gravitational and Space Biology**, Arlington, Virginia.
*http://asgsb.org/annual_meeting.html*

6–8 **9th International Workshop on Simulation for European Space Programmes — SESP 2006**, Noordwijk, The Netherlands.
*http://www.congrex.nl/06c29/main.html*

6–10 **Measuring the Earth II**, San Antonio, Texas.
*http://www.asprs.org/fall2006/index.htm*

13–17 **Science with ALMA: A New Era for Astrophysics**, Madrid, Spain.
*http://www.oan.es/alma2006/*

13–17 **Third European Space Weather Week**, Brussels, Belgium.
*http://sidc.oma.be/esww3/*

28–30 **Astrophysics Enabled by the Return to the Moon**, Baltimore, Maryland.
*http://www.stsci.edu/institute/conference/moon*

## December

5–6 **Advanced RF Sensors for Earth Observation 2006**, Noordwijk, The Netherlands.
*http://www.congrex.nl/06c33/main.html*

8–10 **Workshop on Early Planetary Differentiation: A Multi-Planetary and Multi-Disciplinary Perspective**, Sonoma County, California.
*http://www.lpi.usra.edu/meetings/epd2006*

11–15 **2006 AGU Fall Meeting**, San Francisco, California.
*http://www.agu.org/meetings/fm06/*