

THE PLANETARY REPORT

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DARK SKIES?

LIGHT POLLUTION IS OBSCURING
OUR VIEW OF THE STARS



EMILY STEWART LAKDAWALLA
blogs at planetary.org/blog



Image: NASA/JPL/SSI/Gordan Ugarkovic

Saturn's two largest moons

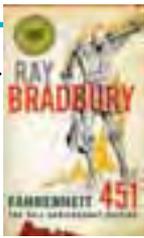
Color cameras shine on board *Cassini*

HAZE-SHROUDED TITAN SITS BEHIND ICY RHEA in a view captured by *Cassini* on November 19, 2009. Titan is almost exactly twice as far from *Cassini* as Rhea is, so Rhea's size is exaggerated by a factor of two. *Cassini* takes "mutual event" photos featuring two or more moons in order to provide precise positional information for determining the moons' orbits. Late in 2009, *Cassini*'s engineers switched from taking mutual event pictures in black and white to using the red, green, and blue filters necessary for composing color images. The result has been an explosion in the number of beautiful images like this one, of orange Titan (outlined in blue haze), yellow Saturn, and other rings paired with gray-brown moons. 🌕

—Emily Stewart Lakdawalla

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SEE MORE EVERY DAY! PLANETARY.ORG/BLOG



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ON THE COVER: A love affair with space exploration began early in life for many of us, when we first gazed at a sparkling night sky and wondered what kinds of worlds might fill the universe. Many Earthlings—denizens of cities and densely populated areas—have never seen a truly clear sky, however. Excess, unshielded light at night creates light pollution. Not only do runaway photons cloud our view of the heavens, but they also can disrupt ecosystems and the well-being of animals such as birds, reptiles, and humans.
 Photo: Maximilian Stock, Ltd./Science Photo Library



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YOUR PLACE IN SPACE



BILL NYE is chief executive officer of *The Planetary Society*.

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Making History

Getting Involved in Politics, Missions, and Change

WELCOME, PLANETARY SURFERS FROM ALL over the world. The Planetary Society has a new website and a new logo. As people living on Earth here at the start of the 21st century, you and I are able to communicate with more people than any humans before us, ever—since the beginning of time. It's remarkable. Our new site makes it easier for you and me to be in touch, and especially for you to be in touch with our growing community of space enthusiasts, buddies, colleagues, new acquaintances, and button-wearing Space Geeks®. Please enjoy this issue of *The Planetary Report* you're holding in your hands right now, but in the next few days (or even minutes), check out planetary.org. We've made more than one big change and dozens of smaller ones.

We very much wanted to get the site up and running in time for the USA Science & Engineering Festival in Washington, D.C. I admit I didn't quite believe the estimates of the expected number of visitors ... until I was there. I'm pretty sure the festival had 100,000 visitors, and several thousand of those came by our booth. It was gratifying to meet so many young people who have a strong interest in space exploration. For the many of you who came by to say "hi," or listen to one of our very compelling speakers, or get a book autographed, or just wanted to spend time with like-minded space enthusiasts, thank you. It was great to see you, and we appreciate your support.

At the festival, we showed off our new logo for the first time. Just like the Society these days, the new logo has motion. It's taking us to new places while respecting our origins. I hope you like it as well as we do.

WORKING HARD

Since the Society was formed 31 years ago, we have been advocates for government in-

vestment in space exploration. Being in the United States, we petition the U.S. government often. On the first of May, I went around to the offices of three influential congressmen—Adam Schiff, John Culberson, and Frank Wolfe—with our colleague in Washington, Bill Adkins. We described the situation: planetary science is getting cut for reasons that, frankly, aren't clear. Whatever the reason, we did our best to convince the staffers that cuts to planetary exploration would not be in anyone's best interest.

The following week, on Tuesday, May 8, our Board of Directors organized a "lunch and learn" for U.S. Congress members and their staffers. I led off as the emcee. Our colleague Louise Prockter from the Applied Physics Lab, where they build exquisite spacecraft like *New Horizons* and *MESSENGER*, explained the missions outlined in the National Research Council's Planetary Science Decadal Survey. Then our own Neil deGrasse Tyson was up, as the final speaker, and gave the staffers and members of Congress an oration about the great intrinsic value of the space program. We made the case for the importance of planetary exploration for our economic well-being—no other organization besides NASA can land spacecraft on Mars, for example. If we lose that capability, we may never get it back. Missions to other worlds enrich us all.

As your CEO, I am, to many, the face and voice of your Society. As such, I've been busy. I was a speaker at TED, the Technology, Entertainment, and Design meeting in Long Beach, California; at Eastern Missouri State University; at the University of Colorado; and at the National Space Symposium in Colorado Springs, and I was the commencement speaker at Harvey Mudd College and the Rochester Institute of Technology. We are getting people engaged in planetary exploration and the need to keep it funded.



TED

IDEAS WORTH SPREADING

LEFT Bill Nye talks about MarsDials at TED, the Technology, Entertainment, and Design conference in Long Beach, California.

PLAYING HARD

After all, our species has a landing on Mars coming up very soon. With your support, we're participating in the Mars Science Laboratory (MSL) *Curiosity* mission. We're throwing a worldwide party to celebrate the landing: we'll have Planetfest™ 2012 in Pasadena and at museums and science centers around the world. I hope many of you reading along here will participate. Go to your local planetarium or science center and share the excitement of the weekend. We'll have panels of experts, exhibits, displays, and the amazing, edge-of-your-seat experience of being together as *Curiosity* makes its way through the Martian atmosphere and lands in the spectacular Gale crater. I've been through three of these things. It's wonderful to share the experience with others. There's plenty of drama; sometimes missions get in trouble. But with NASA driving, we hope for a very happy ending ... and then the start of years of astonishing discoveries. Get the latest information on Planetfest 2012 at planetfest.org.

On board *Curiosity* is the third MarsDial. It's the test pattern for the cameras, the photometric calibration target. And it's a sundial, used to indicate true north and to reckon time by the Sun—on another world. We have

more about the MarsDial in the center Planetary Society Kids section, so take a look.

Like so many Society members, I was saddened at the recent death of Ray Bradbury. He was a good friend to all of us. He often dreamt of the future and travel between planets, most especially Mars. His stories were cautionary, warning us of the dangers of a government unchecked. He reminded us all of the importance of the written word: the power of prose and poetry. He often remarked that he wrote fantasy rather than science fiction, but it was largely his work that brought science fiction into the mainstream of literature. Because they're so good, his stories have stood the test of time. Thank you, Ray; you changed the world. At The Planetary Society, we will do our best to see to it that your dreams and hopes of exploring the distant regions of the solar system—and Mars especially—are kept alive.

Bill Nye

THIS IS YOUR ORGANIZATION, AND I WANT TO HEAR FROM YOU.

E-mail me at tellbill@planetary.org or send a letter to Bill Nye at
The Planetary Society
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Pasadena, CA 91105

Find more information at planetary.org/yourplace



LOUIS FRIEDMAN is Executive Director Emeritus of The Planetary Society.

A Martian Has Died

By Louis Friedman, June 6, 2012

THE LAST WORDS RAY BRADBURY said to me were, “Yes, I will shout HURRAH!” I was visiting him at his home and had spent a hour or so talking with him about our favorite subject, Mars, as well as reading to him a couple of his own poems. His answer, “yes,” was to my question about whether I could come back and record a video greeting from him to a Planetary Society crowd at Planetfest 2012, celebrating the landing of the Mars Science Laboratory in August 2012. We were supposed to do that recording the next week, but instead, Ray went to the hospital. In June 2012, he passed away at the age of 91.

This touches us deeply, because Ray was a major part of The Planetary Society, and his life and ours were much intertwined. He took us to the future, where he said, “We are the Martians.” Although his long life was replete with an enormous repertoire and myriad accomplishments and subjects, it was inspiring us about Mars for which he will be best remembered and for which he was, I think, proudest. After all, he got to imagine it and then witness the exploration—and today, thanks to members of The Planetary Society, his *Martian Chronicles* is actually on Mars in an archive awaiting future explorers at the *Phoenix* spacecraft landing site ([BIT.LY/TPS120601](http://bit.ly/TPS120601)).

I first had the idea of *Visions of Mars* as a tribute to the three giants of science fiction literature who helped Carl Sagan, Bruce Murray, and me get the Society started in the early 1980s. I called them ABC: Asimov, Bradbury, Clarke. They urged us to form the Society because no one else was doing anything about planetary exploration after the *Viking* mission (which landed in 1976), and they agreed to help us with personal appearances, writing, and even donations. Ray was a close personal friend of Bruce Murray while Bruce was director of JPL, and they and their wives frequently got together to discuss the future of Mars exploration. Eventually I, too, became a friend, and even on my last visit, Ray and I were talking about the same old subject—convincing politicians of the joys and benefits of exploring Mars.

I spoke with Bruce Murray about Ray, and he of course was deeply saddened by the news. He said,

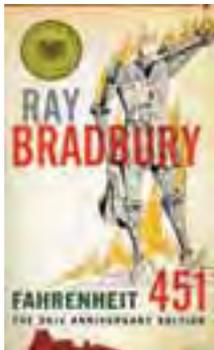
“Ray was a very special person and a giant of his time.” We remembered many conversations with Carl, Ray, and our other early science fiction advisers about the interplay of science and science fiction and how they both represent the enormous public interest in the adventure of space exploration. That public interest was the premise for the Society’s formation.

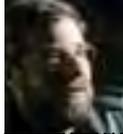
There are many Planetary Society events I can recall with Ray—in recent years they were more celebratory; in earlier years they were actually livelier. We had panel discussions, in which Ray got heckled for bemoaning that women don’t read science fiction, and theatrical events, including one that even starred his good friend Charlton Heston.

In later years, Ray focused on poems and plays, only a few of which had space exploration themes. But everywhere he went, the Mars connection dominated. I tried to get Ray to come with me to Russia once because he is almost as popular there as he is in the United States, but Ray was a global figure who traveled very little. His writings (and speeches), whether about Mars or any other subject, inspired optimism and hope for a creative and better future and resonated well in many languages. When he got bad news—like cancellation or failure of a Mars mission—he immediately focused on the future: “Let’s get on with it,” he would say impatiently when others were wringing their hands or dithering about next steps.

It was that optimism that manifested itself in his promise to shout “HURRAH” for the upcoming Mars landing this summer, even as we both bemoaned the crazy science cuts in the U.S. budget for planetary exploration and wrung our hands about the complexity of successful landing of the huge *Curiosity* rover. He was optimistic—so am I. I’d be willing to jump the gun and declare we should name *Curiosity*’s landing site the Ray Bradbury Memorial Station. I know NASA will have to form a committee to consider that, but as Ray would say, “Just get on with it.”

We will miss Ray, but a lot less than you might think—his words fill the ether and always will inspire all of us who want to explore new worlds. 🌟





W. SCOTT KARDEL is Public Affairs Director for the International Dark-Sky Association.

14 OCT. 2003 (EAST COAST BLACKOUT)



NORMAL NIGHT, EAST COAST, NORTH AMERICA



LEFT This Goodwood, Ontario house, illuminated by flashlights and candles only, was photographed on the evening of August 14, 2003 during the immense blackout that affected parts of the northeastern United States and Canada.

RIGHT With power restored on the evening of August 15, local lights—as well as those from Toronto, 45 minutes away—returned the beautiful night sky to its usual murky blur.

Into the Dark Reclaiming the Night Skies

“**BEFORE WE INVENTED CIVILIZATION** our ancestors lived mainly in the open out under the sky. Before we devised artificial lights and atmospheric pollution and modern forms of nocturnal entertainment we watched the stars. There were practical calendar reasons of course but there was more to it than that. Even today the most jaded city dweller can be unexpectedly moved upon encountering a clear night sky studded with thousands of twinkling stars. When it happens to me after all these years it still takes my breath away.”

— *Carl Sagan, Pale Blue Dot: A Vision of the Human Future in Space*

Carl Sagan’s experience is not unique. For most people, viewing a star-filled sky is a breathtaking and moving experience. For all of human history, our nightly encounter with the stars has inspired people

of every culture to create stories that connect them to the night sky. In modern times, the stars continue to inspire and have awakened dreams of exploring space. Dark, star-filled skies, however, are becoming harder and harder to find.

There was a time when the average person, even someone living in a city, could step outside his or her home and see the Milky Way. That time is long behind us. Electric light fills the night and blots out all but the brightest of stars in almost every urban area. It is estimated that more than two thirds of Americans live where they can no longer see and be inspired by the sight of the Milky Way. Seeing a brilliant star-filled sky is now a challenge, so much so that dark skies are a part of the growing ecotourism movement.

Light pollution costs us more than the loss of an inspiring night sky. The International Dark-Sky Association (IDA), a nonprofit devoted to stopping light

RECLAIMING THE NIGHT SKIES

pollution, conservatively estimates that annually, in the United States alone, some \$2.2 billion of energy is wasted in lighting up the sky. That is the equivalent of throwing away the cost of a new *Curiosity* mission to Mars every year. Astronauts aboard the International Space Station can easily see and photograph this wasted light from their vantage point in orbit. The



ABOVE: *Wasted light is easily visible to astronauts in orbit. Here, Scott Kardel created stacked images taken by astronauts on board the International Space Station as it made a nighttime pass over the U.S. and Canada. The station is illuminated by Earth's city lights.*

idea of having brightly illuminated cities has become so pervasive that it has been suggested that one way to look for extraterrestrial life is to look for the light pollution of alien cities.

As technology has evolved, lighting up the night has become much easier. Some see this as a sign of progress—a way for us to beat back the night to allay our fears of whatever unknown dangers might be lurking nearby in the dark. Scientists have demonstrated that adding light at night makes people feel safer, yet there is no conclusive evidence that it actually improves safety. Some towns in the United States and in the United Kingdom recently have removed or dimmed streetlights because they can no longer afford to keep them on. Studies out of the United Kingdom are suggesting that, counter to what most people would expect, crime is going down where streetlights have been turned off.

HARM TO NATURE

The glow of light pollution now extends well beyond our communities. At the fringes where cities meet, the natural environment's light at night can play a damaging role that puts further pressure on wildlife already suffering from habitat loss. Of all the animals on our planet, perhaps none is under more threat from light pollution than sea turtles, which live in the ocean but are born at night on dark, sandy beaches. Hatchling sea turtles have one immediate goal to secure their best chance of survival—find the ocean. They have evolved to look for the ocean by seeing the light of the moon and stars reflected off the waves. In the natural world, these reflections are the only source of light where the newly hatched sea turtles exist. They home in on the light and make for the water.

In the modern world, adult female sea turtles have a hard time finding an appropriately dark beach to lay their eggs, and our lights confuse their hatchlings. Instead of reaching the safety of the ocean, the newborns instead head for roads, civilization, danger, and death. Light pollution is a major contributing factor in endangering or threatening all species of sea turtles. In response to this threat, turtle-friendly lights have been developed that are designed not only to keep light where it is needed for humans but also to limit the spectrum of light to have the least possible impact on turtles.

Light at night also poses a big danger to migratory birds. Birds often fly directly into tall illuminated structures such as high-rise buildings and communication towers. It is estimated that in North America alone, more than 100 million birds die each year from collisions with lighted structures.

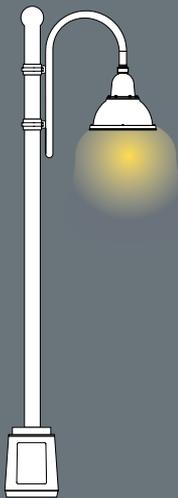
Even without a solid structure to collide with, birds are endangered by light at night because they are often drawn to bright beams of light. Confused, they become fixated and entrapped by the light, flying around in the beam until they fall in exhaustion or death.

In response to this danger to birds, the Fatal Light Awareness Program (FLAP) was started in Toronto, Ontario, Canada. This and other Lights Out campaigns are spreading across North America in an effort to raise awareness of the problem and extinguish lights in high-rise buildings during periods of bird migration. The effort is one of the first to tie the need to fight light

The "good neighbor guide" to reducing light pollution

NO!

YES



The light fixtures in the left column produce both light pollution and energy waste. While they may give users a sense of security, unshielded fixtures that create glare and splatter light everywhere may make a property less safe by not focusing the light where it is needed. In addition, unshielded lights create sky conditions that are not conducive to viewing the stars.

TOP: Sea turtle hatchlings depend on the light of the Moon and stars on the waves to find their way home to the ocean. Unshielded lighting causes them to head for the city or the road—and often an untimely death. Turtle-friendly lights have been developed to keep illumination—and turtles—in their proper places. **MIDDLE:** In addition to brightening the night sky, improper lighting often produces glare, harsh shadows, and light trespass. This unshielded streetlight illuminates much more than the street below it. **BOTTOM:** Harsh shadows produced by bad lighting can hide those who should not be hidden, such as intruders or pedestrians. Notice how this person disappears from view when entering a crosswalk.

RECLAIMING THE NIGHT SKIES

NEW YORK



CAIRO



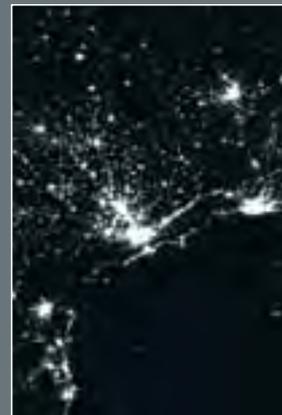
EUROPE



SHANGHAI



SAO PAULO



These satellite images show lights from five regions of Earth at night in 2010. To view an interactive Google map of our entire planet as it looked at night two years ago, go to BIT.LY/TPS120603.

pollution specifically to the protection of wildlife, but dark skies awareness is now a growing trend in the environmental movement.

HARM TO HUMANS

Researchers are finding increasing evidence that exposure to light at night is also harmful to people. Like birds and sea turtles, we operate under a 24-hour cycle that, on average, balances daylight and the dark of night.

It seems that we need more than a proper diet and sufficient exercise to maintain good health: we also need the natural cycles of day and night. It is well documented that long periods without experiencing natural sunlight can lead to depression. It is surprising to many that darkness is needed too.

Light at night is everywhere, indoors and out. When we are not out at night in a well-lit street or public place, we are inside, in front of a TV, computer, or other illuminated electronic device. The exposure to light at night—especially light that is rich in the color blue—can reset our internal clocks and lead to disruptions of our natural day/night (circadian) rhythms. Sleep disorders and major long-term health problems can result. Research is ongoing, but studies have directly linked high levels of light pollution, as measured by satellite, with breast cancer. Other studies report similar findings with night-shift workers.

The rise of our technological civilization is removing us from many aspects of the natural world. One consequence is that we are essentially eliminating night

and cutting ourselves off from the inspiration of the stars. In response, the IDA has been working tirelessly to educate people about the problem while urging governments and industries to enact lighting controls and build more dark-sky-friendly lighting fixtures. The IDA is also working to recognize and preserve dark-sky places.

To highlight locations with inspirational night-scapes, the IDA certifies International Dark-Sky Places (IDPs). Such locations include parks, reserves, and communities that have exceptional night skies and that have programs in place to protect against light pollution. IDP locations serve as reminders that the extraordinary wonders of the night sky and night environment are as important a part of our lifestyle and history as are daylight hours. The IDA recognizes that without the inspiration to be gained by viewing the night sky, much of the world's history, art, music, literature, science, and other elements of culture would not have been created. IDPs celebrate this rich heritage with innovative outreach programs to inspire people to cherish the sky and to make others aware of its importance.

REDUCING THE PROBLEM

Word is slowly spreading that light pollution is the easiest form of pollution to fix: all it takes is the flick of a switch. Change starts with the individual, one house or one business at a time. When whole neighborhoods or communities practice dark-sky activities, the difference is apparent!



LEFT This photo, taken from atop Southern California's Palomar Mountain (home to Palomar Observatory), shows the contrast between city lights and stars. How many more stars would be visible were it not for light pollution from San Diego?

When choosing outdoor lighting, use only fully shielded lights. This cuts down on glare and keeps light pointing down, where it needs to be. Shielded lighting makes it possible to focus more light on the ground even when using a light source that puts out fewer lumens (less total light). Some existing lights, such as floodlights, can be upgraded easily with a simple shield.

Aside from shielding lights, it is important to use light only when it is really needed, and only as much light as is necessary for the task. This, in turn, conserves energy, cuts down on greenhouse gas emissions, and generally makes the night sky better for everyone.

Those who choose to make a bigger difference can join the IDA and help to promote the changes needed to bring the stars back, so that the next generation can be inspired to go out and explore them. 🌟

W. SCOTT KARDEL Before taking his current position with the International Dark-Sky Association, Scott Kardel spent eight years as the public affairs coordinator for California's Palomar Observatory. He directed its public outreach program and served as the observatory's representative on light pollution issues. Scott is a lifetime member of the IDA and, in 2007, he received the IDA's Executive Director's Special Award.

If you've missed *Planetary Radio* lately, here are some recent highlights:



Kim Stanley Robinson on his new novel, 2312.



The Legacy of Ray Bradbury



Visiting the Spacecraft Technology Expo



Searching for Pandora with Debra Fischer



Cutting-Edge Approaches to Protecting Interplanetary Astronauts



Franck Marchis, Planetary Astronomer, SETI Institute



Solving the Pioneer Anomaly



VIP tour! Planetary Radio visited L'Garde, Inc.

Find these shows and our entire archive of *Planetary Radio* at planetary.org/radio!

Garry Hunt brings a distinctive perspective to the now-raging debate over the cuts to NASA's science program, proposed in the administration's fiscal year 2013 budget. In his scientific career, Garry worked for JPL/NASA on the Viking mission to Mars and Voyager's Grand Tour of the outer planets and beyond. He left science to enter the world of business and now serves as managing partner of Elbury Enterprises in the United Kingdom. Observing the budget battle from these two points of view, Garry sees damage extending beyond the loss of planetary missions and reaching the world of business and commerce.

As a member of The Planetary Society's Council of Advisers, he shares his thoughts here on the cuts to NASA science. In February, when we first received this letter, we made it available as a guest post on our website. The message bears repeating, however, so we're pleased to be able to share it with readers of The Planetary Report.

—Editors

THE NEWS THAT THE U.S. administration is proposing a substantial reduction in the NASA budget has sent shock waves of alarm throughout the international science community. The planetary science program will be drastically affected. The news of the cuts was immediately accompanied by numerous protests from a wide science community concerned

NASA's budget supports activities that are enablers for national and individual wealth creation, from which further scientific knowledge ultimately is gained.

with the exploration of the solar system and the search for life on other worlds. These immediate protests by scientists are to be expected. I am sure, in my original career as a space scientist, I would have been part of these protests, quickly voicing my own

objections to these cuts, which will take away opportunities to continue research activities that have changed our collective views of the Earth and planets through these past decades of planetary exploration.

But will these shouts of horror, letters to the press, and protest speeches by members of the science community at conferences and to political committees carry much weight with the politicians and administrators responsible for this cut in the NASA budget? I doubt it. But I do believe there should be vigorous protests from the business and commercial communities about this shortsighted decision by the U.S. administration, as the effects will reach far beyond science alone.

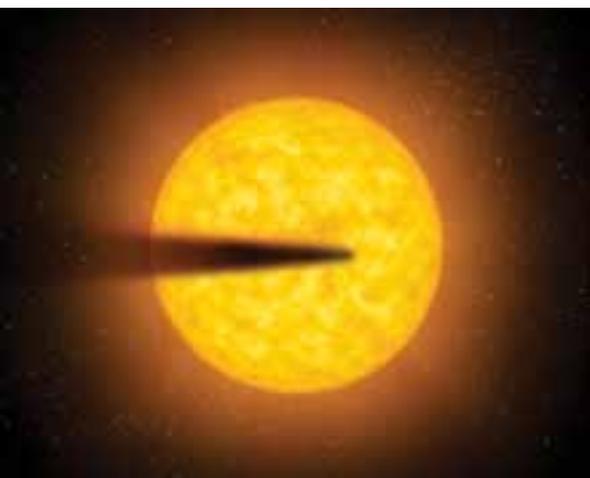
The United States is a leading industrial nation that thrives on wealth creation by individuals and corporations, creating an entrepreneurial culture of innovation through the exploitation of science and technology. As a nation it must generate revenue through millions of companies, large and small, while also requiring high employment to gain income for the nation through various levels of taxation. But these proposed cuts in the NASA budget are then in complete opposition to this financial equation and the well-established U.S. working culture.

NASA's budget supports activities that are enablers for national and individual wealth creation, from which further scientific knowledge ultimately is gained. NASA's space exploration activities are then not just scientific research. The many recent developments in engineering, communications, information technology, and robotics are just some of the enormous advancements that have been made as a consequence of the activities during such missions as *Voyager*, *Viking*, *Cassini*, and the Mars rovers, from which the United States, many developed and developing nations of the world, businesses, companies, and individuals have all benefited. Furthermore, these activities and their associated mission activities also create many jobs for numerous commercial companies, large and small, which then add to the U.S. culture of wealth creation.

The proposed reduction in the NASA budget is, in my opinion, very shortsighted. It has been made by people who understand neither the full picture nor the implications of their decision, which are far broader than just science. 🍀

Planet to Dust?

SCIENTISTS HAVE DETECTED a possible planet, about 1,500 light-years away, that appears to be evaporating under the heat of its parent star. They infer that a long tail of debris—much like a comet’s tail—is following the planet and that this tail may tell the story of the planet’s demise. The group, made up of researchers from MIT, NASA, and elsewhere, made their discovery using data from the



Kepler Observatory. They published their findings online in *The Astrophysical Journal* on March 24, 2012.

The team found that the dusty planet circles its parent star, dubbed KIC 12557548, every 15 hours—one of the shortest planet orbits ever observed. Such a short orbit must be very tight and implies that the planet must be heated to 1,980 degrees Celsius (3,600 degrees Fahrenheit) by its orange-hot parent star. The researchers hypothesize that rocky material at the surface of the planet melts and evaporates at such high temperatures, forming a wind that carries both gas and dust into space. Dense clouds of the dust trail the planet as it speeds around its star. According to the team’s calculations, the tiny exoplanet, not much larger than Mercury, will completely disintegrate within 100 million years.

—from the Massachusetts
Institute of Technology

Higher Odds

NEW DATA FROM the asteroid-tracking NEOWISE mission reveals that twice as many asteroids as previously thought are in orbits that could bring them into contact with our home planet. “We were very surprised to find that,” says WISE Deputy Project Scientist Amy Mainzer of the Jet Propulsion Laboratory. “We were not expecting to find [that result] at all.”

NEOWISE, which took data with NASA’s Wide-Field Infrared Survey Explorer (WISE) space telescope from 2010 to 2011, has completed the most accurate census yet of potentially hazardous asteroids: those that come within 8 million kilometers (about 5 million miles) of Earth and are large enough to survive the trip through the atmosphere. Because WISE searched in infrared wavelengths, it was equally as sensitive to large, dim asteroids as to small, bright ones. Previous surveys had trouble judging the size, and therefore threat level, of dimmer asteroids.

Mainzer and her colleagues sampled 107 potentially hazardous asteroids (a representative sample of the entire population) and extrapolated to predict the total number. They found that about 4,700 of that total—give or take 1,500—are 100 meters or larger in diameter. Only 20 to 30 percent of these have actually been observed. Twice as many of those as previously thought are on so-called low-inclination orbits, meaning that they are closely aligned with Earth’s orbit and, therefore, have a greater chance of hitting us. “It’s easier for them to make close approaches to the Earth more often,” Mainzer says. “Our best recourse is to make sure we know where they are, where they’re going, and what they’re made of.”

—from New Scientist



ABOVE This diagram shows the differences between orbits of a typical near-Earth asteroid (blue) and a potentially hazardous asteroid, or PHA (orange). PHAs are a subset of the near-Earth asteroids (NEAs). They have the closest orbits to Earth’s, coming within about 8 million kilometers (5 million miles), and they are large enough to survive passage through our atmosphere and cause damage on a regional, or wider, scale.

LEFT Data from NASA’s Kepler mission suggests that a possible Mercury-sized planet candidate may be disintegrating as it transits, or crosses, its parent star, KIC 12557548. This illustration depicts the comet-like tail of gas and dust that may be blowing off the planet’s superheated surface.

CURIOSITY KNOWS NO BOUNDS

PLANETFEST



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BILL NYE
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SATURDAY:
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CHRIS CARBARRY
PLANETARY RADIO LIVE
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EMILY LAKDAWALLA

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Curiosity Landing Time: August 5, 2012, 10:30 p.m. Pacific Time

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	Advance Price on or before 7/15/12		Regular Price after 7/15/2012		Day & # tickets		Totals	
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Youth (9-17)	\$15.00	\$15.00	\$19.00	\$19.00	x	=		
Child (0-8)	Free*	Free*	Free*	Free*	x	=		
Multi-day Pass					Multi-day			
Adult (18-64)	\$55.00	\$60.50	\$61.00	\$67.00	x	=		
Senior (65+)	\$45.00	\$49.50	\$53.00	\$56.00	x	=		
Youth (9-17)	\$25.00	\$25.00	\$30.00	\$30.00	x	=		
Child (0-8)	Free*	Free*	Free*	Free*	x	=		
Grand Total								

*We need to know # of child (free) tickets.

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What Is a Planet?

Q As a longtime member of The Planetary Society, I have often wondered, what is the current, most widely accepted definition of exactly what a planet is (as well as other solar-orbiting objects, such as planetoids, asteroids, comets, and space dust)? —John A. Rupkalvis, Burbank, California

A Most people shared a widely accepted understanding of what was meant by the word *planet* until 1995, when astronomers began to discover planets of other stars, as well as worlds at the far reaches of our own solar system. Identifying and categorizing these newfound bodies pointed out the lack of a scientific definition of *planet*. The word comes from the term *planetai*, used by the ancient Greeks to describe the “wanderers” of the heavens: the Sun, the Moon, Mercury, Venus, Mars, Jupiter, and Saturn. *Planet* thus hails from a time when people considered the Earth not as a planet but, rather, as the stationary hub of the universe.

In 2006, the International Astronomical Union (IAU) charged a committee with crafting a specific, scientifically useful definition. I had the privilege of serving on the Planet Definition Committee. We suggested defining a planet as a stellar-orbiting body big enough to have been shaped round by its own gravity. This definition would have applied to Pluto as well as to the asteroid Ceres and several Kuiper belt objects. During the August 2006 IAU meeting in Prague, however, the terms of the definition were debated

and altered to include a third criterion: a planet—in addition to orbiting a star and appearing round—also must be the dominant body in its orbit. On that count, Pluto lost its planet status, and Ceres never measured up.

The planet-definition crisis recalled a similar nomenclature confusion in the early 1800s, when the first asteroids came to light. Astronomers were ready to consider Ceres and Vesta as new planets, but, over time, as other such objects were discovered in the region between Mars and Jupiter, a new term was suggested for them: they were not planets but asteroids. Pluto was declared a planet upon its discovery in 1930, but as its numerous companions in the Kuiper belt revealed themselves to astronomers, Pluto’s planet-hood was called into question.

The other terms you mention are not officially defined, as far as I know. The line between asteroid and comet is particularly fuzzy at the moment, as the difference between these categories seems to be largely one of position (asteroids in the general vicinity of Earth, Mars, and Jupiter; comets on the outskirts and in the Oort cloud). Nevertheless, most astronomers would likely agree as to what constitutes dust, an asteroid, a planetoid, and so on.

Much emotion still surrounds the Pluto issue, proving the power of words. The situation provides a good opportunity to show how scientific understanding changes with new discoveries. 🌌

—Dava Sobel, Author





BRUCE BETTS is director of projects for the Planetary Society.

THE MARS SCIENCE Laboratory (MSL) mission will land on Mars on August 5 (August 6 in some time zones), 2012. What will be landing is *Curiosity*, a highly capable rover about the size of a small car, much larger than previous Mars rovers. The images here will help you follow along during the harrowing Entry, Descent, and

Landing (EDL). The whole process lasts only a few minutes from the top of the atmosphere to landing, but there are many, many steps to accomplish in the challenging task of landing a huge rover on the surface of Mars.

In the realm of planetary bodies, Mars is a particularly difficult one on which to land. There is enough atmosphere that you have to worry about atmospheric heating and flying supersonic through an atmosphere; however, there

is not enough atmosphere to allow you lots of time to slow down.

Much of EDL looks similar to previous Mars landings, but there are some key differences. Two of the most significant are guided entry and the sky crane landing. High in the atmosphere, MSL will use a guided entry: small rockets controlled by an onboard computer will make adjustments during the entry. Because of this, the landing ellipse (i.e., the most probable area of landing) for MSL is 20 × 7 kilometers (12 × 4 miles), whereas the Mars Exploration Rover landing ellipse was 150 × 20 kilometers (93 × 12 miles).

Because of the larger mass of *Curiosity* compared with earlier payloads delivered to the Mars surface, engineers have chosen to use a sky crane to lower the rover. During the final part of its descent, after use of heat shields and parachutes, steerable rockets will slow the vehicle to near zero velocity both vertically and horizontally. Then, a bridle and “umbilical cord” will lower the rover to the ground, while the rest of the vehicle hovers using rockets. Once the rover touches down, the bridle will be cut and the descent stage will pitch and fly off to crash far away. As opposed to past rovers, at this point, *Curiosity* will be ready to roll immediately, able to quickly begin its scientific odyssey.

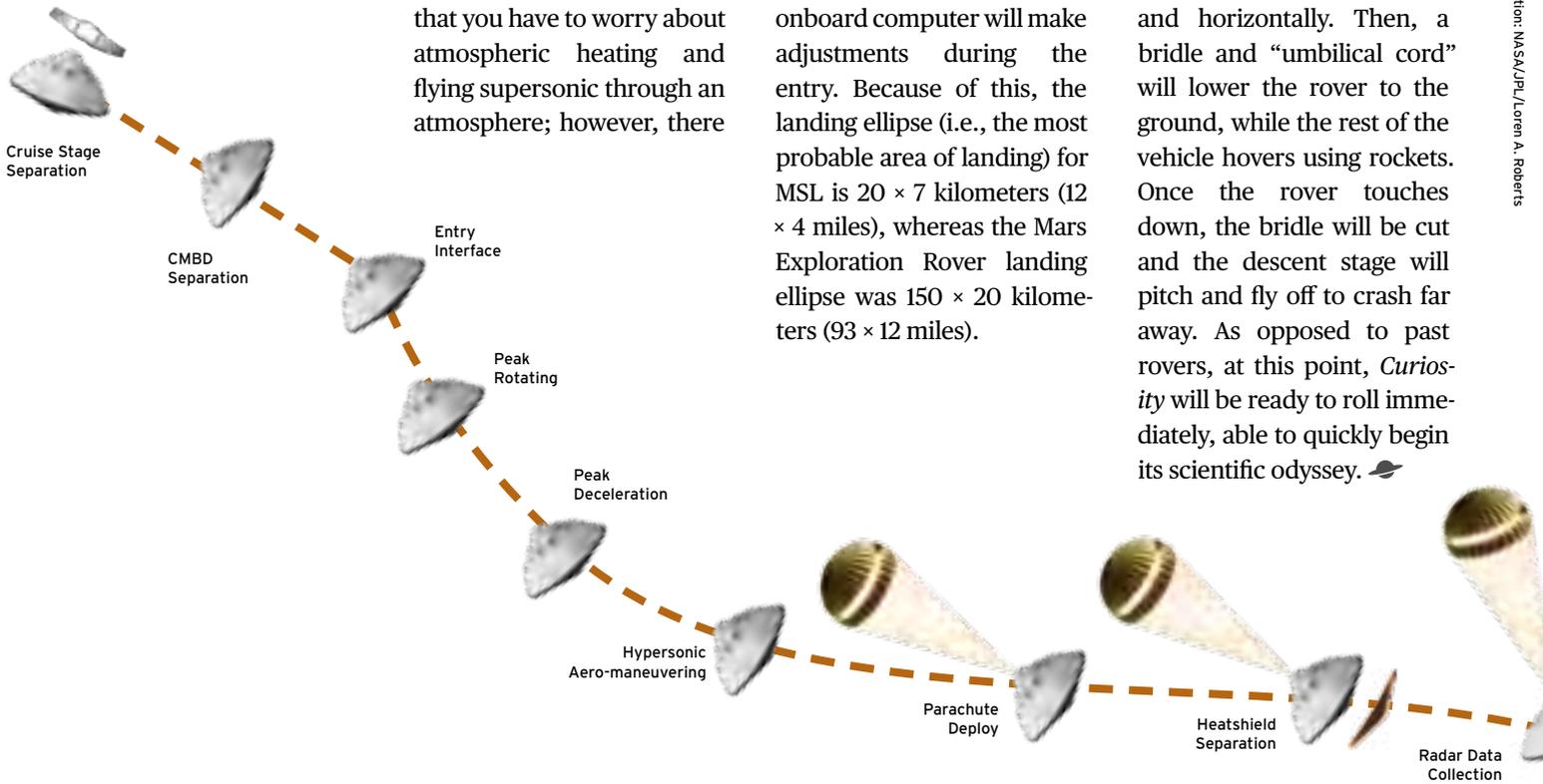


Illustration: NASA/JPL/Loren A. Roberts

Entry, Descent, Landing

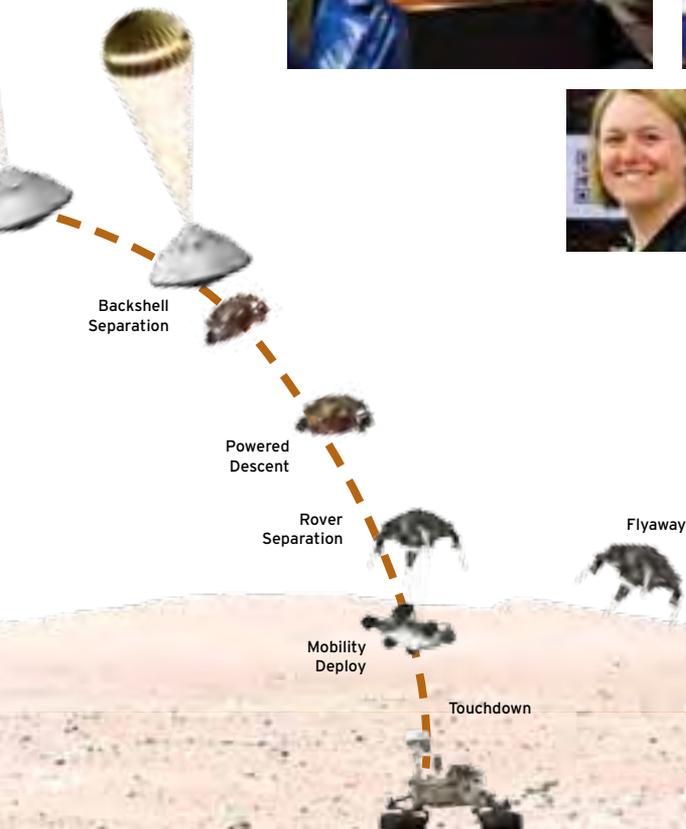
Mars Science Laboratory Has a Unique Landing Plan



The Planetary Society is planning a huge party to celebrate *Curiosity's* Mars landing, and you are invited! Join us in Pasadena, CA on August 4 and 5 for **PlanetFest 2012—Curiosity Knows No Bounds**. For more details, see our ad on page 14.



WITH **BILL NYE** on hand, you won't be surprised to hear that the Planetary Society booth was a very popular stop at the April 2012 USA Science & Engineering Festival. Hundreds of thousands of science geeks made their way to the Washington, D.C. Convention Center, and they all wanted to meet Bill! Nearly 30 talented, tireless, enthusiastic D.C. volunteers gave our visitors a terrific experience. They also helped sign up hundreds of new members! We could not be more grateful for their superb support. 🦋



SOCIETY TRAVEL



JAMES D. BURKE is technical editor of *The Planetary Report*.

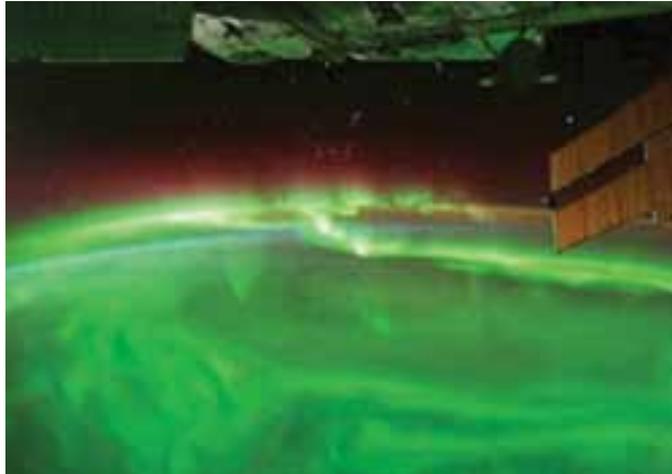
ANDREA CARROLL is Chief Development Officer for *The Planetary Society*.

BELOW Aurora at Mt. Aurora Skiland. Cheryl and Michael Shintani left their native Hawaii to capture images of the aurora atop a windswept mountain northeast of Fairbanks, Alaska.



ABOVE LEFT At Poker Flat Research Range, retired director Neal Brown explains the auroral studies conducted at the world's only university-owned and -operated rocket range.

ABOVE CENTER This aurora, visible from the ISS, appeared at lower latitudes due to a geomagnetic storm—the insertion of energy into Earth's magnetic environment—caused by a coronal mass ejection from the Sun on September 14, 2011.



BOTTOM Planetary Society Aurora Borealis Expedition members in front of the Trans-Alaska Pipeline. Throughout the week-long expedition, Betchart Expeditions leaders, naturalist Bob Nansen (back row, fifth from right in red jacket) and photographer/naturalist interpreter Brad Josephs (kneeling in front), along with bus driver Paul Smith, gave fascinating informal talks about Alaskan history, culture, flora, and fauna. The 12-hour trip from Anchorage, along the Cook Inlet and across the interior to Fairbanks aboard Alaska Rail, was a highlight for the diverse landscape, wildlife, and conversations along the way.

The Magnificent Aurora

Society Members Travel to the Far Ends of the Earth

OF ALL GRAND VISIONS IN THE sky, the aurora is often the most spectacular. Ancient peoples, at least those living in latitudes high enough to see it, marveled and made legends. Chinese observations have been recorded since 2600 BC, and over later centuries, people in every generation have tried to portray and explain the phenomenon.

The term “Aurora Borealis”

is said to have been invented by Galileo in 1619. Could he have seen it himself? People in Alpine Europe rarely witness it; more likely is the possibility of a traveler's report. Galileo's contemporaries were in the midst of a great expansion of wandering all across Europe by monks and minstrels, warriors and students, and spinners of tall tales.

Scandinavian civilization

was a rich source of legend and speculation, giving centuries of background for the later unraveling of the mystery. The foundations of modern auroral science began to be laid in the seventeenth century with the dawning understanding of electricity and magnetism. Studies of Earth as a magnet and of variations in the geomagnetic field steadily advanced, driven by the

Photos: top left and bottom right: Brad Josephs; top center: NASA; top right: Cheryl Shintani

RIGHT Morning light illuminated a spectacularly rose-colored Mt. Denali.



need to map magnetism and use it for navigation. In the nineteenth century, electricity and magnetism were found to be one entity, and the concept of a magnetic storm took hold. By the beginning of the twentieth century, careful observations had proved that the aurora glows in a near-vacuum above all weather.

Through the lifelong work of S. I. Asafoku in Alaska, aided by a network of all-sky cameras across North America, a picture of the northern auroral oval emerged—a picture splendidly confirmed today by observations from satellites. Now we know that the source of the aurora is the Sun. Our star sends out an enormous flood of charged particles, electrons and ions. Some are captured by Earth's magnetic field and guided down to strike the tenuous upper atmosphere, where they knock atoms and molecules into higher-energy states that decay to emit light at characteristic wavelengths. The result can be a general red glow from oxygen atoms or a waving, spiraling blue, green, and crimson curtain

of excited nitrogen and oxygen atoms and molecules at altitudes above 100 kilometers (60 miles) and forming grand ovals extending all the way around the Arctic and Antarctic regions. As magnetic fields swirl and interact, the show continuously changes, making nights memorable all across Earth's circumpolar lands.

Our home is not the only body with an aurora. Jupiter and Saturn, having great magnetospheres of their own, also capture solar plasma particles and put on dazzling shows. Indeed, this must be happening in any family of star and planets whose physical properties resemble those of our solar system. Auroras emit intense radiation at long-wave radio frequencies. Could we search for this signal? Perhaps, but the difficulties are extreme because the interesting wavelength region is awash in other natural and artificial noise. It may be that this detection will not happen until we have a quiet radio observatory on the far side of the Moon. 🌕

—James D. Burke

Find out more about Society Expeditions at BETCHARTEXPEDITIONS.COM or contact Andrea Carroll, Director of Development, at andrea.carroll@planetary.org or 626-793-5100, extension 214.

The Magnificent Expedition

On the first day of our Planetary Society Betchart Expeditions journey to Alaska in mid-March to view the Aurora Borealis, Rich spoke of how, 15 years earlier, he had uncontrollably laughed out loud, lying face up on snow in sub-zero weather, as he watched the aurora. Today, he was back for more with our group of 34, soon to board the train for a 12-hour ride from Anchorage to Fairbanks, hoping to share the aurora with his wife, Terri.

A few days later, long after midnight, high on a windy hill at Skiland, padded like the Michelin Man and even then frozen under layers of clothes and chunky boots, my face encased in an icy balaclava, there I am laughing, shouting, pointing, and wondering. There is the aurora. Waves of green light shimmering, the whole sky a curtain fluttering as if blown by a gentle breeze in an open window. Then shifting, every bit of the sky aglow, pulsating to a silent, hard beat. It is magnificent.

The entire journey was magnificent. It began with meeting a moose outside the hotel. We saw a sundog in the evening sky and Mt. Denali glowing pink at dawn. Along the way, we saw eagles, Dal sheep, a ptarmigan swimming in the snow, and the Pipeline. There were fascinating lectures and even a tour of Poker Flat Research Range, a scientific rocket-launching facility. Our guides and educators were great. My fellow travelers were smart, funny, charming, gracious—explorers all.

—Andrea Carroll



BRUCE BETTS is director of projects for the Planetary Society.

Zapping Rocks with Lasers

Saving the World by Destroying Space Invaders

IN THE NOT-SO-DISTANT future, if an asteroid is on a collision course with Earth, we might choose the *Star Wars* solution to that problem: dispatch several spacecraft to swarm around the asteroid and zap it with lasers. In contrast to the solution in the film, however, Red Leader doesn't need

of Strathclyde in Scotland to investigate this promising but understudied possible asteroid deflection technique, often called *surface ablation*. Because it would involve several small spacecraft firing lasers, this project is called Laser Bees. (It used to be called Mirror Bees, but that is so last

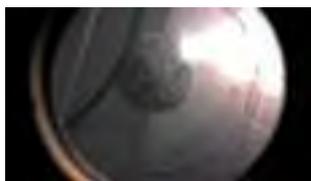
disadvantages. Laser Bees are intriguing because studies indicate they may offer the ability to move asteroids comparatively quickly. Much work must be done to determine if this really pans out, and that is where the Laser Bees project comes in.

The project is a joint venture of the Universities of

LEFT Artist's conception of laser bees spacecraft swarming around a dangerous asteroid, represented by comet Tempel 1.



CENTER A very porous rock (top) and a less porous sandstone rock during laser ablation in the lab. Notice the conical plumes of material being ejected.



RIGHT An experimental setup showing a rock ready to be zapped, at right, and microscope slides at left, ready to catch ejecta plume material.



FACING PAGE The test chamber from behind the target rock, with slides set up to capture the ejecta.

to die at the hands of Darth Asteroid—these spacecraft would be robotic, and they wouldn't be designed to blow up the asteroid but, rather, to vaporize surface rock at just the right location to create jets of rock vapor that would gradually move the asteroid to a safe orbit. World saved, rocks vaporized, and a good time had by all.

Is this scenario realistic? That is what we are trying to find out. The Planetary Society has been sponsoring research at the University

year!) The research originally focused on both lasers and an alternative of using mirrors to reflect sunlight onto a spot to do the vaporizing. The mirror solution turns out to be more complex—for example, in lining up the Sun, the mirror, and the asteroid—and potentially less efficient. All hail Laser Bees, the victor.

The means for potential deflection techniques for asteroids range from nuclear weapons to gravity tugs. Each has advantages and

Strathclyde and of Glasgow and is led by Strathclyde professor Massimiliano Vasile. His graduate student Alison Gibbings visited The Planetary Society earlier this year and presented their results to date. Using support provided by Planetary Society members, the Laser Bees team has created an elaborate laboratory setup that enables them to zap rocks with a high-powered laser, including trials with the rock in a vacuum chamber. They have done preliminary tests

Thanks!

Planetary Society Members have helped make the Laser Bees project possible.



IN THE SKY

Saturn is near Virgo's similarly bright star Spica in the early evening in the west. Reddish Mars starts the summer to the right of Saturn and Spica but becomes closer until, on the nights of August 13 and 14, reddish Mars is in the middle of a line segment with the lower and bluish Spica and the higher and yellowish Saturn at the ends. All are low in the west at that time. On August 21, the Moon joins the other three. The Perseid meteor shower peaks on August 12-13, but increased activity can be seen from several days before to several days after. The Perseids are typically one of the best showers of the year, with an average of 60 meteors per hour from a dark site. Bright Jupiter and extremely bright Venus are low in the east in the predawn sky and grow farther apart over the summer as Jupiter gets higher in the sky. Venus is very close to Taurus' brightest star, Aldebaran, on July 9.



RANDOM SPACE FACT

The density of material at the center of the Sun is 151 grams per cubic centimeter, which is 151 times the density of water and 13 times the density of lead.



TRIVIA CONTEST

Our September Equinox 2011 contest winner wishes to remain anonymous. Congratulations! **THE QUESTION WAS:** What is the name/designation of the 400-meter-diameter asteroid that will fly within 0.85 lunar distance of Earth on November 8, 2011?

THE ANSWER: 2005 YU55.

Try to win a free year's Planetary Society membership and a *Planetary Radio* T-shirt by answering this question:

Who were the members of the International Space Station Expedition 2 crew?

E-mail your answer to planetaryreport@planetary.org or mail your answer to *The Planetary Report*, 85 South Grand Avenue, Pasadena, CA 91105. Make sure you include the answer and your name, mailing address, and e-mail address (if you have one). By entering this contest, you are authorizing *The Planetary Report* to publish your name and hometown. Submissions must be received by September 1, 2012. The winner will be chosen by a random drawing from among all the correct entries received.

For a weekly dose of "What's Up?" complete with humor, a weekly trivia contest, and a range of significant space and science fiction guests, listen to *Planetary Radio* at planetary.org/radio.

on both solid and porous rocks, collecting ejected material on microscope slides placed at a variety of distances. They have compared these results with models and have made a variety of interesting discoveries, including that the process seems more efficient than predicted.

Now the Laser Bees team is poised to take the next steps. These include attaching force sensors to the rocks to measure the force imparted; testing to see if heating the slides, which represent the optical parts of the spacecraft system, will limit deposition of rock material and thus preserve the efficiency of the system even in a "dirty" environment where rock is being ejected from the asteroid;

and, in what should generate great video and great science, using high-speed cameras to record the development of the ejecta plume.

When we discover an asteroid headed for Earth—and it is only a matter of when, not if—we will want a variety of well-studied techniques that can be applied to deflect the asteroid before a regionally destructive catastrophic impact can occur. Thanks to the support of Planetary Society Members and the Laser Bees team, we are moving the process forward to help save the world.

You can find more information about Laser Bees on our website, planetary.org, including Alison's entire presentation from earlier this year and a video of her presentation. 🐝



Annual Report to Our Members

Dear Planetary Society Members, Donors, and Friends,

YOU ARE PART OF A TERRIFIC ORGANIZATION. In fact, *you make* this organization. You help to shape our future in space, and that is critical, now more than ever.

I hope that as you read this review of The Planetary Society's last fiscal year (October 1, 2010 through September 30, 2011), you will take pride and satisfaction in the success that you helped to create. On behalf of the Board of Directors, I thank you.

The year 2011 was remarkable for space science and exploration and, as with any space mission, reflected the tension between opportunity and challenge. We celebrated two 50-year anniversaries: Yuri Gagarin's 1961 flight as the first human in space, and a month later, John F. Kennedy's speech that hurtled the United States toward the Moon. The space shuttle made its final journey. NASA's *Curiosity* rover was readied for Mars. *Opportunity* continued its discovery-filled trek across the Red Planet.

YOU ARE THE VOICE FOR (THE PB&J OF) SPACE EXPLORATION

Ironically, 2011 also found the Society fighting for space as NASA grappled with crucial decisions in the wake of funding cuts. That battle continues today as you and your fellow space advocates worldwide work to *Save Our Science* and future space missions.

Internally, the Society marked another milestone: the first year of CEO Bill Nye's leadership and focus on introducing the PB&J, or Passion, Beauty, & Joy, of space to younger generations. A Planetary Society community of all ages and nationalities is a formidable force in exploration, and we are poised to expand our community with Bill's enthusiastic leadership and your continued support.

Generous funding from the Clarence Foster Stanback Donor Advised Fund of Foundation For The Carolinas made real a dream of Bill's, a special *Planetary Kids* insert in each issue of our quarterly magazine, *The Planetary Report*. Now is a great time to

gift Society membership to the kids in your life and thereby plant the seeds for our future scientists.

Planetary Radio, which airs weekly on dozens of college stations and is a top-ranked podcast, received a Parsec Award for "Best Fact Behind the Fiction Podcast." Member donations and a grant from The Kenneth T. and Eileen L. Norris Foundation fund this program.

The Division of Planetary Sciences of the American Astronomical Society recognized two Members: President Jim Bell received the 2011 Carl Sagan Medal for excellence in public communication, and Society blogger Emily Lakdawalla earned the Jonathan Eberhart Planetary Sciences Journalism Award.

COME SAIL AWAY

An intergenerational team led by Planetary Society Emeritus Executive Director Louis Friedman took the *LightSail-1* solar sail mission to the next level. Your continued generous donations, matched by an anonymous Society Member, built a second, or "spare," spacecraft. Today, the two craft sit ready, awaiting launch to an orbit high enough that atmospheric drag is negligible, about 800 kilometers (500 miles). Think how thrilling it will be, with no telescope needed, to see our sail overhead. You and I built that!

IS ANYBODY (OR ANY THING OR ANY WORLD) OUT THERE?

The Member-funded Living Interplanetary Flight Experiment (LIFE) traveled on the last flight of space shuttle *Endeavour* and on the failed *Phobos-Grunt*. LIFE, a test of whether a living organism could survive a journey through space to Earth inside a meteorite, is now being analyzed; we are exploring future rides into space for LIFE.

Your donations kept the momentum going for searches in both hemispheres for signs of extraterrestrial intelligence: The Planetary Society Optical SETI Telescope in the United States and Southern SETI radio search in Argentina.

You and I, along with the six winners of last year's Gene Shoemaker Near-Earth Objects Grants competition, are helping to protect Earth from the only

Financial Statement

For the fiscal years ended September 30, 2008, 2009, 2010, and 2011 in thousands of dollars

Total All Funds:	FY2011	FY2010	FY2009	FY2008
Assets				
Current Assets				
Cash and Cash Equivalents and Investments	2,693	2,984	2,636	1,316
Membership Dues and Misc. Receivables	35	32	41	29
Inventories	0	0	28	39
Prepaid Expenses	90	51	64	39
Total Current Assets	2,818	3,067	2,769	1,423
Land, Building, and Equipment	49	61	583	618
Total Assets	2,867	3,128	3,352	2,041

	FY2011	FY2010	FY2009	FY2008
Liabilities				
Accounts Payable and Accrued Expenses	92	232	141	154
Deferred Dues and Grant Revenue*	1,036	1,330	1,606	1,115
Total Liabilities	1,128	1,562	1,747	1,269
Net Assets (Deficits)				
Unrestricted	1,249	876	226	192
Temporarily Restricted	488	688	1,377	578
Permanently Restricted	2	2	2	2
Total Net Assets	1,739	1,566	1,605	772
Total Liabilities and Net Assets (Fund Balances)	2,867	3,128	3,352	2,041

	FY2011	FY2010	FY2009	FY2008
Revenues				
Membership Dues	1,319	1,110	1,101	1,207
Donations/Grants	1,949	1,446	2,208	1,613
Bequests	286	210	277	170
Other**	174	1,206	144	184
Total	3,728	3,972	3,730	3,174

	FY2011	FY2010	FY2009	FY2008
Expenses				
Member Development and Fundraising	453	492	488	400
Communications: Print/Web/Radio	588	583	621	552
Education & Information	49	110	81	184
Programs***	265	298	172	353
Member Services	228	345	371	426
Administration	412	325	318	304
Projects	537	438	616	921
Solar Sail	1,023	1,420	230	182
Total	3,555	4,011	2,897	3,322

* Income received but not yet recognized

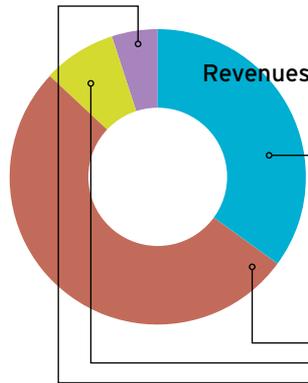
** Admissions, events, interest, net sales, royalties, etc.

*** Events, lectures, tours, expeditions, gain on sale of property

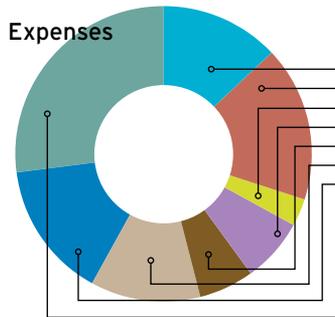
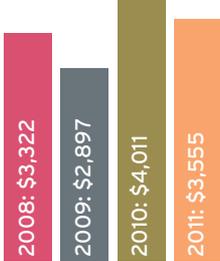
Note: FY11 changed Publications Department to Communications and added Radio to new department

YEAR TO YEAR (in thousands)

Revenues



Expenses



preventable natural disaster. It's a need not covered by our space agencies and one for which the Society continues to make a valuable difference.

Yale University's Debra Fischer credits The Planetary Society with helping to leverage grants for a planet hunt around Alpha Centauri. Members helped to fund FINDS Exo-Earths (Fiber-optic Improved Next-generation Doppler Search for Exo-Earths), a project to search for smaller exoplanets and to verify Earth-sized planet candidates identified by the *Kepler* mission.

YOUR INVESTMENT HAS MAJOR RETURNS, AND YOU MAKE OUR FUTURE IN SPACE

It's simple. You can see it in our balance sheet. Your generous donations and planned gifts—for projects, advocacy, education, and the less glamorous but necessary day-to-day work—matter. Your Member-

ship matters—whether as a *Discovery Team* Member, an Annual supporter, a *New Millennium Committee* Member, or a Charter Member. Your support is vital in this difficult economy.

We need you to be an ambassador. Please introduce a friend, relative, or coworker to The Planetary Society; give memberships to the young people in your life; make a generous gift of cash, securities, matching gifts, or time and expertise; or sustain the future with a planned gift. However you choose, please make The Planetary Society a lasting part of your personal legacy.

What an incredible opportunity you and I have to create a better future. Thank you. 🍀

Dan Geraci

Dan Geraci
Chairman of the Board



Stargazers: A Tribute to Members

Someone recently asked me what I like best about my job. "Our Members," I answered. Many of you, often unknown to you, have touched my heart.

Richard Sobel, a Charter Member whom I did not know, died recently. His wife, Planetary Society Member Joanne Rosenbaum, sent me a poem their friend had written in celebration of Richard's life. I think it's beautiful.

I offer it to you with hopes that you will think of those, some still here and some not, who have touched your heart.

Celebrate someone special with a tribute gift—online at planetary.org/tribute—or consider including The Planetary Society in your estate plans. E-mail or call me at andrea.carroll@planetary.org or 626-793-5100, Ext. 214, for more information.

—Andrea Carroll, Chief Development Officer

STARGAZERS by Cynthia Martin

some men see the stars
as a metaphor
for love that sings a heart

some men read their light
as a siren
calling from a distant shore

but you, you saw the stars
for what they are

great storms of gas raging through the sky
unmindful of poet or voyager
unwary of the astronomer
peering at their core

now

you soar through the cosmos
unleashed
from a withered body

you have unraveled
the mystery
the secret of this universe

we long for you to share it
but all we receive is this

be happy that you loved me
I am content to have loved you
watch for me among the stars
where I belong at last

