Communicating Astronomy: From Sideline to Profession

Rick Fienberg
(Ph.D. 1985)

Symposium in Honor of Giovanni Fazio
May 28, 2009

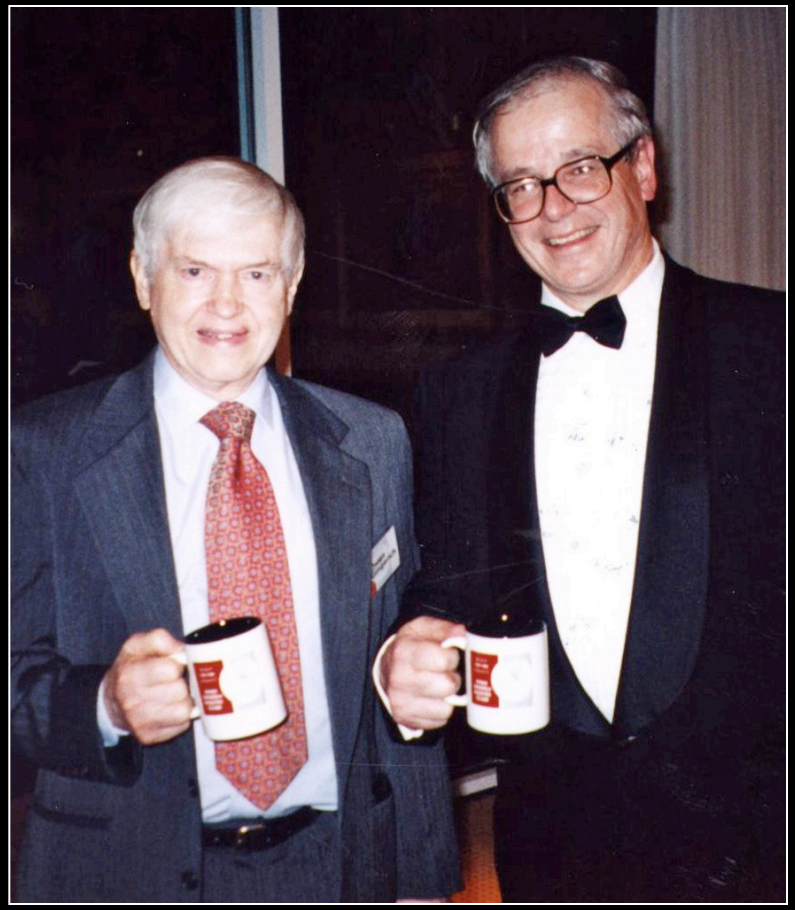
INTERNATIONAL YEAR OF ASTRONOMY 2009

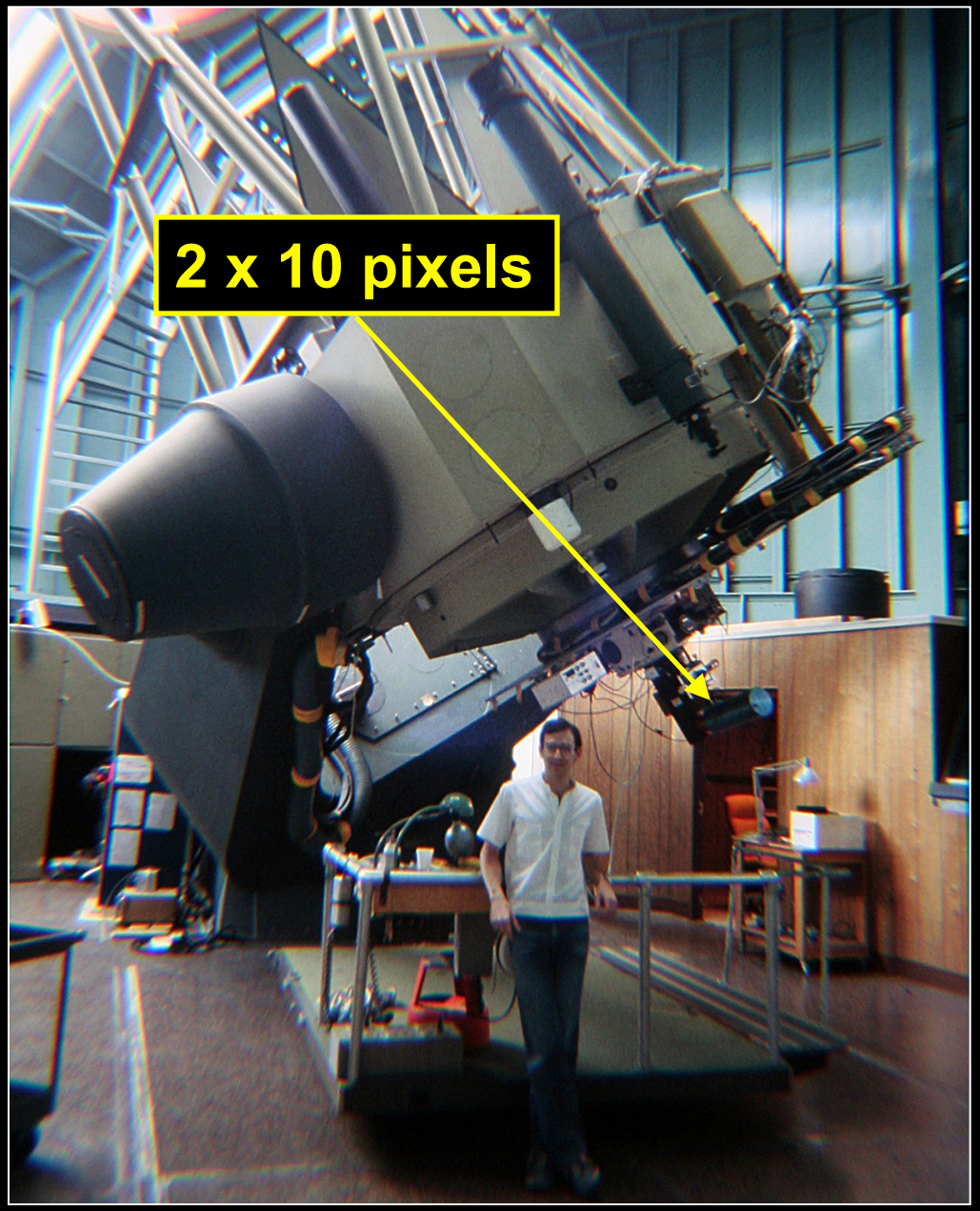
IAU USA NATIONAL NODE

THE UNIVERSE — YOURS TO DISCOVER

Science A-17

The Astronomical Perspective





Kitt Peak, 1981

Laboratory Exercises in Astronomy — The Rotation of the Sun

OWEN GINGERICH and RICHARD TRESCH-FIENBERG, *Harvard-Smithsonian Center for Astrophysics*

WHEN Galileo Galilei and a few of his contemporaries turned their new telescopes to the Sun in 1611, they were astonished to find that its supposedly pure ethereal substance was blemished by a variety of dark spots. The Jesuit astronomer Christopher Scheiner argued at first that these spots were caused by clouds interposed between the Earth and the Sun. But Galileo, by careful measurements of the spots' positions, showed convincingly that they had to be on the solar surface itself.

In 1863 Richard Christopher Carrington published his discovery, based on detailed observations over a 7½-year period from 1853 to 1861, that the average latitude of the spots depends on when they are observed in the 11-year sunspot cycle. He also found that the period of rotation depends on the latitude of the spots — it is 25 days near the equator and 28 days at latitude 45°. Thereby, Carrington deduced that the visible surface of the Sun rotates differentially and thus is not solid. This discovery helped revolutionize ideas about the nature of the Sun almost as effectively as the spectrum analysis that was going on in the same decade.

More recently, astronomers have begun to suspect that this differential rotation of the Sun's outer layers is not constant and may vary over the centuries. As we shall see in this exercise, determining the differential rotation of the Sun requires more data than we can present here. Nevertheless, we can derive a fairly accurate rotational period for the Sun, and we can use this information to gain some knowledge about the stability of sunspot groups.

The principal observational data for this exercise have been provided by the U. S. Naval Observatory, which for many years routinely photographed the solar disk around noon each day. In the late spring of 1951, when an unusually high peak of solar activity had begun to wane, a streak of unseasonably clear weather occurred in Washington, D. C., and photographs could be taken daily for many weeks. From this extraordinary sequence we have selected 12 images that show the movement of a number of rather large groups. Several individual spots exceed the Earth in size!

The photographs were also taken at a time when the Earth crossed the plane of the solar equator; thus, the spots appear to move in straight lines across the disk. This is not always the case, as may be seen in the figure below, but it provides a helpful simplification for our exercise. If you wish to derive a value for the solar rotation period from your own sunspot drawings or photographs obtained at a different season, you may have to proceed in a somewhat more complicated way.

Before beginning the exercise, it is worthwhile to examine the pictures to see the manner in which the sunspot groups are moving and changing. Can you identify any groups that disappear over the western (left) limb of the Sun and then reappear at the eastern limb a couple of weeks later? It is difficult to answer this question without making some specific measurements of the solar rotation. (Notice that the Sun appears to rotate from east to west, contrary to the defined west-to-east rotation of the Earth. Actually, both the Sun and Earth rotate counterclockwise when viewed from their north poles, but the directions for the Sun are specified the way it appears in our sky, *not* as if it were an independent globe in space.)

SUNSPOTS AND SOLAR ROTATION

The Sun's rotation period can be determined by measuring the angular displacement of sunspots during a known time interval. The trick is to convert linear measurements of the apparent solar disk pictured on the next two pages to angular measurements of the actual solar sphere. The geometrical method we shall describe is simple yet elegant; except for a few modern touches it dates back to the time of Ptolemy.

Probably the easiest way to measure the movements of the spots is to transfer their successive images onto a single circle. Our experiments show this is most easily done using a thin plastic sheet such as those sold as paper protectors or for making transparent photocopies. It is possible to work with a very thin piece of tracing paper, but this slows down the procedure considerably.

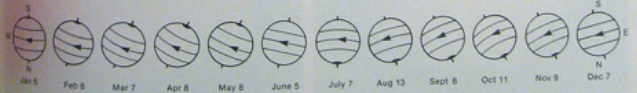
First, carefully measure to the nearest millimeter the diameter of the image of the Sun in the accompanying photographs. Use a compass to draw a circle of this size on your transparent plastic overlay. (If you draw with a pencil, the circle may not be very dark, but as long as you can see it you will be able to do the exercise.) Align your circle over one of the images and trace the two indicator spikes that mark the orientation of the Sun's rotation axis, labeling them *N* and *S* according to the designation on the photographs. You should use a marking pen specifically intended for use on plastic, since the ink from ordinary felt-tipped pens usually smears badly.

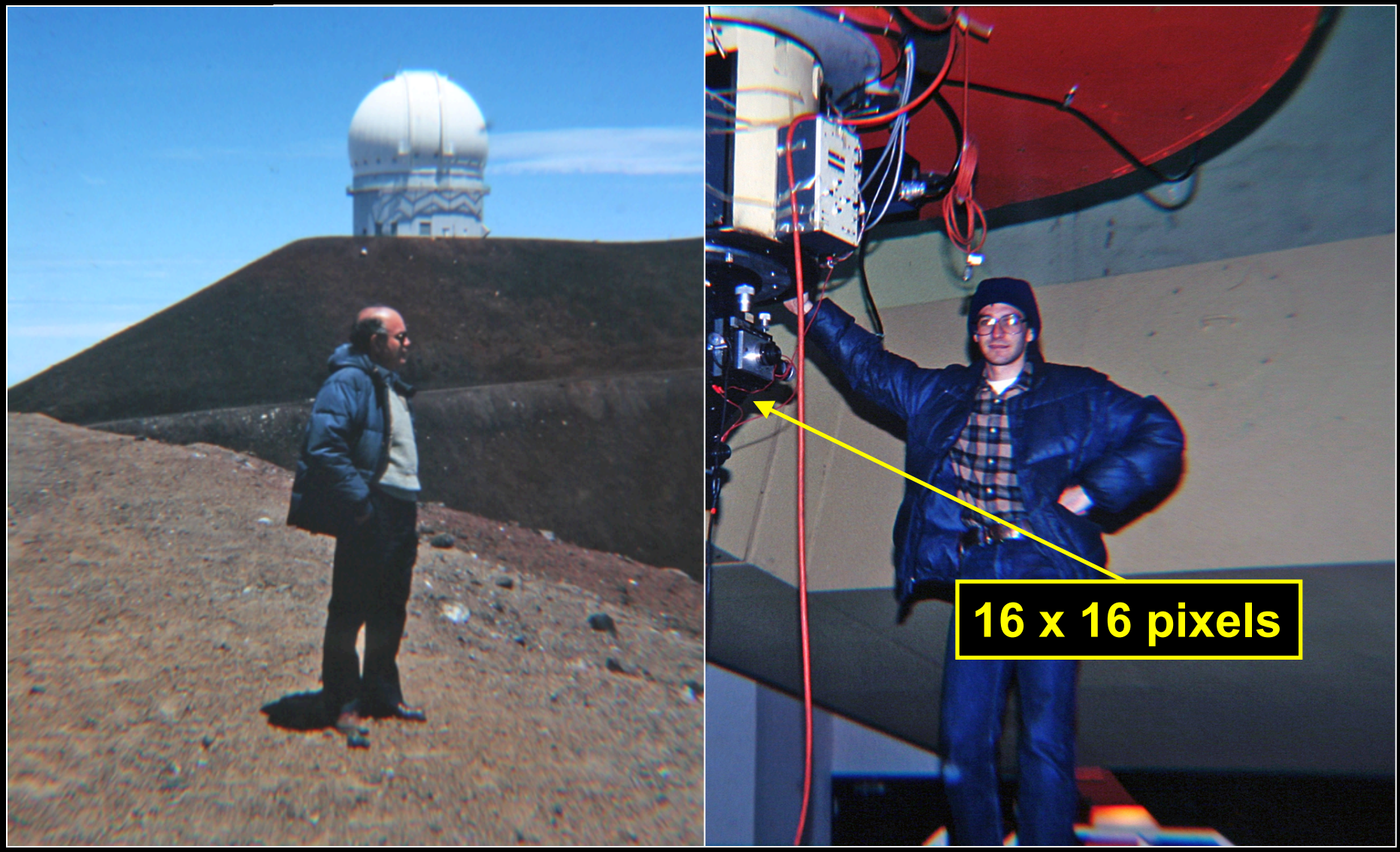
Locate a prominent sunspot that first appears on the approaching (eastern) limb of the Sun early in the sequence. Place your transparency over the picture in which the spot is first visible and match your circle to the limb of the Sun. The spikes on the image and those on your tracing may not line up exactly. If that is the case, use the spikes to align your circle parallel to the *N-S* line, keeping the Sun's limb and your circle concentric.

Trace the position of the sunspot onto

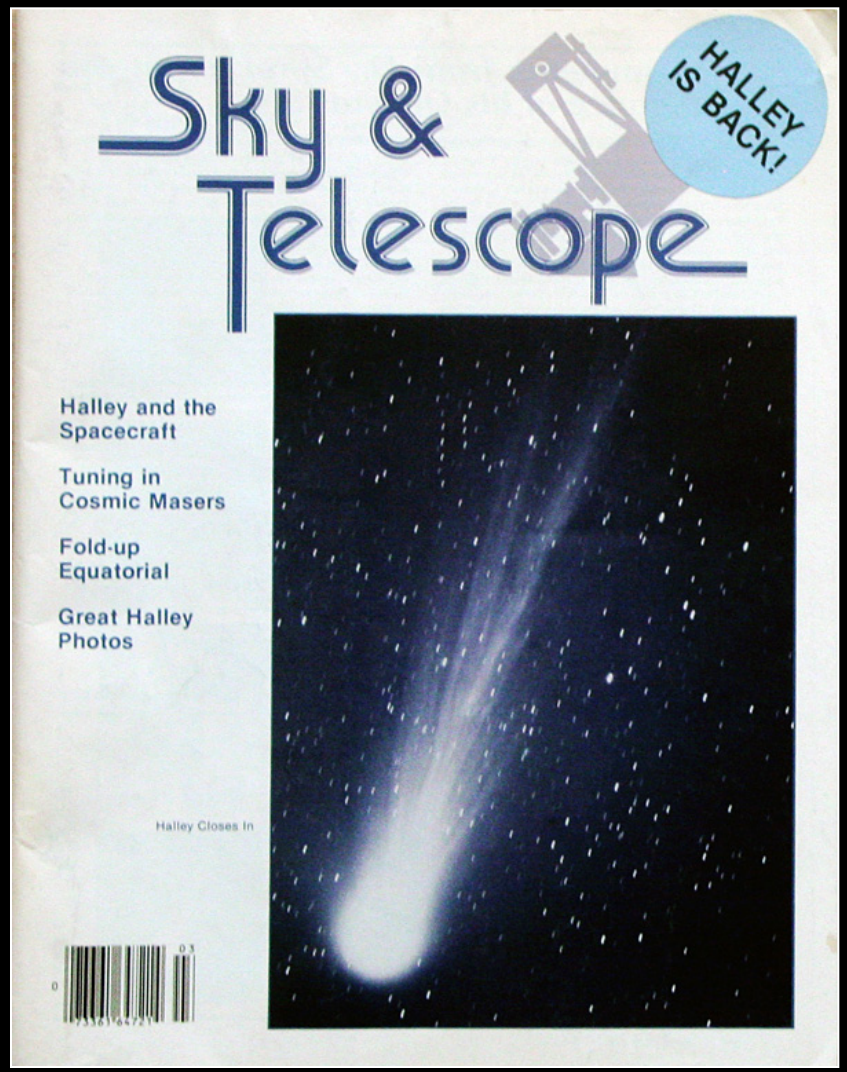
Pages 434 and 435: **These photographs of the Sun were taken at the U. S. Naval Observatory in 1951. Each is labeled with the date and decimal fraction of the day. Spikes mark the Sun's rotational axis (south up, west left). This sequence roughly spans one solar rotation, providing an opportunity to watch long-lived, though ever-changing, sunspot groups disappear around one limb and reappear on the other. Several individual spots are larger than the Earth!**

Below: **The variation of the position angle of the Sun's axis during the year as seen in an inverting telescope from the Northern Hemisphere. The distance of the Sun's rotational pole from the limb has been exaggerated. Only in early June and December are the solar equator and the paths of sunspots seen as straight lines on the disk.**





Mauna Kea, 1983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2008

ASTROPHYSICIST

LYMAN SPITZER JR.

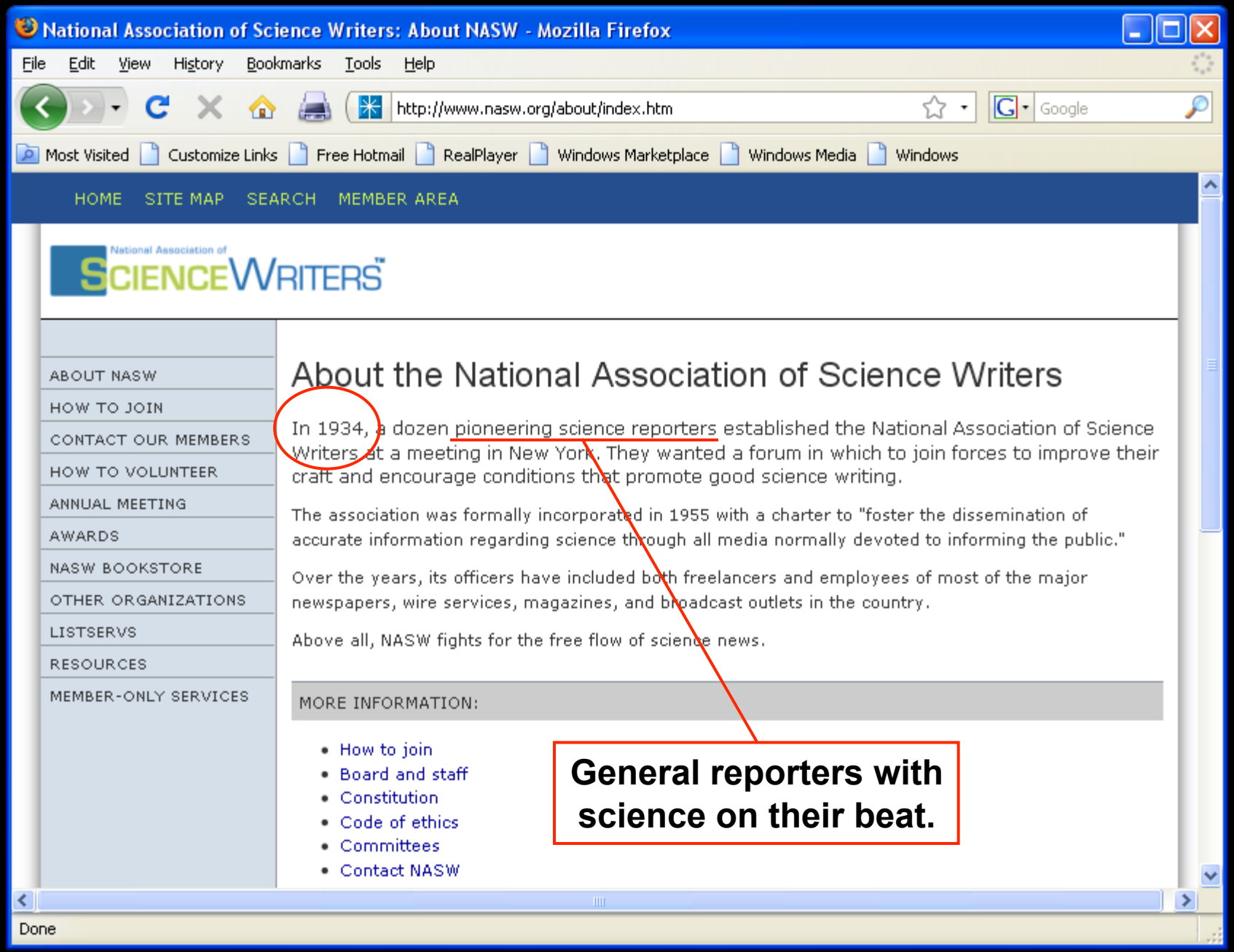
Andover Class of 1931

Lyman Spitzer Jr. was one of the 20th century's great scientists. A world-renowned astrophysicist, he made major contributions in the areas of stellar dynamics, plasma physics and space astronomy. Spitzer was the first person to propose placing a telescope in space, and was the driving force behind development of a space telescope program. Awarded the National Medal of Science by President Carter in 1979, in 2003 NASA named its newest space telescope for Spitzer.

Lyman Spitzer Jr. entered Andover in 1929 and won the Wadsworth Physics Prize in 1930. It was at Andover that Spitzer decided to devote himself to physics and astronomy, thanks to instructor Freddie Boyce. In addition to being an outstanding student, Spitzer was a *Phillipian* editor and member of Philo, the Dramatics Club and the polo team. He went on to Yale, Harvard and Princeton, where he earned his doctorate in 1938.

During World War II he worked with the team that developed sonar. After the war, he returned to Princeton where he taught for the remainder of his career, directed the Princeton Observatory and founded the Princeton Plasma Physics Laboratory. His particular field of study was the interstellar medium - gas and dust between stars from which new stars are formed. In 1947 Spitzer proposed a space-based telescope and in 1965, when the National Academy of Sciences established a committee to study Spitzer's proposal, he became its chairman. Spitzer continued to lobby for what became the Hubble Telescope until it was launched in 1990.

In addition to his professional endeavors, Lyman Spitzer was an avid mountain climber and skier. The Lyman Spitzer Climbing Grants Program at the American Alpine Club supports teams attempting bold first ascents or difficult repeats of the most challenging routes in the world's great mountain ranges.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About the National Association of Science Writers
In 1934, a dozen pioneering science reporters established the National Association of Science Writers at a meeting in New York. They wanted a forum in which to join forces to improve their craft and encourage conditions that promote good science writing.
The association was formally incorporated in 1955 with a charter to "foster the dissemination of accurate information regarding science through all media normally devoted to informing the public."
Over the years, its officers have included both freelancers and employees of most of the major newspapers, wire services, magazines, and broadcast outlets in the country.
Above all, NASW fights for the free flow of science news.
MORE INFORMATION:
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Board and staff
Constitution
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General reporters with science on their beat.
Done

“Plus ca change, plus c'est la meme chose.”

26th AAS meeting, 1921

Hot Topics
**(*New York Times,*
Sept. 3-4, 1921):

- **New size of the universe (10^6 light-years)**
- **Possible existence of “dark matter” in space (dust clouds)**
- **Following up the May 1919 solar eclipse with further tests of Einstein’s prediction of gravitational deflection of starlight by the Sun**

206th AAS meeting, 2005

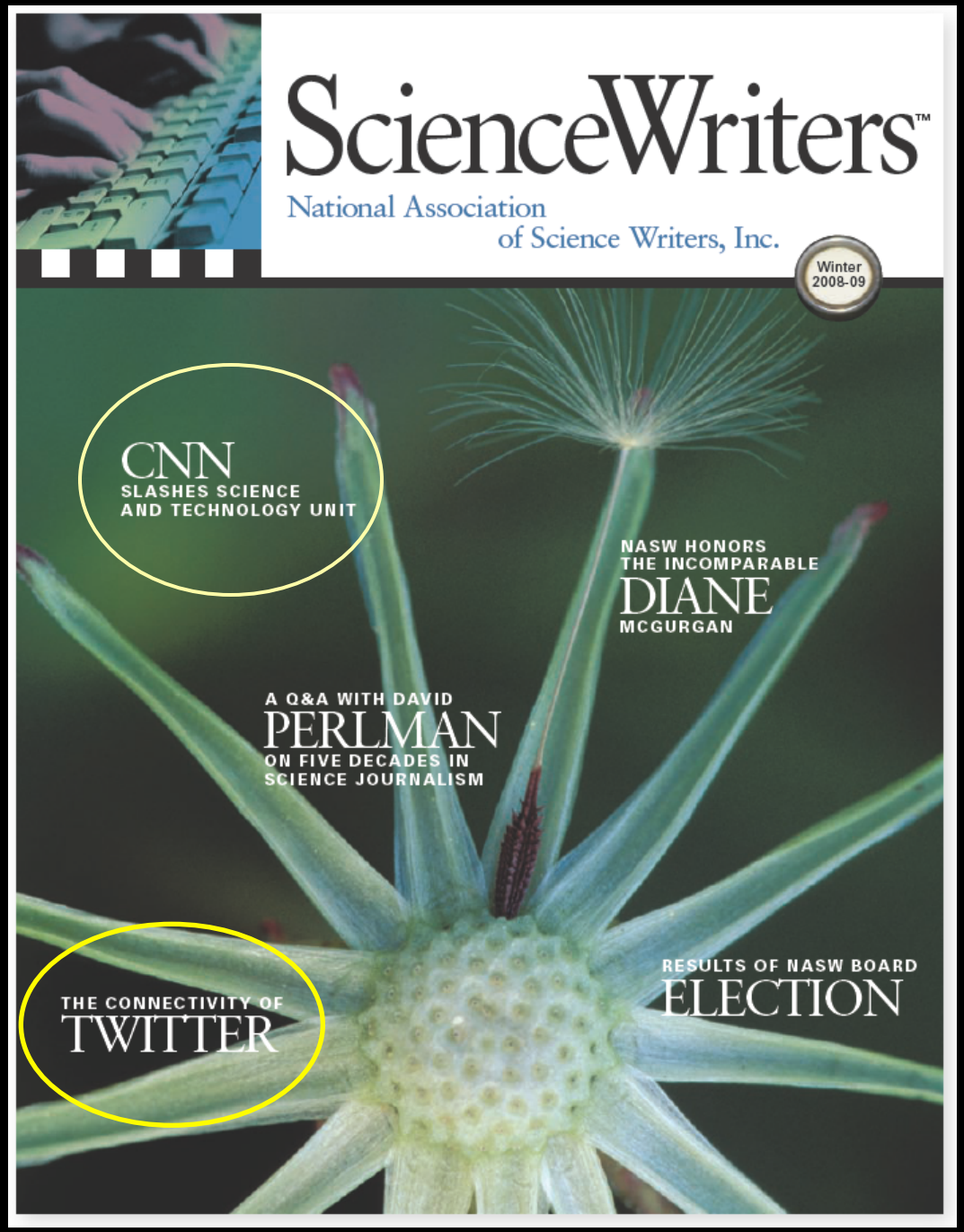
Opening invited talk:
“Imaging Dark Matter with Gravitational Lensing”

Topical sessions include...
- **Dust from the Spitzer Perspective**
- **Formation and Fate of Stardust**

News briefings include...
- **Binary pulsar and close binary white dwarf as tests of general relativity**

Science Writers: An Endangered Species at U.S. Newspapers, Magazines, TV Networks

(Photos by Richard Dreiser, © 2001 AAS)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THE CONNECTIVITY OF
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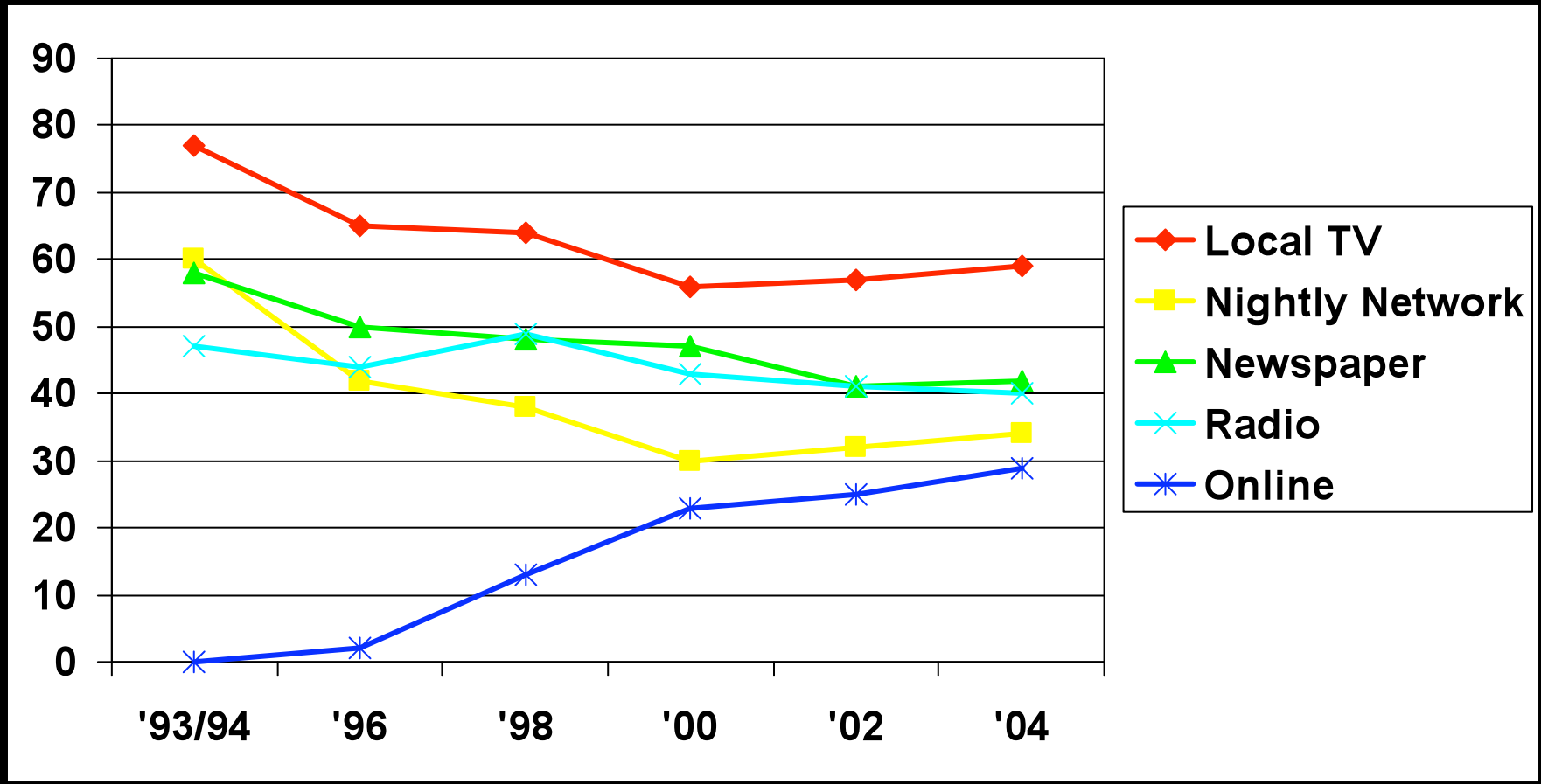

(Source: Pew Research Center, 2004)

News of Interest to the U.S. Public

News followed very closely by American public: 1996–2006
(Percent)

Type of news	1996	1998	2000	2002	2004	2006
Weather	NA	NA	NA	NA	53	50
Crime	41	36	30	30	32	29
Community	35	34	26	31	28	26
Health	34	34	29	26	26	24
Sports	26	27	27	25	25	23
Local government	24	23	20	22	22	20
Washington news	16	19	17	21	24	17
International affairs	16	16	14	21	24	17
Religion	17	18	21	19	20	16
Science and technology	20	22	18	17	16	15
Business and finance	13	17	14	15	14	14
Entertainment	15	16	15	14	15	12
Consumer news	14	15	12	12	13	12
Culture and arts	9	12	10	9	10	9

NA = not available, question not asked

NOTES: Data reflect respondents who said they followed type of news "very closely." Table includes all years for which data collected.

SOURCE: Pew Research Center for the People and the Press, Online papers modestly boost newspaper readership: Maturing Internet news audience broader than deep (30 July 2006), Biennial News Consumption Survey (27 April'22 May 2006), http://people-press.org/reports /display.php3?ReportID=282, accessed 26 April 2007.

Science and Engineering Indicators 2008

Science Literacy in the U.S.

Correct answers to scientific literacy questions, by sex: 2001, 2004, and 2006
(Percent)

Question	2001	2004	2006
Physical science			
The center of the Earth is very hot. (True)			
Male	85	86	85
Female	76	72	75
All radioactivity is man-made. (False)			
Male	81	82	77
Female	71	66	64
Lasers work by focusing sound waves. (False)			
Male	61	59	62
Female	30	28	32
Electrons are smaller than atoms. (True)			
Male	52	52	61
Female	43	39	48
The universe began with a huge explosion. (True)			
Male	43	41	40
Female	24	27	27
The continents have been moving their location for millions of years and will continue to move. (True)			
Male	83	85	85
Female	74	71	75
Does the Earth go around the Sun, or does the Sun go around the Earth? (Earth around Sun)			
How long does it take for the Earth to go around the Sun? (One year)			
Male	66	NA[a]	66
Female	42	NA	46

(Source: Science & Engineering Indicators, 2008)

Information technology has transformed the way trust and knowledge are produced, says anthropologist Sharon Kaufman. "Scientists have to consider their role in this changed landscape and how to compete with these other sources of knowledge." Simply relating the facts of science isn't enough. No matter that the overwhelming weight of evidence shows that vaccines don't cause autism. When scientists find themselves just one more voice in a sea of "opinions" about a complex scientific issue, misinformation takes on a life of its own.

(Source: Public Library of Science, 2009)

The Challenge

“Sadly, we live in a postmodern age when it is ‘cool’ to be ignorant of science and its method; where truth and falsehood are seen as relative values; where profit is often valued above responsibility; where the political will to address long-term problems is sorely lacking. There is a powerful, well-financed, anti-intellectual, anti-science movement in this country and around the world — a movement that threatens the integrity of the progress science has made in our lifetimes....

The Opportunity

"The best defense we have against this movement is outstanding, effective science education for as large a segment of our population as possible.... Given the appeal of our science, an active, well supported, and highly professional cadre of astronomy intermediaries can be one of our country's most effective weapons in this struggle."

Andy Fraknoi, ASP


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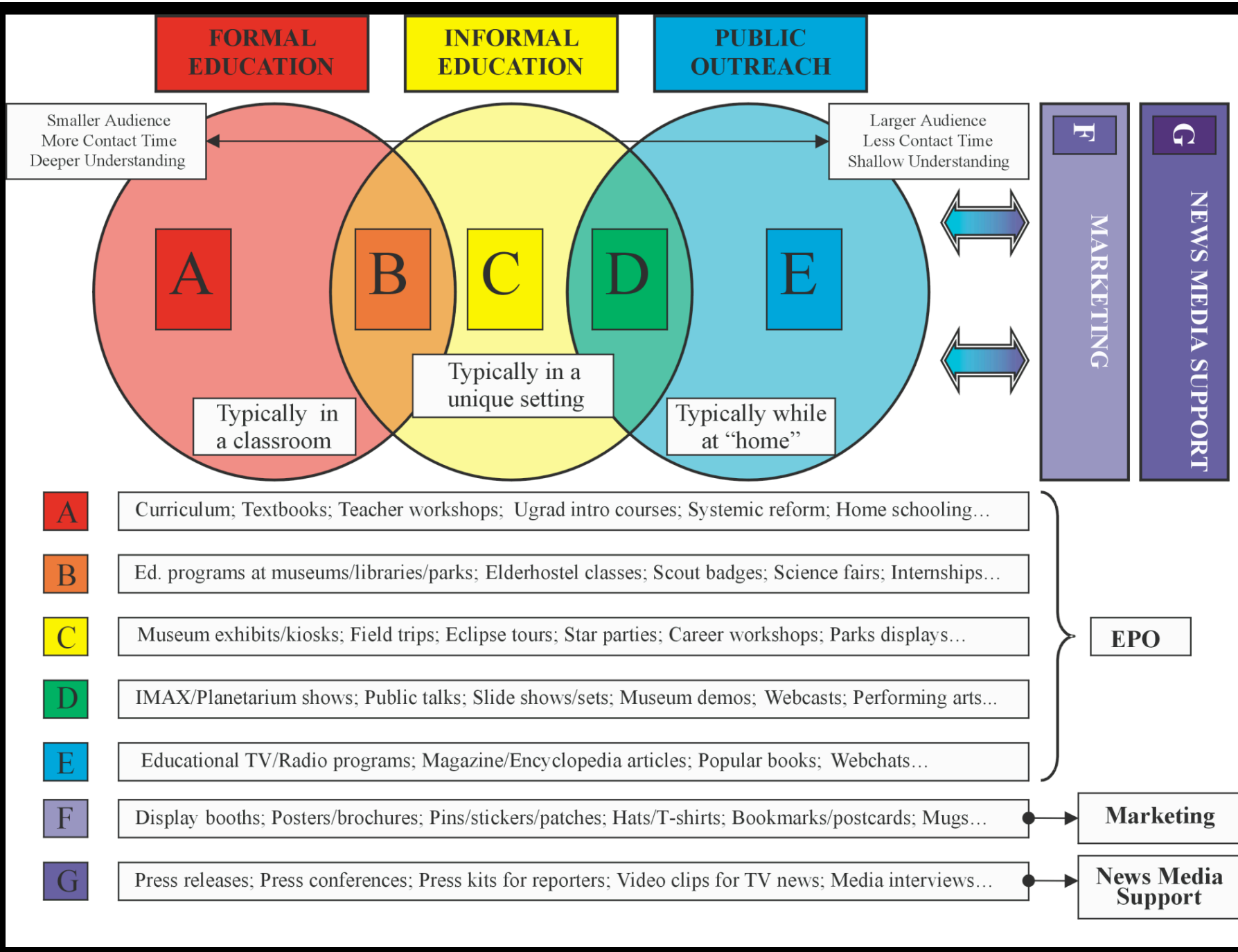
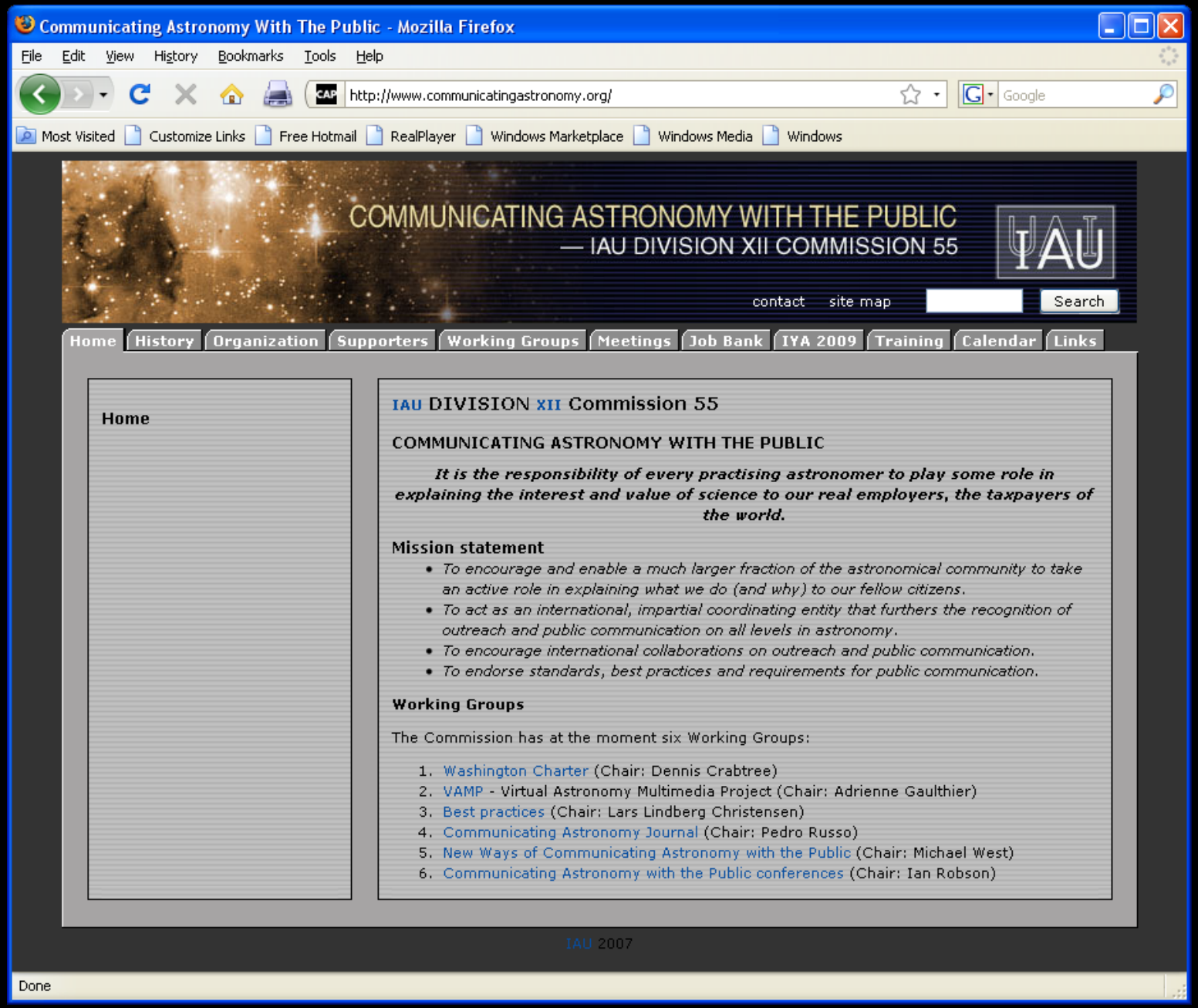


(Source: Cherilynn A. Morrow, 2000)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COMMUNICATING ASTRONOMY WITH THE PUBLIC
It is the responsibility of every practising astronomer to play some role in explaining the interest and value of science to our real employers, the taxpayers of the world.
Mission statement
To encourage and enable a much larger fraction of the astronomical community to take an active role in explaining what we do (and why) to our fellow citizens.
To act as an international, impartial coordinating entity that furthers the recognition of outreach and public communication on all levels in astronomy.
To encourage international collaborations on outreach and public communication.
To endorse standards, best practices and requirements for public communication.
Working Groups
The Commission has at the moment six Working Groups:
1. Washington Charter (Chair: Dennis Crabtree)
2. VAMP - Virtual Astronomy Multimedia Project (Chair: Adrienne Gaulthier)
3. Best practices (Chair: Lars Lindberg Christensen)
4. Communicating Astronomy Journal (Chair: Pedro Russo)
5. New Ways of Communicating Astronomy with the Public (Chair: Michael West)
6. Communicating Astronomy with the Public conferences (Chair: Ian Robson)
IAU 2007
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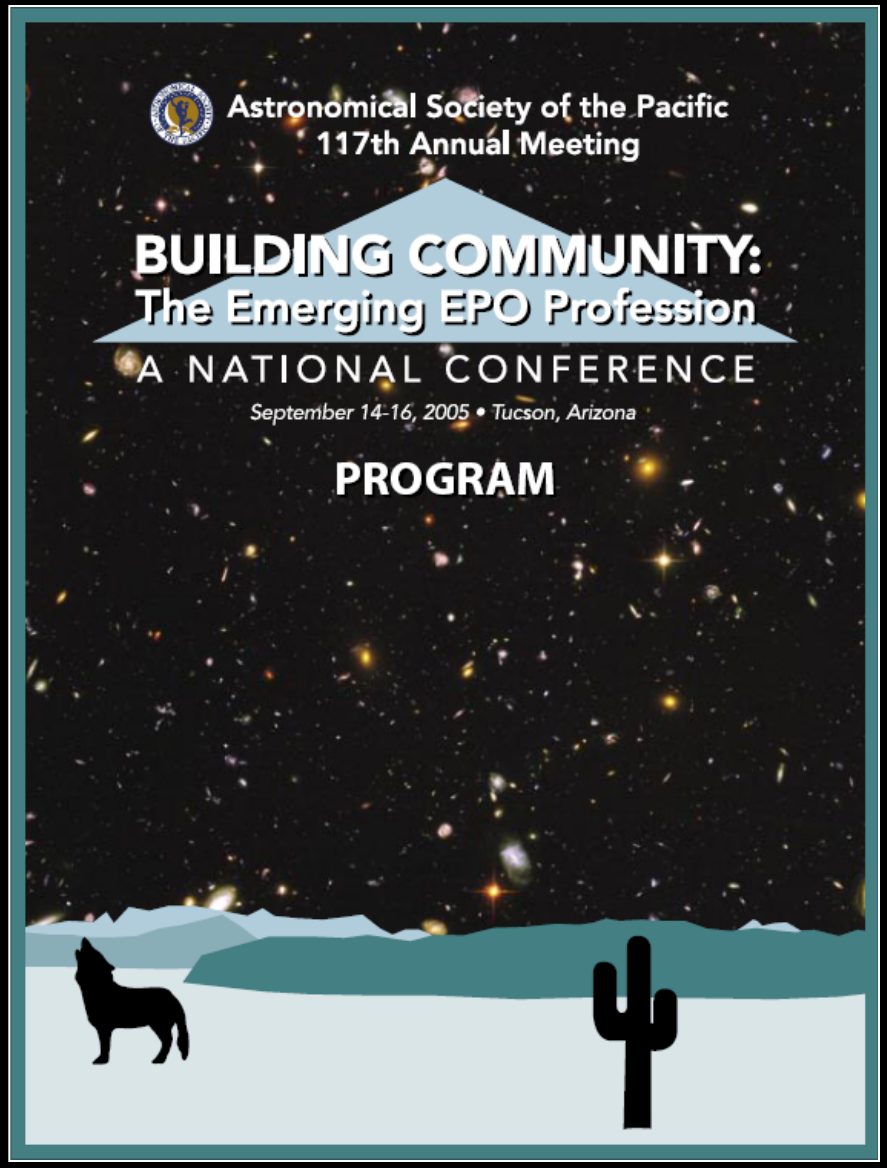

Communicating Astronomy with the Public 2007

Communicating Astronomy to a Global Audience

http://www.communicatingastronomy.org/cap2007/

Eugenides Foundation / Planetarium
Athens, Greece 8-11 October 2007

Scientific Organizing Committee

Lars Lindberg Christensen (ESA/ESO) (co-Chair)
Dennis Crabtree (Gemini Observatory) (co-Chair)
Ian Robson (UK ATC/ROE) (co-Chair)
Christos Goudis (Nat. Observatory of Athens)
Robert Hurt (SSC)
Tim Slater (AAS)
Jin Zhu (Beijing Planetarium)
Patricia Whitelock (South African Astronomical Observatory)

Local Organizing Committee

Christos Goudis (National Observatory of Athens)
Nikos Matsopoulos (National Observatory of Athens)
Raquel Yumi Shida (ESA/ESO)
Dennis Simopoulos (Eugenides Foundation/Planetarium)
Kanaris Tsinganos (Hellenic Astronomical Society)
Manolis Zoulias (National Observatory of Athens)

Specific goals

- To prepare for the International Year of Astronomy 2009
- To make public astronomical knowledge global and accessible to everyone, adapting communication methods to cross national, political, social and cultural borders and impairment limitations
- To promote international collaboration
- To evaluate current tools and methods and prepare for future developments

Key topics

- Case Studies and hands-on demonstrations
- Communication in the YouTube/MySpace/vodcasting mediascape
- Audiovisual, multimedia & online tools
- Social impact and evaluation of astronomy communication
- Education and communication tools for the visually impaired
- Prospects of IAU Commission 55: Communicating Astronomy with the Public

IAU International Astronomical Union Commission 55

National Observatory of Athens

Eugenides Foundation Planetarium

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Communicating Astronomy with the Public

IAU Division XII - Commission 55

CAPjournal

— The CAPjournal is a free peer-reviewed journal for astronomy communicators, online and in print

Public communication of astronomy provides an important link between the scientific astronomical community and society, giving visibility to scientific success stories and supporting both formal and informal science education. While the principal task of an astronomer is to further our knowledge of the Universe, disseminating this new information to a wider audience than the scientific community is becoming increasingly important. This is the main task of public astronomy communication — to bring astronomy to society.

The next few years will be extremely important for astronomy communication and education. The International Year of Astronomy 2009 will serve as a unique platform to inform the public about the latest discoveries in astronomy as well as to emphasize the essential role of astronomy in science education. However, as the astronomy outreach community expands globally, it becomes increasingly important to establish a community of science communication experts.

The IAU DIVISION XII Commission 55 Communicating Astronomy with the Public Journal Working Group prepared a study assessing the feasibility of the Communicating Astronomy with the Public Journal (CAPjournal). The conclusions were inescapable. The present situation of public astronomy communication shows a clear need for a publication addressing the specific needs of the public astronomy communication community.

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Jan 2009

NEWS & Announcements

29 Jan 2009: The CAPjournal issue #5 is online.

23 Sep 2008: The CAPjournal issue #4 is online.

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Sections of the Journal

Astronomy Education Review encourages submissions in any area of astronomy and space science education. The journal/newsletter has seven distinct sections:

1. **Research and Applications:** includes review articles and refereed papers on research in astronomy education (both new work and papers reprinted from other journals), along with ideas about how to apply results of such research in "real life."
2. **Innovations:** features short reports on innovative techniques, approaches, activities, and materials. These reports should convey the essence of the innovation and include ways that interested readers can learn more.
3. **Resources:** presents annotated lists of useful resources for any branch or arena of astronomy education.
4. **Commentary and News:** includes opinion pieces and occasional new items of interest to readers.
5. **Reviews and Excerpts:** describes, evaluates, and occasionally publishes excerpts from books and other materials of interest to educators at all levels.
6. **Letters to the Editor:** publishes short submissions about ideas, lessons learned, opinions, reactions to articles, etc.
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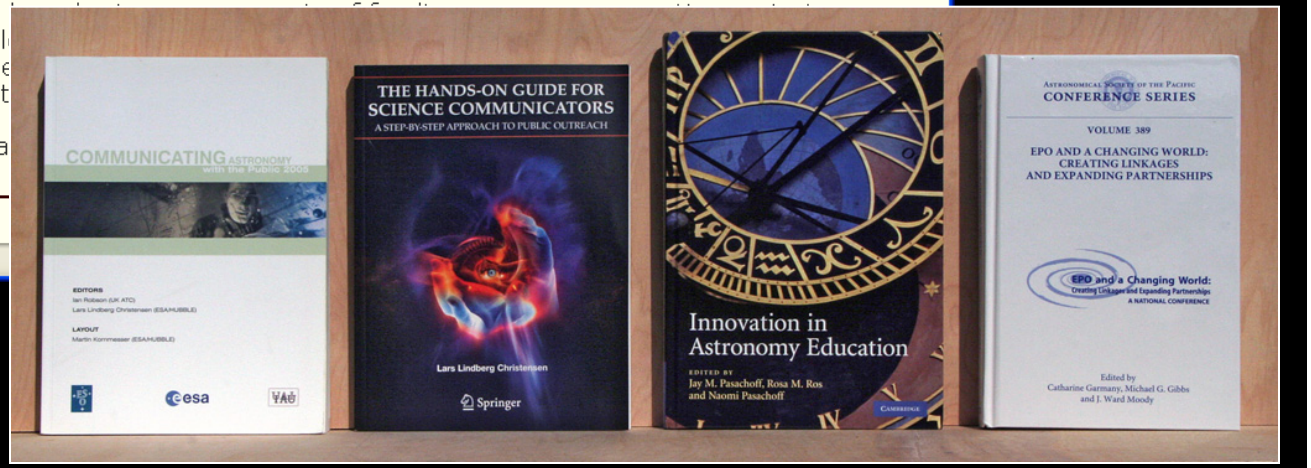

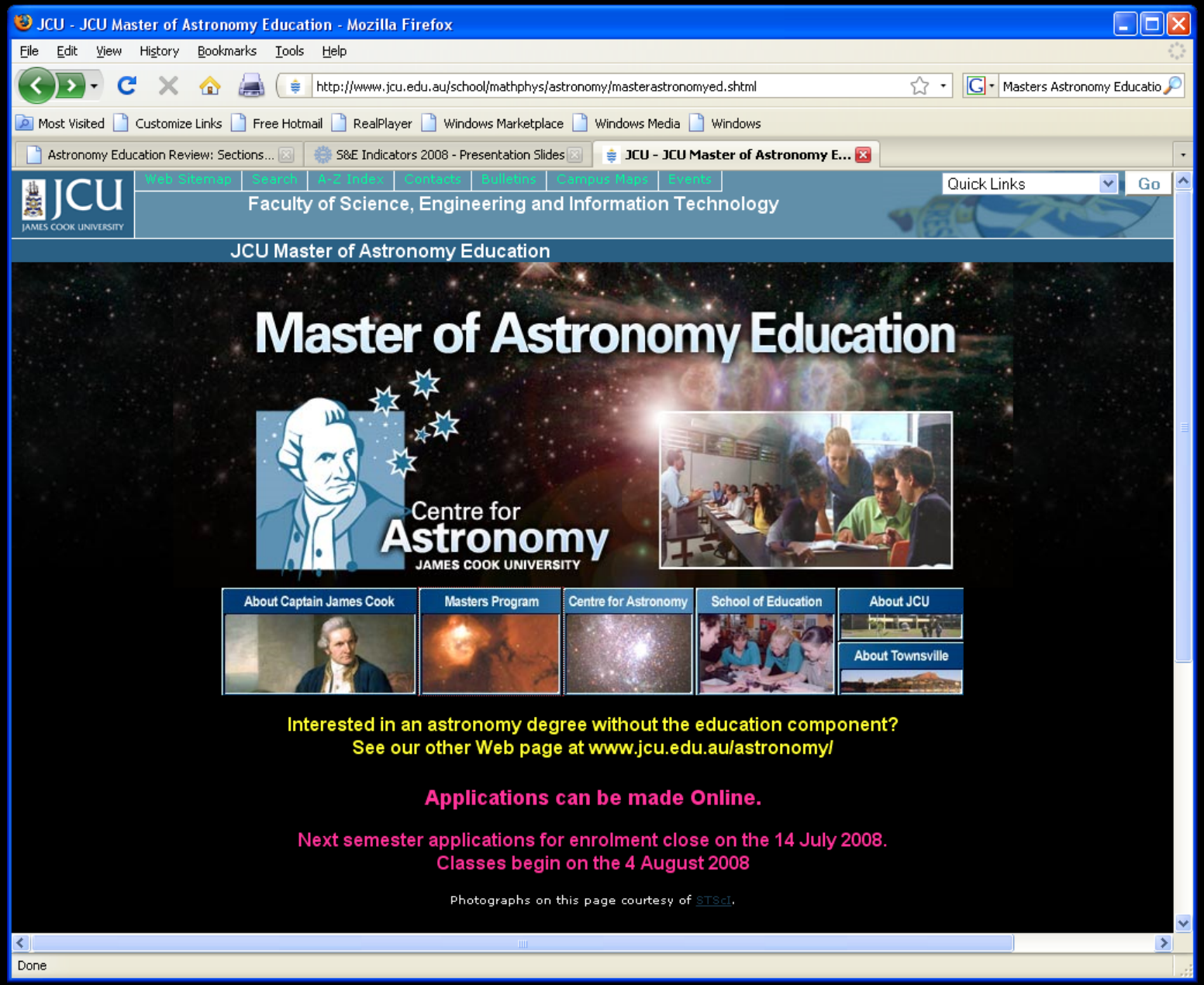
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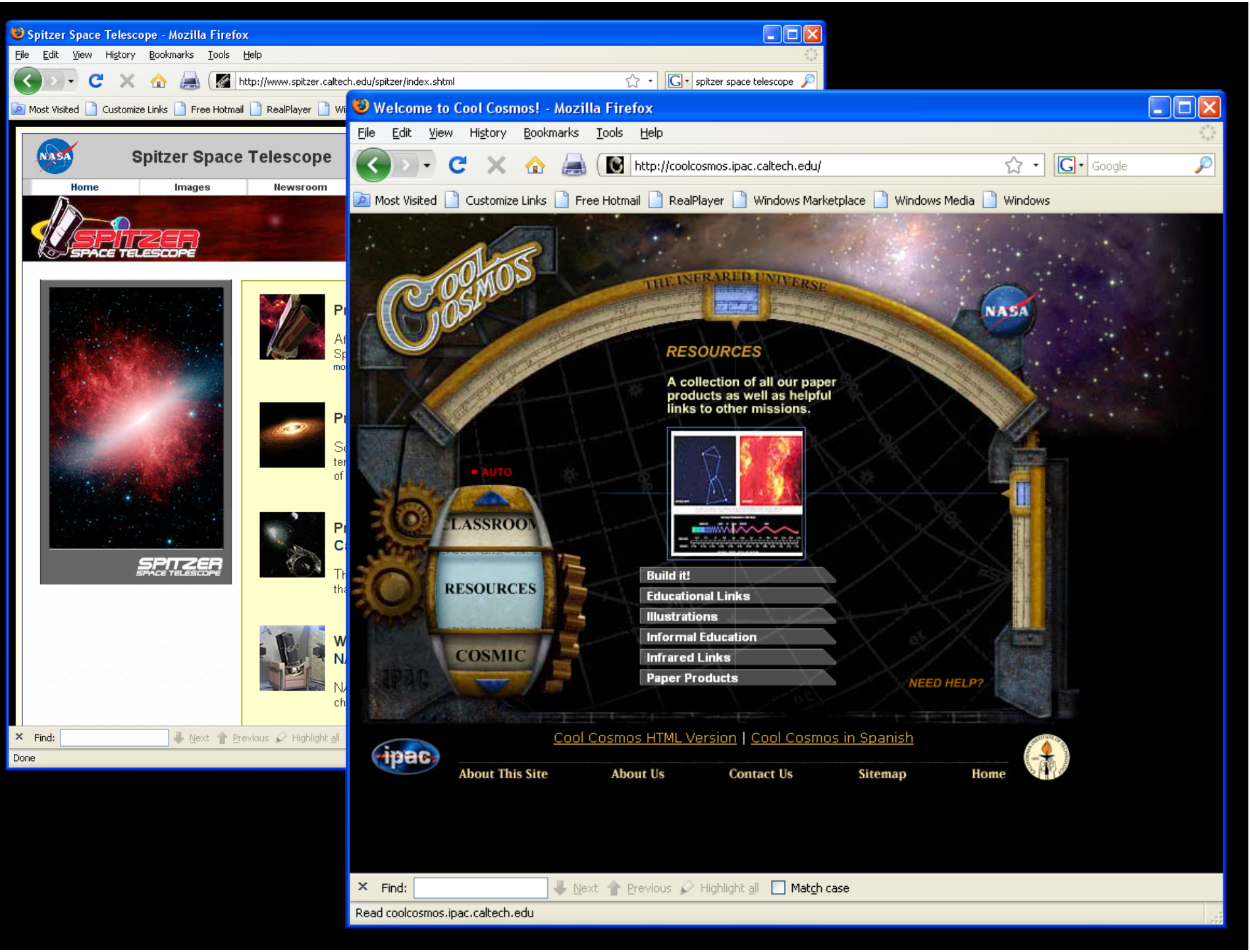
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SOFIA's EPO Program: Education Partnerships at 41,000 feet

Objectives:

- Support NASA's goals to inspire the next generation of explorers
- Enhance science and technology education in communities across the U.S.
- Establish long-term relationships between NASA, educators, and researchers
- Contribute to general public understanding of the value of scientific research

SOFIA: A Unique Astronomy EPO Facility

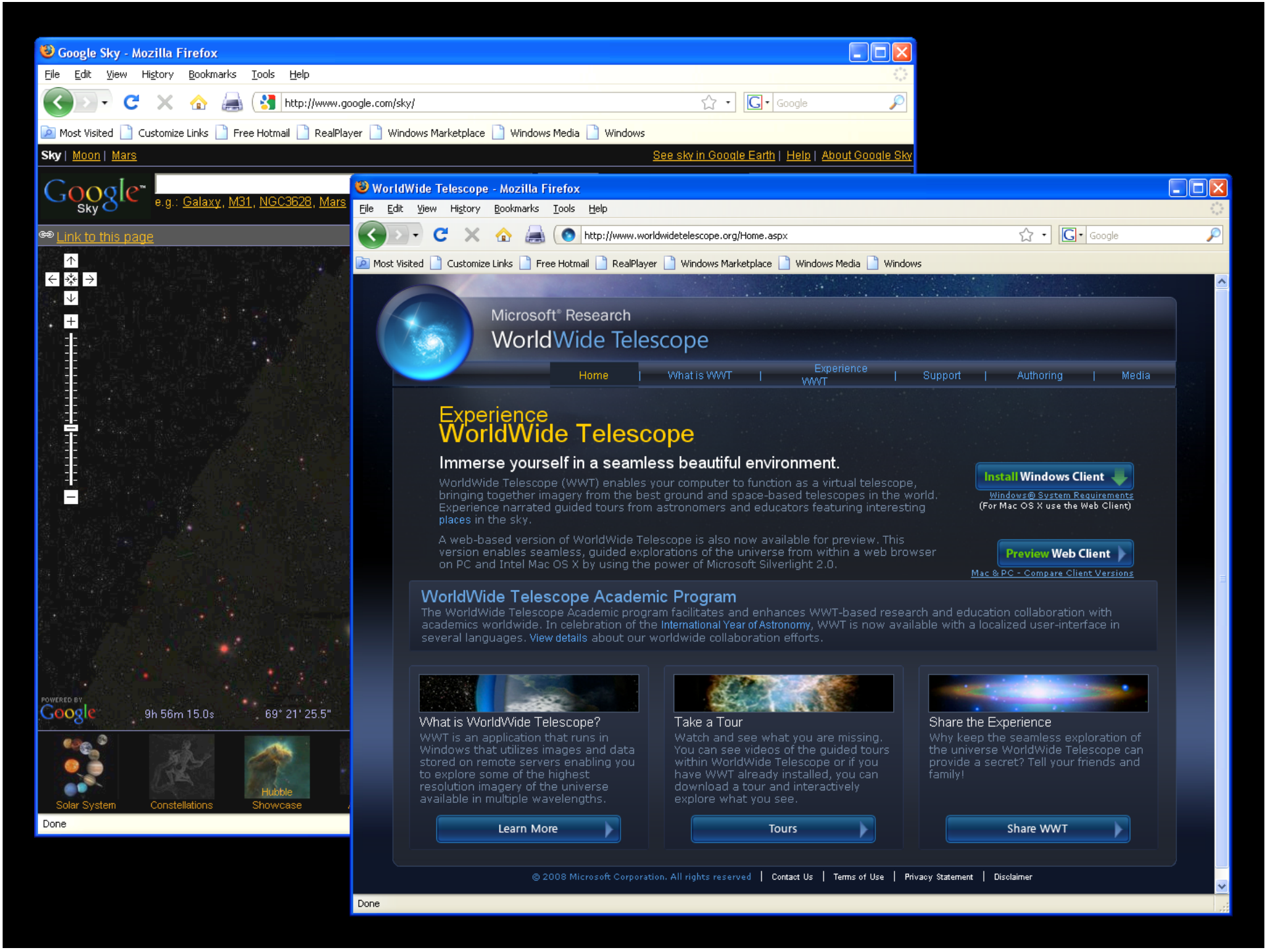
• SOFIA's day-to-day operations are like those of a high-flying ground-based observatory

• But, in terms of its scientific promise, SOFIA is more like a space observatory — which calls for a substantial Public Affairs (press & media) function to inform the public that their investment has paid off

• SOFIA is the only major observatory — ground- or space-based — designed from the start, both physically and administratively, to foster partnerships between educators & scientists in a research environment

• SOFIA is uniquely capable of giving members of the public — teachers, college faculty, undergraduate students, amateur astronomers — familiarity with the processes of scientific research

• SOFIA is capable of delivering unique impact — rivaling the magnitude of HST or Mars rovers, but more personal — in communities across the U.S.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WorldWide Telescope (WWT) enables your computer to function as a virtual telescope, bringing together imagery from the best ground and space-based telescopes in the world. Experience narrated guided tours from astronomers and educators featuring interesting places in the sky.
A web-based version of WorldWide Telescope is also now available for preview. This version enables seamless, guided explorations of the universe from within a web browser on PC and Intel Mac OS X by using the power of Microsoft Silverlight 2.0.
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Mac & PC - Compare Client Versions
WorldWide Telescope Academic Program
The WorldWide Telescope Academic program facilitates and enhances WWT-based research and education collaboration with academics worldwide. In celebration of the International Year of Astronomy, WWT is now available with a localized user-interface in several languages. View details about our worldwide collaboration efforts.
What is WorldWide Telescope?
WWT is an application that runs in Windows that utilizes images and data stored on remote servers enabling you to explore some of the highest resolution imagery of the universe available in multiple wavelengths.
Learn More
Take a Tour
Watch and see what you are missing. You can see videos of the guided tours within WorldWide Telescope or if you have WWT already installed, you can download a tour and interactively explore what you see.
Tours
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ESA astronaut Frank De Winne starts his six-month OasISS mission with the launch of the Soyuz TMA-15 spacecraft to the International Space Station on
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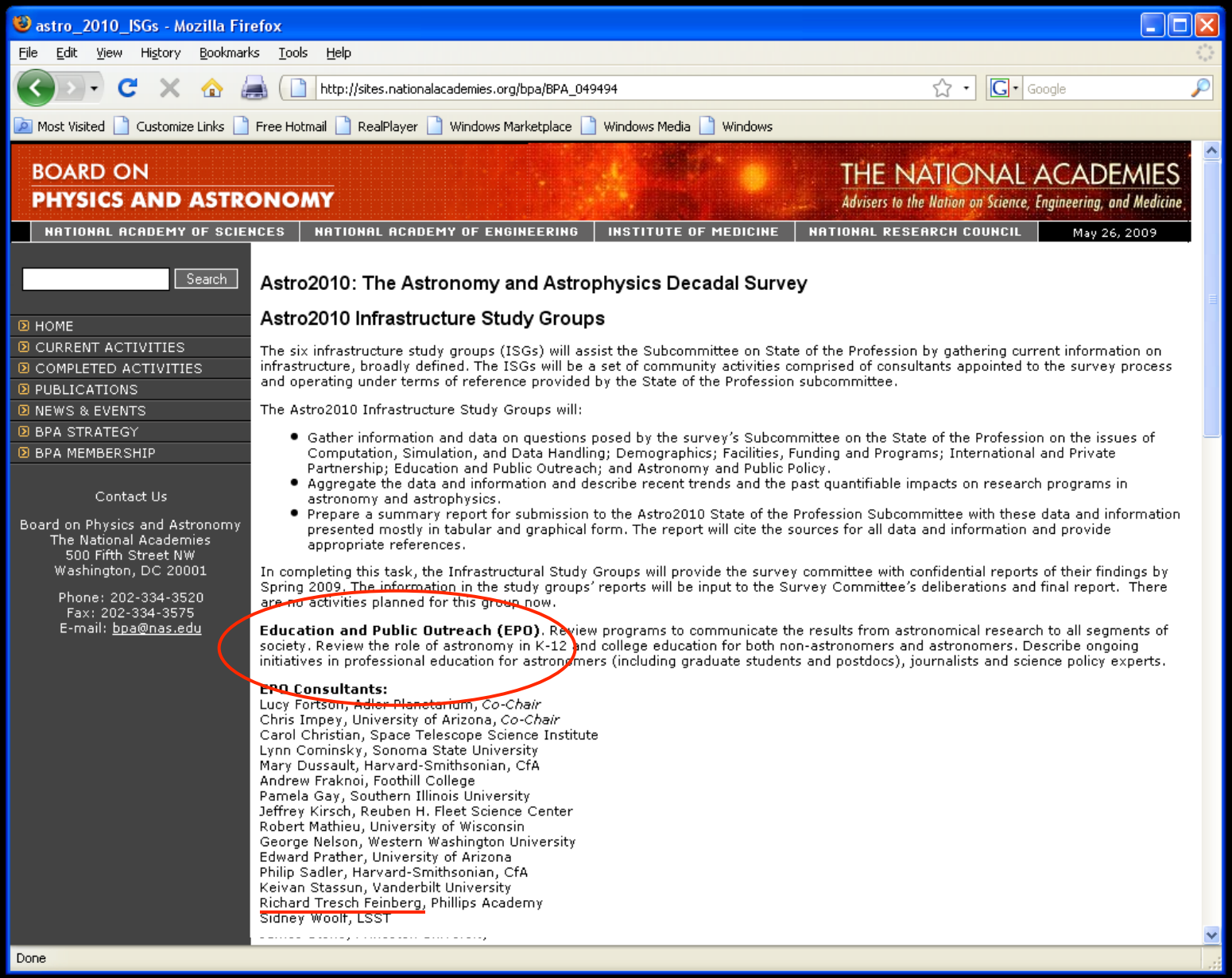
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Astro2010: The Astronomy and Astrophysics Decadal Survey
Astro2010 Infrastructure Study Groups
The six infrastructure study groups (ISGs) will assist the Subcommittee on State of the Profession by gathering current information on infrastructure, broadly defined. The ISGs will be a set of community activities comprised of consultants appointed to the survey process and operating under terms of reference provided by the State of the Profession subcommittee.
The Astro2010 Infrastructure Study Groups will:
Gather information and data on questions posed by the survey's Subcommittee on the State of the Profession on the issues of Computation, Simulation, and Data Handling; Demographics; Facilities, Funding and Programs; International and Private Partnership; Education and Public Outreach; and Astronomy and Public Policy.
Aggregate the data and information and describe recent trends and the past quantifiable impacts on research programs in astronomy and astrophysics.
Prepare a summary report for submission to the Astro2010 State of the Profession Subcommittee with these data and information presented mostly in tabular and graphical form. The report will cite the sources for all data and information and provide appropriate references.
In completing this task, the Infrastructural Study Groups will provide the survey committee with confidential reports of their findings by Spring 2009. The information in the study groups' reports will be input to the Survey Committee's deliberations and final report. There are no activities planned for this group now.
Education and Public Outreach (EPO). Review programs to communicate the results from astronomical research to all segments of society. Review the role of astronomy in K-12 and college education for both non-astronomers and astronomers. Describe ongoing initiatives in professional education for astronomers (including graduate students and postdocs), journalists and science policy experts.
EPO Consultants:
Lucy Fortson, Adler Planetarium, Co-Chair
Chris Impey, University of Arizona, Co-Chair
Carol Christian, Space Telescope Science Institute
Lynn Cominsky, Sonoma State University
Mary Dussault, Harvard-Smithsonian, CfA
Andrew Fraknoi, Foothill College
Pamela Gay, Southern Illinois University
Jeffrey Kirsch, Reuben H. Fleet Science Center
Robert Mathieu, University of Wisconsin
George Nelson, Western Washington University
Edward Prather, University of Arizona
Philip Sadler, Harvard-Smithsonian, CfA
Keivan Stassun, Vanderbilt University
Richard Tresch Feinberg, Phillips Academy
Sidney Woolf, LSST
Done

The Opportunity

"Given the appeal of our science, an active, well supported, and highly professional cadre of astronomy intermediaries can be one of our country's most effective weapons in [the struggle to increase the public's science literacy and support for science]."

Andy Fraknoi, ASP