



## ***Space Science Media Needs of Science Center Professionals***

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***“We love NASA, we really do. We’re the true believers, but for a long time we were out in the wilderness because education was not a high priority for NASA and it’s great to see the change and it’s great to see that you’re worrying about things like this.”***



Jubilant astronomers unveiled humankind’s most spectacular views of the universe, courtesy of the newly installed Advanced Camera for Surveys (ACS) aboard NASA’s Hubble Space Telescope.

--Hubble Press Release, April 30, 2002

<http://hubblesite.org/newscenter/archive/2002/11/image/i>

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## **I. Introduction**

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NASA's Office of Space Science enlisted the Sun-Earth Connection Education Forum at Space Sciences Laboratory, UC Berkeley in partnership with the American Institutes for Research to determine the space science media needs of science center communities<sup>1</sup>. Over the past few years, NASA has increasingly recognized the role that science centers play in presenting and interpreting space science. Science centers work directly with students through school outreach programs and field trips, reaching an estimated 39 million school children every year. Studies have identified out-of-school exposure to science, including visits to science centers, as a significant factor in career choice, thus science centers are strategic partners to enable NASA to "inspire the next generation of explorers." In addition, it is estimated that more than 60 percent of the adult public in the United States goes to science centers at least once a year.<sup>2</sup> By working with science centers, NASA can inspire the public with the excitement of space science.

NASA has begun to carry out user requirements research within the science center communities, including the Earth Science Enterprise's "NASA is Listening Report 2000"<sup>3</sup>, NASA's

Space Science Enterprise "ASTC '98 Questionnaire"<sup>4</sup>, the Great Lakes Planetarium Association's survey conducted on behalf of DePaul University,<sup>5</sup> and NASA Astrobiology Institute's "Informal Education Survey."<sup>6</sup>

The research reported here was conducted to assist NASA's Office of Space Science in exploring solutions to better service the media needs of these communities. This study was focused primarily on media needs, but we also asked science center professionals to compare media needs to other priorities, such as professional development and a speaker's bureau. For our purposes, "media" refers to images, animations, simulations and videos that are available via the World Wide Web, as well as the captions, background information and other information associated with such media. UC Berkeley oversaw this research and provided the information on existing NASA resources for these communities. The American Institutes for Research and Blue Crow Consulting provided the research methodology, conducted the usability sessions and phone interviews, and assisted in analyzing and interpreting the results.

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<sup>1</sup> In this document, the phrase "Science Centers" refers to Science Centers, Science Museums, and Planetaria.

<sup>2</sup> Association of Science-Technology Centers, "Making the Case," 2001, <http://www.astc.org/resource/case/index.htm>

<sup>3</sup> NASA Earth Science Enterprise, "NASA is Listening," 2000, <http://talkto.jpl.nasa.gov>.

<sup>4</sup> NASA Space Science Enterprise Science Museum Working Group, ND, <http://cfa-www.harvard.edu/seuforum/museums/index.html>

<sup>5</sup> DePaul University, IL. ND, Bernhard Beck-Winchatz: [bbeck@condor.depaul.edu](mailto:bbeck@condor.depaul.edu) (private communication).

<sup>6</sup> NASA's Astrobiology Institute, "Informal Education Survey," 2002, <http://www.smm.org/mml/ab/>.

## **II. Objective**

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The overall objective of this research is to make a recommendation to NASA's Office of Space Science on next steps for meeting the space science media needs of the science center community.

To this end, we collected information about:

- Current space science resources being used by science centers
- The types of space science media that science centers personnel use within their programs and products, and the tools they use to gather those resources
- How adequate these resources and tools are for enabling science centers to “translate” space science for their audiences
- The types of requests the NASA space science community receives from science centers
- The relative priority of potential new resources NASA Office of Space Science could develop for these communities

## **III. Methods**

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Our research was conducted in three phases. In Phase I, our research staff reviewed a sample of existing space science websites and conducted informational interviews with members of the informal science community.

The informational interviews were designed to identify the space science related products and programs currently offered, and to identify the people involved in the development and presentation of products and programs at informal education institutions. There were eight initial contacts with representatives of five institutions in the San Francisco Bay Area. These initial contacts were typically directors or supervisors in their departments and had knowledge of the space science products and programs presented at their institutions.

During Phase II, we conducted face-to-face interviews with the key informants identified in the informational interviews. The key informants, who were the people most intimately involved in the development and presentation of space science products and programs, included exhibit designers and developers, and science center staff. Nine individuals from four institutions in the San Francisco Bay Area were selected to serve as key informants. This group was selected to represent as many different job types and departments possible.

Key informant interviews provided an opportunity to conduct usability testing of various selected websites. In usability testing, participants are asked to think aloud as they perform a variety of tasks (i.e., using websites to locate and select information for the creation of space science exhibits and programs.) By listening to their verbalizations of their cognitive processes and their responses to specific probes and questions, one can obtain insights about the procedures employed by science center staff for locating space science

materials. In addition, information about website characteristics (such as organization and content) and the needs of science center professionals also emerge. (See Appendix A for the protocol used for these interviews.)

The results of the first two phases informed the development of a telephone survey instrument, which was administered to a national sample of science center program developers during Phase III. Respondents were recruited through the NASA booth at the ASTC 2001 conference, as well as through an email solicitation to science centers that have collaborated with NASA in the past. Interested individuals were requested to fill out a web-based survey. The online survey asked respondents to rate the

usefulness of certain website features and content, as well as certain types of assistance that NASA could provide. Usefulness was assessed on a six-point scale ranging from “not at all useful” to “essential.” (See Appendix B for the online survey.)

Fifteen of these individuals were selected for a telephone interview. Thirteen of them completed the web survey in advance of their interviews, and the other two interviewees were asked to respond verbally to the web survey questions in their telephone interviews. During the telephone interviews, respondents were asked to elaborate on specific web survey responses to provide a deeper understanding of the reasons for each usefulness rating. (A

<b>May '02</b>	<b>July '02</b>	<b>Aug-Oct '02</b>
<p><b><u>Phase 1:</u></b></p> <ul style="list-style-type: none"> <li>• Informational interviews with senior members at science center institutions</li> <li>• Identify people involved in development and presentation of space science</li> <li>• Selection of key informants</li> </ul> <p><b>Initial Contacts (8)</b></p>	<p><b><u>Phase 2:</u></b></p> <ul style="list-style-type: none"> <li>• Usability testing of space science websites by key informants</li> <li>• Identify characteristics of useful websites</li> </ul> <p><b>Key Informants (9)</b></p>	<p><b><u>Phase 3:</u></b></p> <ul style="list-style-type: none"> <li>• Develop web survey</li> <li>• Administer web survey in advance to national sample</li> <li>• Conduct follow-up phone interviews with National Sample</li> </ul> <p><b>National Sample (15)</b></p>

copy of this interview protocol is presented as Appendix C.) Telephone survey respondents were compensated for their time.

In all, we interviewed 32 professionals from science centers. The institutions were located throughout the country, ranged in size from over 500,000 annual visitors, to less than 50,000 annual visitors, and served a variety of audiences—including teachers, students, families, and the general public. (See Appendices D and E for a participant list and institution list.) We selected personnel within each institution that conducted space science programs or developed space science products. Our sample of interviewees included Program Managers, Directors of Education, Planetarium Directors, Exhibits Managers, Astronomers, Directors of Exhibits, and a Special Projects Volunteer. We also interviewed NASA personnel, including NASA Space Science Mission Multimedia Specialists, NASA Media Website Development Teams, and NASA Space Science Informal Education Leads.

## **IV. Results**

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We present the results according to the themes that emerged during research Phases I-III. These themes include: key website content, key website features, image information, animation or simulation information, NASA Space Science websites, and review of the NASA Space Science Portal website. We have presented the web survey results as tables, and also include direct quotes from the phone interviewees.

### **A. Websites**

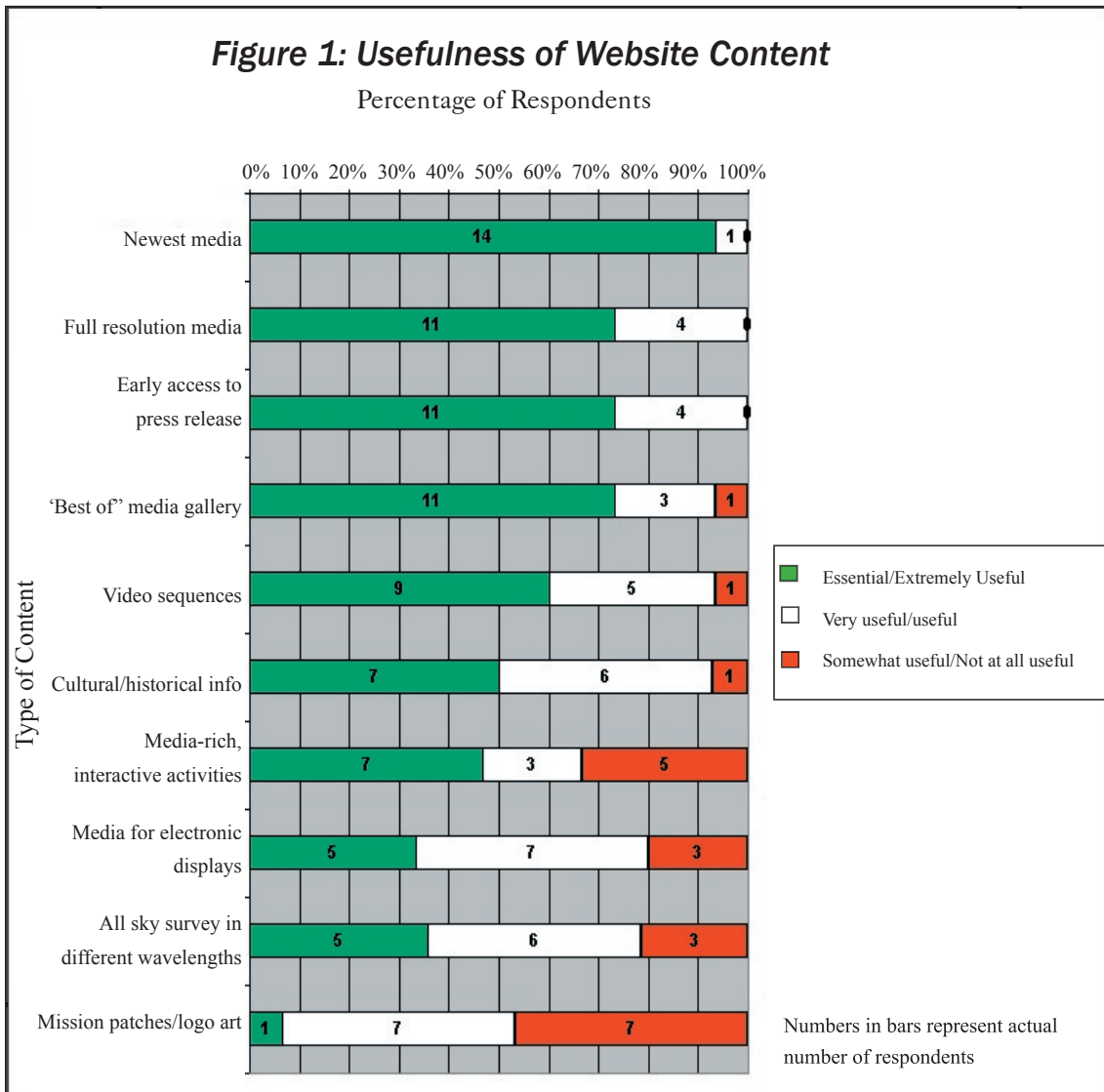
#### **1. Description of Key Website Content**

The web survey asked respondents to rate the various types of content one might find on a website containing space science related information and media. The responses to this survey item are presented in Figure 1. Though all of the types of content received a rating of extremely useful or essential from at least one interviewee, the most highly rated types of content were: the newest media, full resolution media, early access to press releases with media, and a “best of” gallery of media. Mission patches/logo art were clearly least useful to most of the respondents.

##### ***a) Newest Media***

Nearly all respondents rated having the newest media on websites as essential or extremely useful. One interviewee from a small institution said, “For elementary schools, I still take a lot of NASA images off of laser





disk, but I also do PowerPoint presentations, using newer images from the Internet instead of having to use older images from the laser disk.” Another interviewee stated, “New media is very important, because we look more current.” An interviewee that produced programming for distribution selects three of the “coolest new images” each week, and annotates them in preparation for distribution. Access to the newest media enables science center professionals to present current, exciting information to their audiences. (Refer to Screenshots 1, 3 and 4, for examples of exemplary websites.)

**b) Full Resolution**

Full-resolution media is also important to this community, particularly to those who work in full-sized planetariums. An interviewee from a large institution said, “Full resolution media is what NASA is for and what the web is for. We should be able to get all the pixels that exist.” Another said, “You have to remember what we’re doing with a lot of the images. You have to think of the format. A lot of these people who are plugging these things in have them at a higher resolution on their monitor and they may not be thinking of someone who is going to project this 40 or 50

feet onto a dome. We thought we had some really neat stuff [from a recent space shuttle program] and when we got it and put it up the resolution just didn't hold up and we couldn't get it any better." Many users need images in full resolution, that is, the highest resolution available. (Refer to Screenshots 1, 3 and 4, for an example.)

A range of resolution options is also useful. Having some lower resolution options gives science center professionals the choice to preview an image in a smaller file size, or to use a lower resolution image where high resolution is not warranted.

On the topic of resolution, one interviewee from a large institution reflected, "I think it's also important to educate us a little more about what resolution is. What is a TIFF? What is a high resolution JPEG? What is a GIF? What are the recommended uses for the different formats, especially for us working in science centers? Maybe you can have one of the science center colleagues sit with you and write this up so that it's generic throughout all the different mission sites. So you only have to make it once and you can always find out more about what is resolution and how to choose a format. Sometimes we click and we don't know what we're getting. Is it TIFF, and is this the number of megabytes, and if I don't know, am I going to have to sit here for 20 minutes and wait for the image to download?" Providing consistent information on resolution throughout the NASA websites, along with a tutorial about resolution and format, would be useful.

### *c) Early Access to Press Releases*

Interview data showed the importance of having early access to press releases. Interviewees across institution size and type stressed that the public looks to them for answers about space science related information in the news. An interviewee at a large institution said, "When anything breaks in the media that's astronomy or space related, the local media does not call you [NASA], they call me. The quicker I can have access to information and not get caught off guard when the phone calls are coming in before the press release comes out, that's a huge help. A while back, as far back as '96 or '97, at an ASTC meeting, NASA made a big deal of saying that they were going to get us 24-hour pre-release on media releases and for a short time we seemed to be getting them early and then it dried up. Now it's real hit or miss. A lot of times I'm getting the information in my hand at the same time the media is or slightly after, so I have to be catching up quickly to respond to phone calls." The majority of interviewees expressed this desire to have early access to press releases. Another interviewee stated, "If you [NASA] do something big in the news, our phones ring off the hook." Another interviewee at a mid-sized institution commented, "If it's going to be the same thing that CNN gets, if I don't get it in advance, so I get a jump on it, or I don't get more materials with it, more data, then how am I going to convince the public to come in here and watch it? They will stay at home and watch it. We want people to know more about science, but we want to get them into the science center to learn more about science, and we use

programs to do that. Any time you can give me an extra something I can say that we have that someone won't get on their local cable access TV then I'm all for that." Interviewees cited early access to embargoed press releases through Hubble as a good model.

Press releases with media were also appealing to interviewees. On the importance of press releases with media, an interviewee at a small institution said, "For example, a press release comes to me via e-mail and it's got a link to where those images can be found, I follow that a lot. I am just so typically pressed for time...the new things I am incorporating are still things that are coming to me first. And that's one of the reasons I appreciate the e-mail press release type options." Many respondents appreciate receiving early access to press releases, and find press releases with associated media to be especially useful.

#### *d) A "Best of" Gallery of Media*

A "Best of" gallery of media was also deemed essential or extremely useful by about two thirds of the survey respondents. One interviewee explained why this "best of" gallery is extremely useful. "If we're looking for particular things, sometimes you have to wade through a lot to get it, but in most cases, if you [NASA] have gone through the filtering process and you say, 'here are our top five images,' that's going to be best for us, that's going to get us what we need." Again, Hubble was cited as a model. When discussing what a "best of" gallery might include, one interviewee said, "Not only is it the best pictures, sometimes it's the most interesting image of a subject. It's, 'this image shows us something that we

never knew before.' Space Science Telescope Institute has been very good at really selecting the ones that are very different and are a unique perspective and have that aesthetic quality that will capture the imagination of people who might not even think about astronomy." (Refer to Screenshot 1, the Hubble Heritage Website, for an example.) Several cited the "Pillars of Creation" image as a good example of an image that belongs in a "best of" gallery. Interviewees defined "best of" in a variety of ways, but for most respondents, "best of" is synonymous with most popular. A few stated that a "best of" gallery containing the newest media would also be extremely useful to them. One interviewee reflected that it would be "interesting to see how NASA defines 'the best' images, to compare with how I would define 'the best' NASA images" A "best of" gallery of media is useful and timesaving to this group of interviewees.

#### *e) Video Sequences*

Video sequences were also highly rated. Several interviewees emphasized that moving images capture audience attention in a way that still images cannot. An interviewee who produced planetarium programs stated, "We love to have motion, animation of any kind that we can get. When NASA can provide that, that's fantastic and we will use that. When it's not available, we'll even do our own animation and video editing to make sure we have that." An interviewee from a mid-sized institution commented, "On displays we've found there's a place for static images and text, but based on our audience evaluations, video is a way to engage our visitors in a way that a slide show of stills can't. If there is a video clip, we go

right for it.” Even those who were not directly involved in the planetarium at their institution indicated they would use video sequences.

***f) Cultural and Historical Information***

About half of the interviewees also felt that cultural and historical information on various subjects would be extremely useful content on a space science related website. An interviewee from a large institution said, “And we’ve found that this is one of the ways of trying to target that relevance question, the ‘what does this have to do with me?’ Or ‘what does this even have to do with people here on Earth?’ We’re talking about things so far away and so far beyond us. And that human element that everyone, no matter who you are or where you’re from or what your background is, there has been that element of astronomy that has played some role in every culture, even today’s modern culture.” For many of the interviewees, cultural and historical information on astronomy is seen as a way to pique public interest and to make the topic relevant to the general public.

***g) General information***

General information regarding instruments and NASA missions, background information, basic facts and people involved is also highly desired. Information such as the size of the astronomical object, the length of a NASA mission, and details on the instruments themselves can help project developers convey the information to the public.

## 2. Description of Key Website Features

The web survey also asked respondents to rate the usefulness of various website features. Responses to this item are presented in Figure 2.

Each of the following features was extremely useful or essential for at least a few respondents. The most useful features were the site search, content written at a level suitable for the public, thumbnails of media, multiple resolution options, an icon denoting a video clip, and related links for each subject. Since our interviewees were not disabled, Section 508 compliant websites were not a priority for them as users. However, for those science center professionals who are disabled, as well as for members of the public, Section 508 compliance would be critical to provide

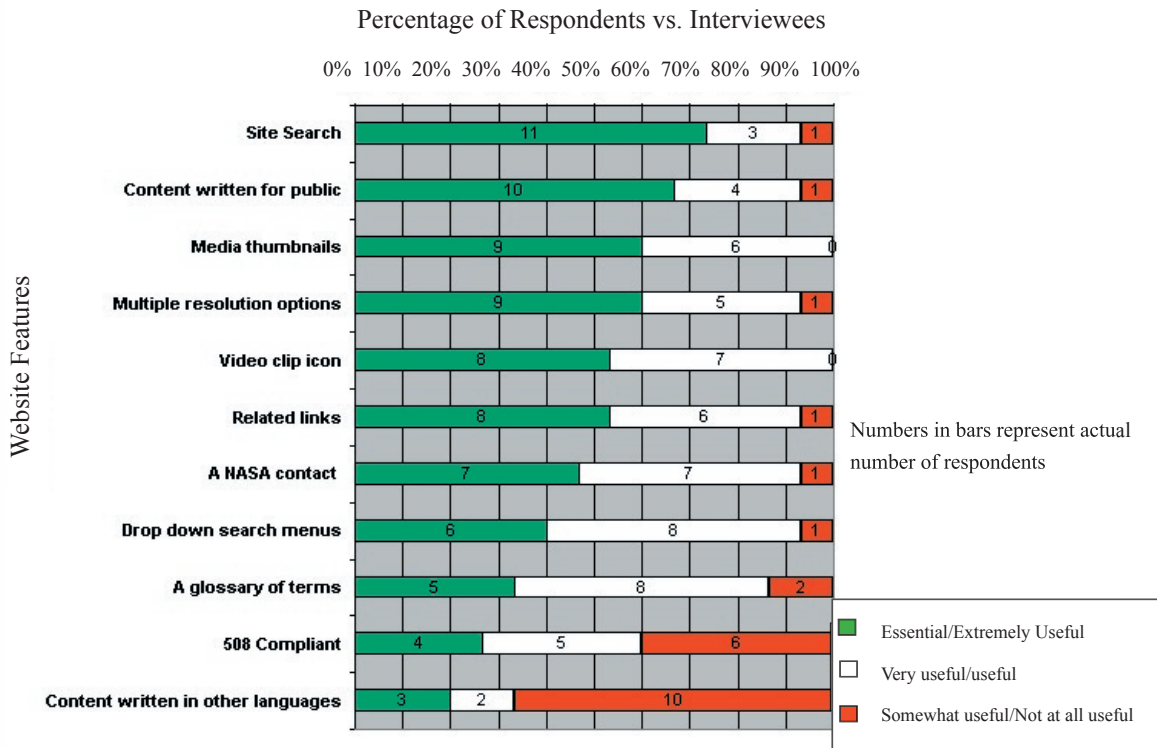
them access to NASA sites.

### a) Site Search

Over two-thirds of the interviewees think that a site search feature is essential. The majority of interviewees prefer searching by keyword to browsing when navigating a website or database, and about half of the interviewees will begin an online search for media with a keyword search on an Internet search engine like Google™. One interviewee pointed out that being able to search for an image by keyword often dramatically reduces the time it takes to find an image. The preferred location for the search function is on the home page of the website.

The search feature should return results quickly. According to one interviewee, “speed

**Figure 2: Usefulness of Website Features**



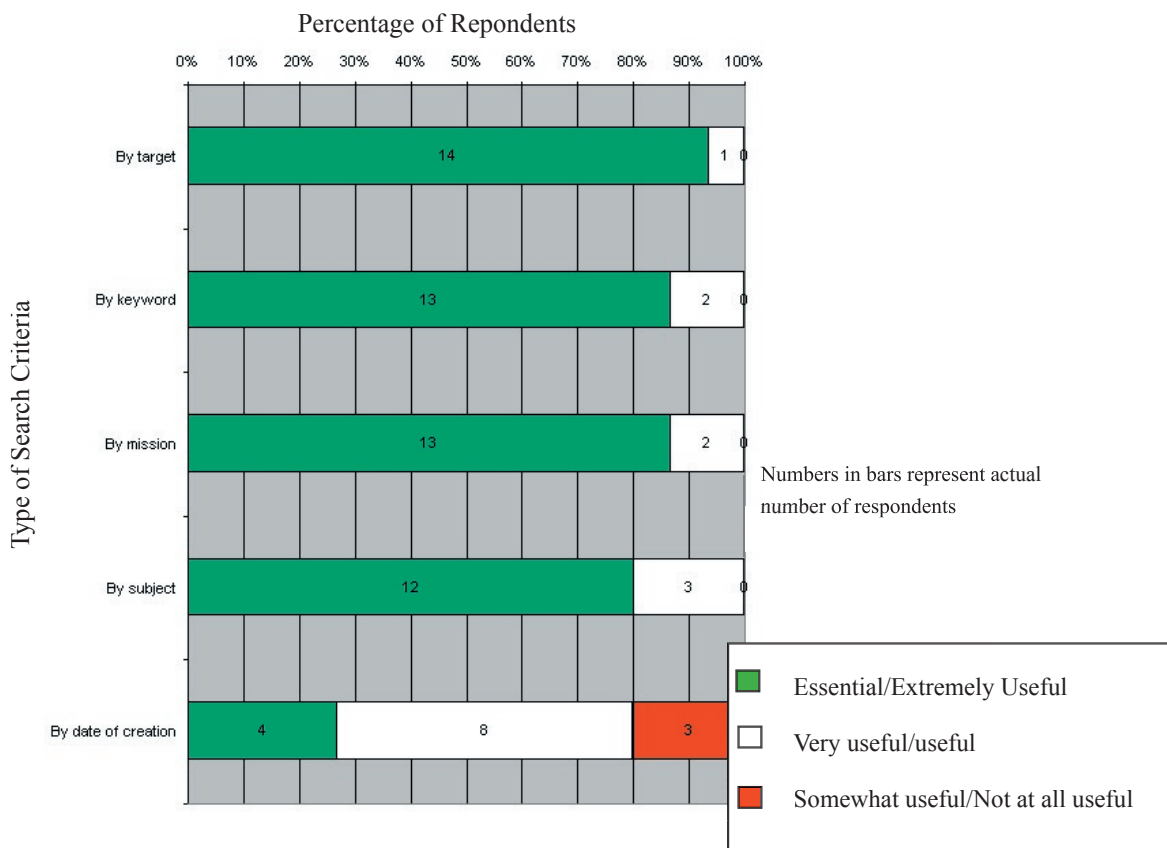
is key.” One interviewee commented that he was reluctant to use the search feature on the NASA Image Exchange site because most NASA site searches are incredibly slow. After entering a search, he said, “Fast search, a good start.”

**b) Search Criteria**

Respondents were also asked to rate the usefulness of particular search criteria on the pre-interview survey. Results are presented below, as Figure 3.

As the figure illustrates, respondents find searching by target and keyword to be most useful. At times, their search needs are narrowly focused. As one interviewee stated, “Very often we’re looking for something very specific. We’re not just talking about Jupiter, we’re looking for information about a particular moon and we need images that look like this. So being able to search for something very specific within a general site is something we do a lot of.” Websites that allow users to search by a specific target or keyword are most useful to this community.

**Figure 3: Usefulness of Search Criteria**





In addition to a search function, interviewees want browse options available. Depending upon what they are looking for and the stage of the project, browsing by topic and mission are important as well as searching by keyword. Interviewees want clear categories and headings when browsing. Categories and headings that are poorly labeled waste time, or result in not locating the image at all.

Respondents felt that the first search results should provide a limited amount of information, including a thumbnail of the item, a short description, and the resolution/file size. This small amount of information enables them to select an image from the larger sample. They would then like to be able to click on a search result to get additional information such as date and mission, a more detailed description and copyright information.

#### ***c) Content Written at the Level of the General Public***

Interviewees want to see content written at the level of the general public. For most of the interviewees, “a level suitable for the public,” is synonymous with the level at which a newspaper or popular magazine is written, specifically a middle school reading level. However, if they had to choose between content written at a general public level and content written at a “scientist” or “dedicated teacher” level, they preferred the latter. Several interviewees explained that it is often easier to rewrite content to the appropriate, more general level, than it is to find the technical information.

#### ***d) Thumbnails of Media***

One interviewee commented that thumbnails hasten the searching process, and, together with full resolution images, are the basic requirements of an image website. At the Hubble Animations page, one informant asked: “Where are the thumbnails? Speed is an issue and downloading animations just to get a look at what it is like is a waste of time.” (Refer to Screenshot 2, the Hubble Informal Science Website, for an example of how thumbnails should be displayed and to Screenshot 3, the Hubble Public Affairs Animations page, for an example of the page without thumbnails.)

#### ***e) Multiple Resolution Options***

It is important to have the option of obtaining images in an array of resolutions, as most interviewees use images for a variety of purposes (e.g. planetarium dome, exhibit on science center floor, workbook of materials for teachers, postcards for visitors to take home). In addition, an icon denoting highest resolution available would save time by avoiding a search for a higher resolution version that may not exist. Several interviewees mentioned searching many databases and contacting staff at NASA to find a higher resolution version of an image, only to find that the image they had was the highest resolution available. (Refer to Screenshot 2, the Hubble Informal Science Website, for an example of multiple resolution options.)

#### ***f) Icon Denoting a Video Clip***

An icon denoting a video clip was another website feature that about a third of the survey

respondents found extremely useful. An interviewee from a large institution stated, “On displays we’ve found there’s a place for static images and text but based on our audience evaluations, video is a way to engage our visitors in a way that a slide show of stills can’t do. If there is a video clip, we go right for it.” Videos are of high value to these interviewees, and symbols that enable respondents to quickly locate videos are useful.

**g) Related Links for Each Subject**

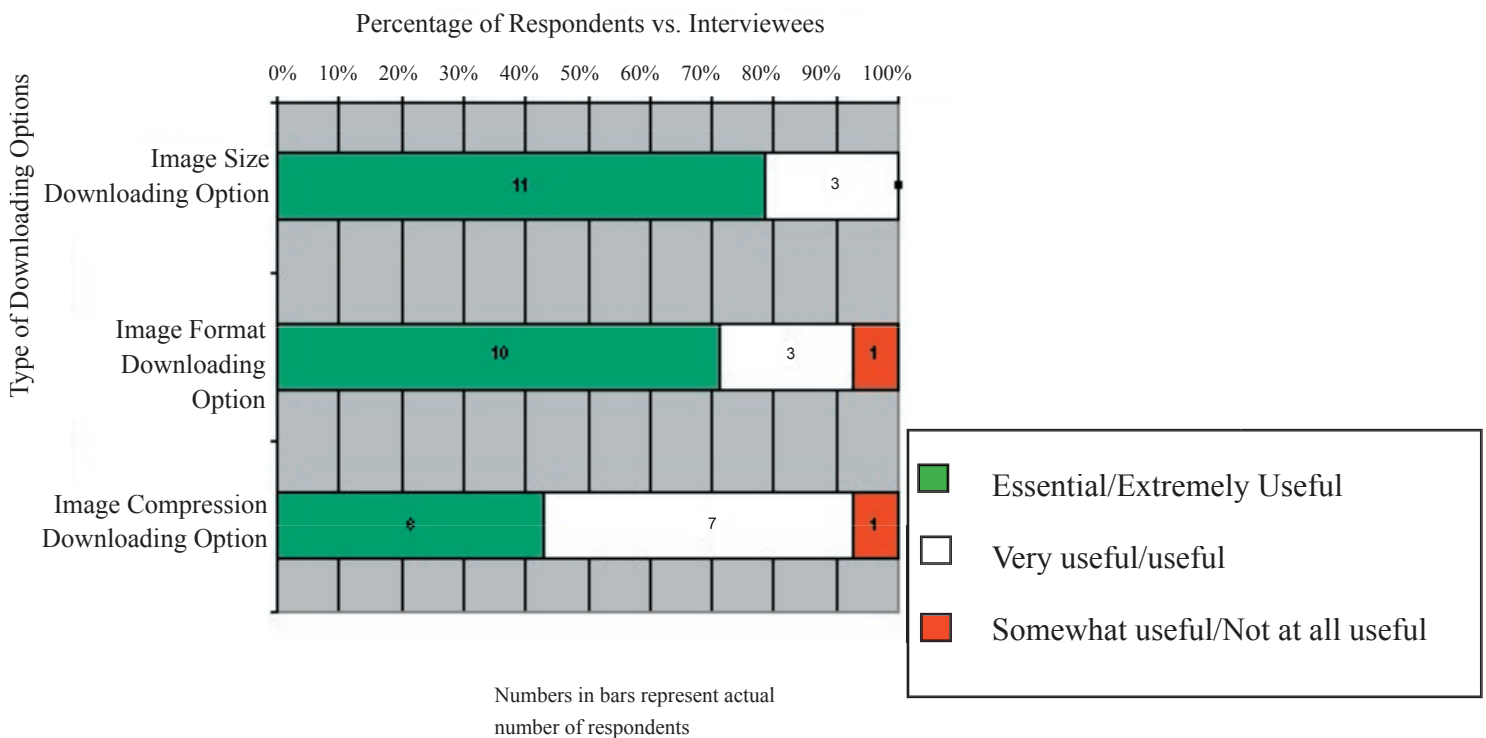
The difficulty of finding additional information on a topic seemed salient to many interviewees, and illustrates the importance of providing related links on each topic. One interviewee said that, “It’s nice to have more information just a few clicks away.” Providing related

links saves time for those staff working on a particular topic.

**h) Downloading Options**

The majority of interviewees use DSL or T1 lines to connect to the Internet, so the issue of image compression was not a major concern. Many interviewees said things like “I just click on an image and hope it downloads.” Images are most often downloaded in JPEG, GIFF and TIFF formats. While image compression is not particularly useful for images, one interviewee noted that it would be very useful for videos. “The amount of time I feel you’re going to save from a compressed to a non-compressed format is going to be taken by uncompressing it [the image] anyway. If it’s a video sequence, then that’s a different story because that’s

**Figure 4: Usefulness of Downloading Options**





time-intensive.” The large video files that must be compressed are intended for play on video monitors (as compared to small website animations, which are not compressed).

### *i) Additional Features*

Interviewees mentioned the importance of an intuitive and easy-to-use interface. The interfaces for Planetary Photojournal and NASA Image Exchange were noteworthy. Time is a major concern for science center

professionals; many do not have the time to figure out an interface that does not make sense to them. The layout for the National Space Science Data Center site (NSSDC) was described as “clean and simple” whereas the Planetary Image Atlas site prompted comments such as, “What am I looking at?” and “I am completely lost.”

Screenshot 1 shows the website features that were identified by interviewees as useful.

The screenshot shows a Microsoft Internet Explorer browser window displaying the Hubble Heritage Gallery of Images. The browser's address bar shows the URL <http://heritage.stsci.edu/gallery/galindex.html>. The website content includes a navigation menu with links for "Hubble Heritage Home", "Information Center", and "View All Images". The main heading is "Hubble Heritage Gallery of Images". Below this, there are five entries, each featuring a thumbnail image on the left and a list of links on the right. The entries are: DEM L 106 (December 5, 2002), NGC 6369 (November 7, 2002), NGC 4319 (October 3, 2002), Hoag's Object (September 5, 2002), and Gomez's Hamburger (August 1, 2002). Each entry's links include "Image homepage; big display; full-resolution tiff", "Descriptions of the object including facts and a caption", and "Biographies of the astronomers and supplemental material".

Annotations on the screenshot include:

- A box labeled "Image information, including why the image is of interest" with an arrow pointing to the first entry's text.
- A box labeled "Thumbnail" with an arrow pointing to the first entry's image.
- A box labeled "A 'Best of' gallery of images" with an arrow pointing to the main heading.
- A box labeled "Related links" with an arrow pointing to the list of links for the first entry.

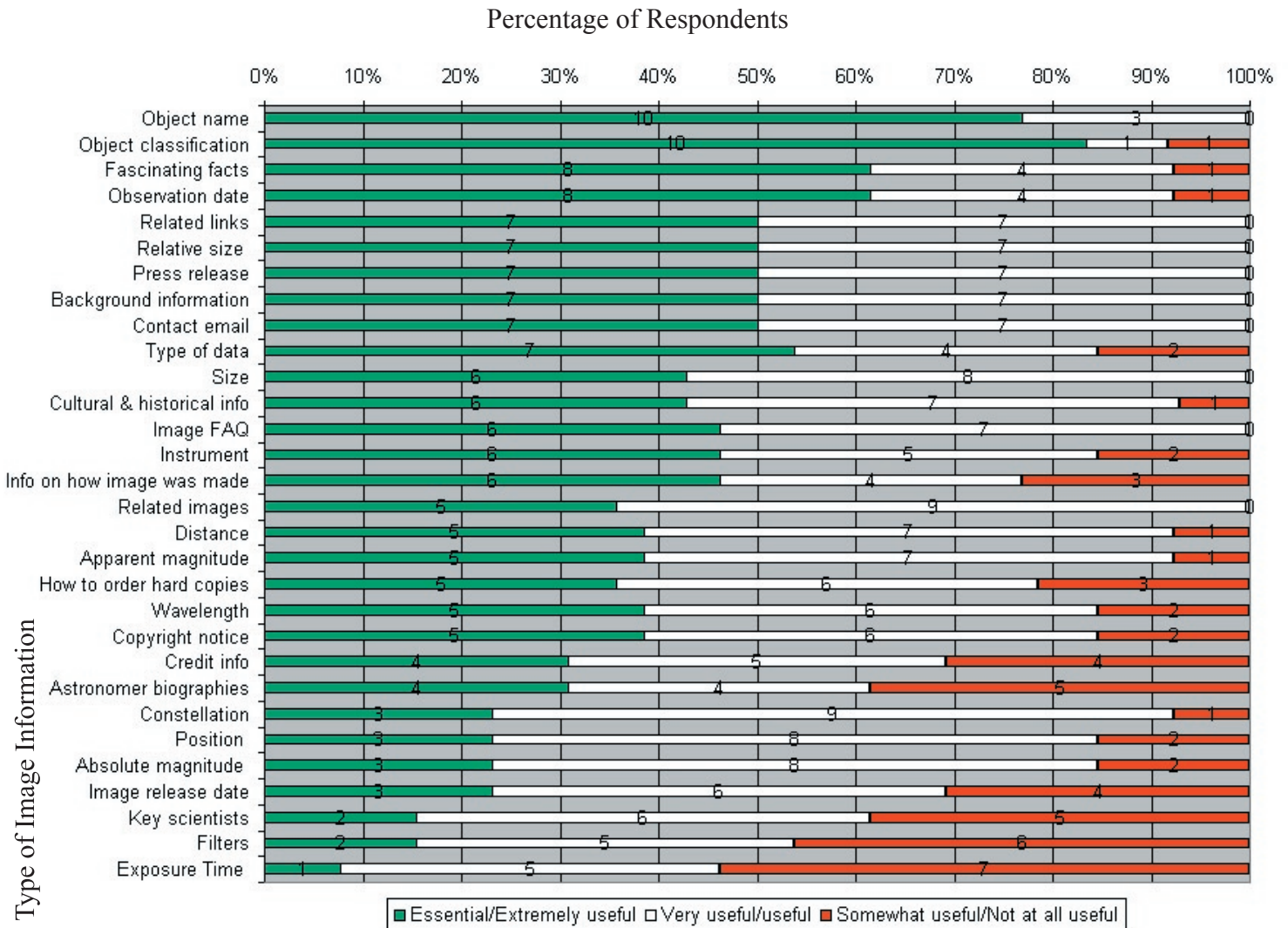
**Screenshot 1: This screenshot of the Hubble Heritage Website shows website content that interviewees identified as useful.**

### 3. Image Information

The web survey asked respondents to rate the usefulness of certain types of information that might be presented with an image. The responses to this survey item are presented in Figure 5.

Phone interviewees were not asked to elaborate on their ratings of the usefulness of various kinds of image information. However, some interviewees did discuss the usefulness of different types of information. One interviewee responded that he would like to see, “The date, for sure, because that is so important these days

Figure 5: Usefulness of Image Information



because things are changing so fast. Where it came from, what instrument. The patch of sky that we're seeing, too, is also important. For example, it's helpful when there's a caption going along with this image of the galaxy... describing the size of the galaxy or a cluster of galaxies, knowing the field of view and how wide a field of view we're looking at and seeing x number of galaxies in that field of view is pretty important too." Another interviewee stated, "On things like size, if you put on an arc field [angular scale], if you put on in a manner that you can't relate to, it's a lot less useful. If you said, this is ten or 100 of our Suns, that's useful, but even more useful is if you said the number of our Earths. It's so much more useful to have a relative base frame to go from. Otherwise, if I'm going to use that in a program, I'm going to have to research and figure it out for myself."

#### **4. Animation or Simulation Information**

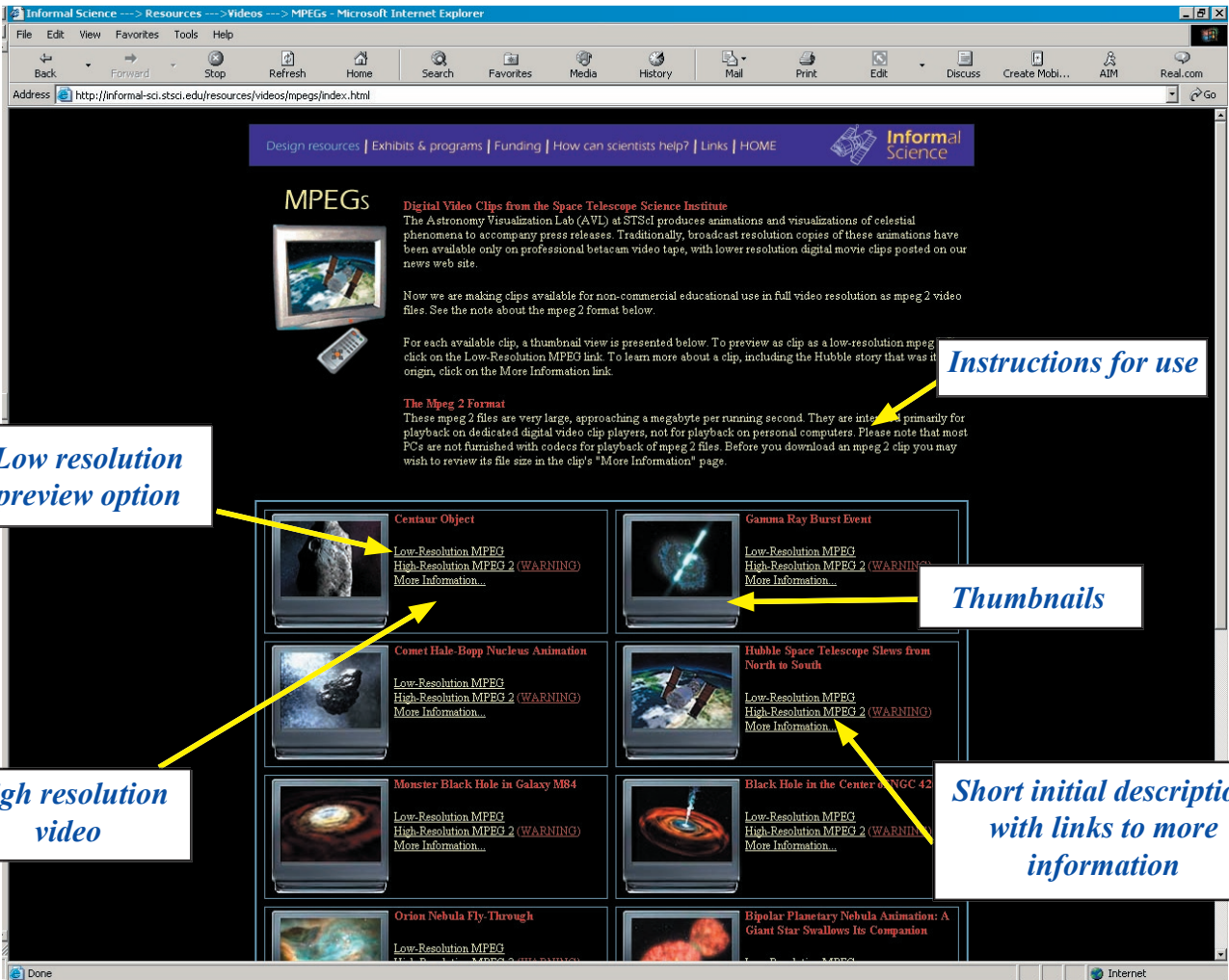
When viewing an animation or simulation, people most like to see a brief description of what they are watching, the date the images were taken, and like to have links to related information. When the animation is one of a series, one respondent advised including a short description of each. "In the past there have been a lot of times where there's been a series of animations on a topic and the topic might have been Supernova 1987 and then here are all these other great images with no other content. So it's like, that's a wonderful sequence, I wonder what that's trying to show...we see our job as really to a large extent to help tell NASA's story, so if there's a key issue or item that they feel should be stressed on a topic, associating that

with the media and saying, 'this connects to this theme which we think is really important,' that's great direction for us. We don't consider that stepping on our toes, we want to know what you (NASA) considers most important, what would you like the public to know about in terms of this particular mission or this particular image you're giving us."

When asked what information he would like to see accompanying an animation, one interviewee responded, "What's the big idea? What's the background information you need to know to understand it? Why is it important to anybody?" A third interviewee gave a similar response: "Obviously, we need all the basics, we need to know as much as we can about the resolution options, we want to know the copyright stuff, but it's also great to have a little explanation. Sometimes the animations are not always clear and obvious as to what we're seeing. Just a short blurb on content is usually enough." One idea that emerged is to include as a separate file, an audio clip explanation of the video sequence.

#### **5. NASA Space Science Websites**

The current state of searches within NASA sites has led many science center professionals to rely on a general search engine. One interviewee stated, "For a while, I did try search engines on NASA websites, but I wasn't as successful finding things with those search engines as I was with Google™ So, I've just kind of been in the habit of using Google™ ever since." Another stated, "When we're looking for NASA-related stuff, obviously, going to the JPL sites is one of our best. Hubble Heritage, a lot of great things there.



*Low resolution preview option*

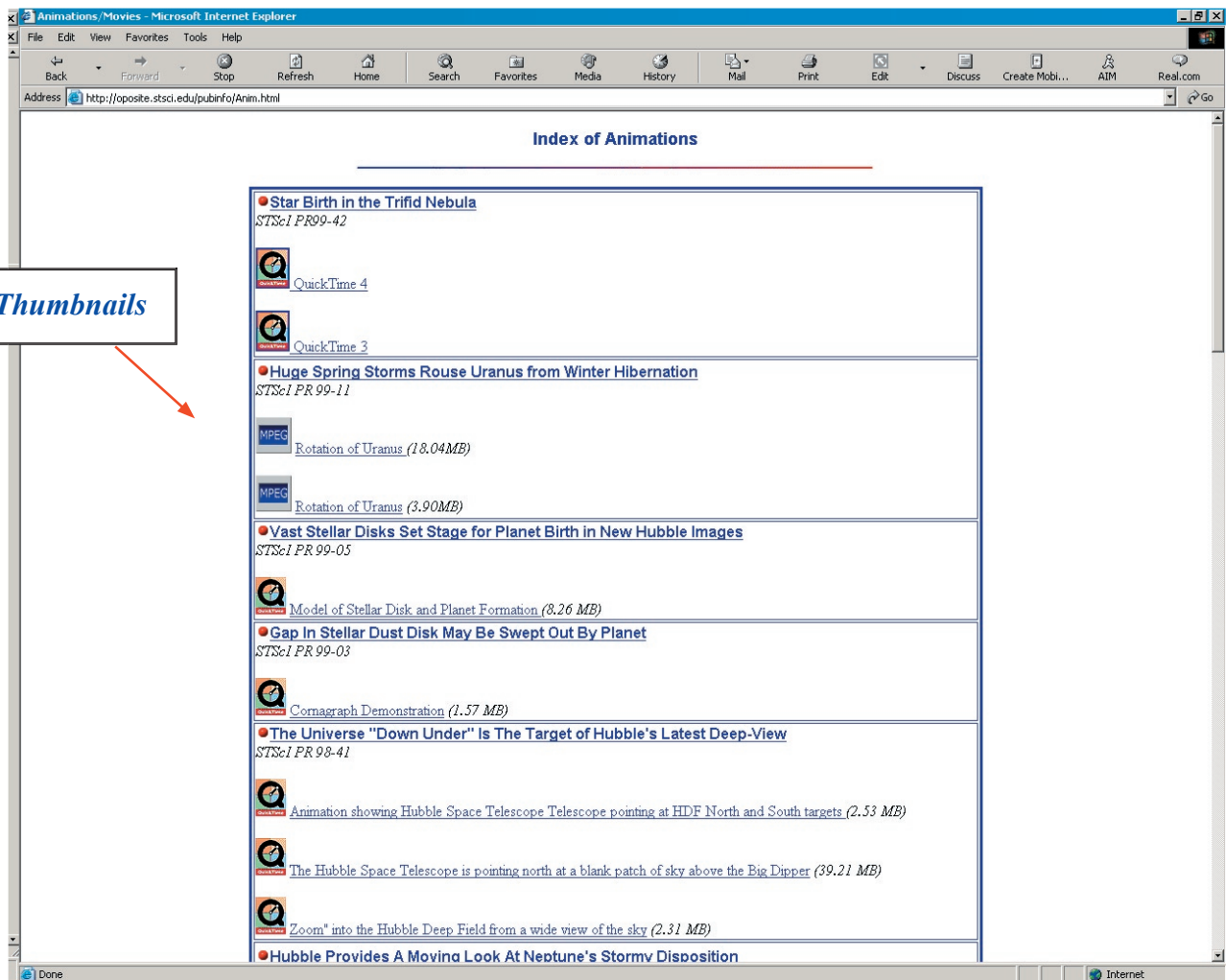
*Instructions for use*

*High resolution video*

*Thumbnails*

*Short initial description with links to more information*

*Screenshot 2: This screenshot of the Hubble Informal Science Website shows website format that interviewees identified as useful.*



*Screenshot 3: This screenshot of the Hubble Press Release Animation Archives shows a website that lacks thumbnails.*



But again, sometimes you never know where you're going to end up, in terms of where the best stuff is. Sometimes...someone else may located good materials on a NASA site and left a link saying 'you'll find great images here.' So I would say a substantial amount of the time we find things that way rather than just searching a NASA site directly, because it's not always clearly organized."

As part of Phase II, usability testing of various selected websites was conducted. We chose a variety of space science (including some non-NASA) sites to review during the Phase II interviews. We chose sites that feature images, videos, or information that science center professionals would find useful. We posed real work scenarios (for example: "Locate the first image of simultaneous auroras on the North and South Poles") to the Key Informants in order to obtain feedback about these websites. The websites we reviewed were:

## SOLAR SYSTEM

- NASA's Planetary Photojournal (<http://photojournal.jpl.nasa.gov>)
- Views of the Solar System (<http://www.solarviews.com/ss.html>)
- The Nine Planets (<http://www.seds.org/billa/tnp>)
- Planetary Image Atlas (<http://www-pdsimage.jpl.nasa.gov/PDS/public/Atlas/Atlas.html>)
- Solar System Simulator (<http://samadhi.jpl.nasa.gov>)

- PDS Mars Explorer (<http://www-pdsimage.wr.usgs.gov/PDS/public/mapmaker/mapmkr.htm>)

## GENERAL ASTRONOMY

- Hubble Space Telescope (<http://oposite.stsci.edu/pubinfo/pictures.html>)
- Animations from Hubble Space Telescope (<http://oposite.stsci.edu/pubinfo/Anim.html>)
- Hubble's Videos and Immersive Visualizations (<http://informal-sci.stsci.edu/resources/videos/index.html>)
- Chandra Photo Album (<http://chandra.harvard.edu/photo/>)
- Animations from Chandra X-Ray Observatory (<http://chandra.harvard.edu/resources/animations/index.html>)
- Astronomy Picture of the Day (<http://antwrp.gsfc.nasa.gov/apod/astropix.html>)
- Infrared Images (<http://www.ipac.caltech.edu/Outreach/Gallery/IRAS/irasgallery.html>)

## SUN-EARTH CONNECTION

- Solar and Heliospheric Observatory (<http://sohowww.nascom.nasa.gov/gallery/>)
- SOHO movies: (<http://sohowww.nascom.nasa.gov/gallery/LASCO/>)

- Comprehensive List of Sun-Earth Connection Image Resources (<http://sunearth.gsfc.nasa.gov/edmulti.htm>)
- IMAGE Gallery: (<http://image.gsfc.nasa.gov/gallery/>)
- Yohkoh Solar Observatory Images of the Sun (<http://www.lmsal.com/SXT/Eimages.html>)

#### OTHER USEFUL SITES

- NASA Space Science Portal (<http://spacescienceportal.org>)
- National Space Science Data Center's Photo Gallery ([http://nssdc.gsfc.nasa.gov/photo\\_gallery/](http://nssdc.gsfc.nasa.gov/photo_gallery/))
- NASA Image Exchange (<http://nix.nasa.gov/>)
- Great Images in NASA (<http://grin.hq.nasa.gov/>)

Of the sites we reviewed during our key informant interviews, the sites with the most desirable qualities included:

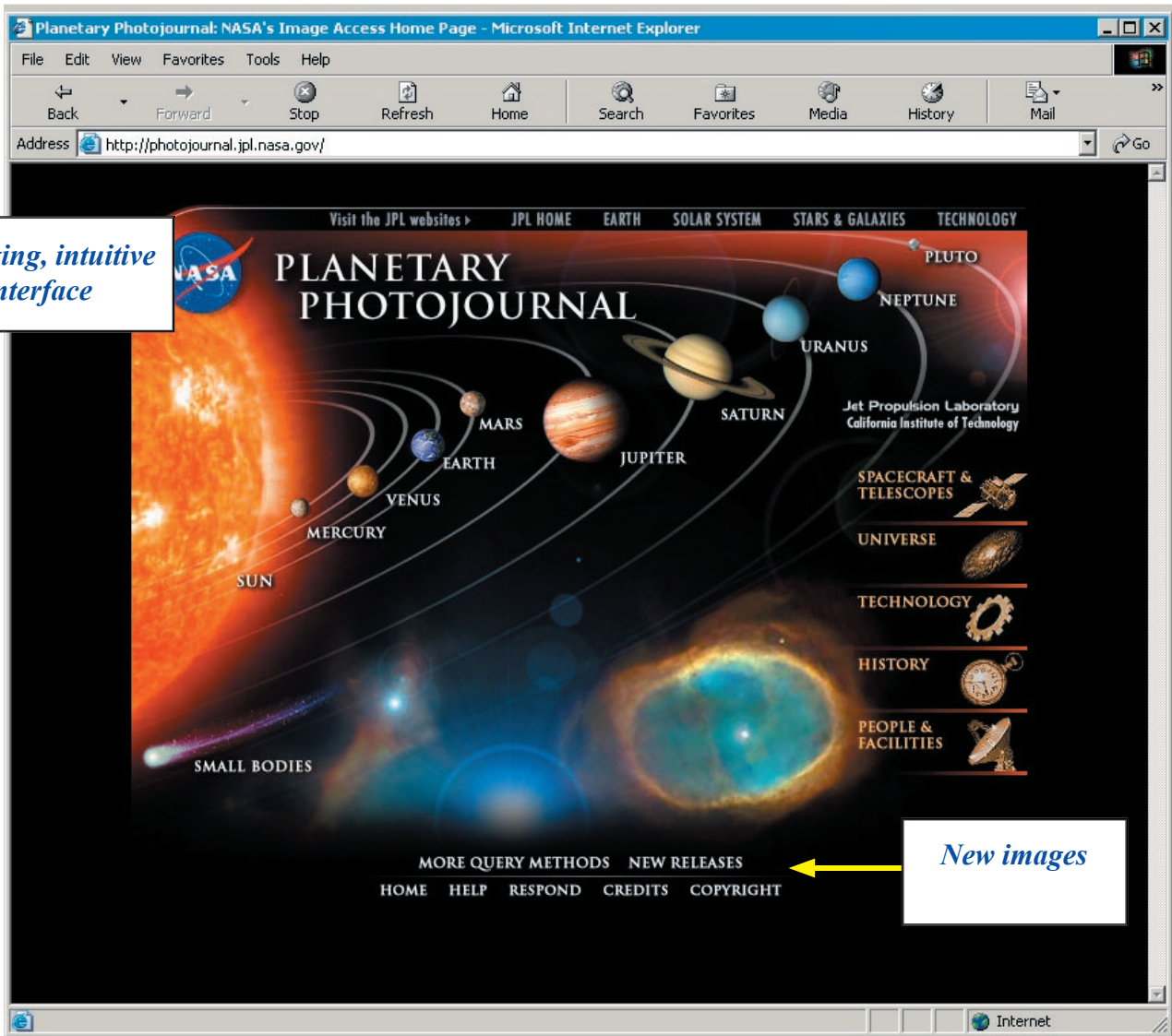
- Planetary Photojournal (<http://photojournal.jpl.nasa.gov>), because of it has an easy-to-use interface and a clear presentation of search results (Refer to Screenshot 4, the Planetary Photojournal, to see an example.)
- NASA Image Exchange (<http://nix.nasa.gov>), because it has search and browse options on the first

page, accesses several databases and denotes videos with an icon. However the NASA Image Exchange does not contain many space science images and also lacks full resolution images.

- The Nine Planets (<http://seds.lpl.arizona.edu/nineplanets/nineplanets/nineplanets.html>), because it provides an abundance of basic information about the planets along with historical and mythological background.

Phone interviewees listed several additional websites as favorites: Hubble Heritage and other Hubble sites, JPL sites (in addition to Planetary Photojournal), and the “NASA homepage.” When asked for the URL to clarify which of the JPL sites to which they referred, for example, it became clear that interviewees tend to group sites by mission (such as Hubble), NASA Center (such as JPL), or just “NASA” but do not always distinguish between the many sites of a mission, a Center, or even NASA.

Concerns about sites ranged from too few high resolution images to getting lost in the extensive list of space science sites. Changes to current sites would improve their usefulness. Our research team will share the feedback on individual sites with the web curators of those sites.



*Screenshot 4a: This screenshot of the Planetary Photojournal shows a web interface that interviewees identified as useful.*



Catalog Page for PIA03162 - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites Media History Mail

Address http://ppj2.jpl.nasa.gov/catalog/PIA03162


Visit the JPL websites > JPL HOME EARTH SOLAR SYSTEM STARS & GALAXIES TECHNOLOGY

NASA PLANETARY PHOTOJOURNAL

-Select an Image Gallery- GO

Jet Propulsion Laboratory  
California Institute of Technology

PIA03162: A Change of Seasons on Saturn - October, 2000



Target Name: [Saturn](#)

Is a satellite of: [Sol \(our sun\)](#)

Mission: [Hubble Space Telescope \(HST\)](#)

Spacecraft: [Hubble Space Telescope](#)

Instrument: [Wide Field and Planetary Camera 2](#)

Product Size: [3000 samples x 1500 lines](#)

Produced By: [Space Telescope Science Institute](#)

Producer ID: [STSCI-PRC01-15E](#)

Addition Date: [2001-07-20](#)

Primary Data Set: [Space Telescope Science Institute](#)

Full-Res TIFF: [PIA03162.tif \(5.81 megabytes\)](#)

Click on the image to download a moderately sized image in [JPEG](#) format (possibly reduced in size for conversion).

**Original Caption Released with Image:**

Looming like a giant flying saucer in our outer solar system, Saturn puts on a show as the planet and its magnificent ring system nod majestically over the course of its 29-year journey around the Sun. A series of Hubble Space Telescope images, captured from 1996 to 2000, show Saturn's rings open up from just past edge-on to nearly fully open as it moves from autumn towards winter in its Northern Hemisphere (for the composite view of all images see [PIA03156](#)).

Saturn's equator is tilted relative to its orbit by 27 degrees, very similar to the 23-degree tilt of the Earth. As Saturn moves along its orbit, first one hemisphere, then the other is tilted towards the Sun. This cyclical change causes seasons on Saturn, just as the changing orientation of Earth's tilt causes seasons on our planet. The first image in this sequence, on the lower left, was taken soon after the autumnal equinox in Saturn's Northern Hemisphere (which is the same as the spring equinox in its Southern Hemisphere). By the final image in the sequence, on the upper right, the tilt is nearing its extreme, or winter solstice in the Northern Hemisphere (summer solstice in the Southern Hemisphere).

*Features images from many missions*

*Download in TIFF, GIF, JPEG, and PICT formats*

*Full resolution image*

*Explanatory text*

*Screenshot 4b: This screenshot of the Planetary Photojournal shows search results that interviewees identified as useful.*

## 6. The NASA Space Science Portal Website

To assess the effectiveness of the NASA Space Science Portal site as a resource for science center professionals, each participant in the key informant interviews was asked to provide feedback on the section of the site pertinent to media. Each visited the Resources page of the site and was asked for their first impressions. In addition, each informant was asked to complete a task starting from the NASA Space

Science Portal Resources page. Examples of tasks included: (1) find information on the comet that crashed into Jupiter in the late 1990s and find images of the comet fragment collisions, and (2) find an image of a spiral galaxy that has been in the news.

General impressions of the site were, for the most part, negative. Many of the informants complained of seeing “too much text” and being “overwhelmed with information.” Not only was there too much text, many commented

The screenshot shows a web browser window displaying the NASA Space Science Portal. The browser's address bar shows the URL: <http://mo-www.harvard.edu/spacescienceaccess/resources.htm>. The page header includes the NASA logo and the text "SPACE SCIENCE PORTAL BRINGING THE UNIVERSE TO MUSEUMS AND PLANETARIUMS". Below the header, there are navigation links: "NASA SPACE SCIENCE RESOURCES", "PROJECT SHARING", "BEST PRACTICES", and "evaluate this site". The main content area features a section titled "NASA SPACE SCIENCE RESOURCES" with a paragraph of text and a list of categories: "education resource directory", "images and animations", "space science news", "exhibits", "planetariums shows", "programs", "web activities", and "people". A small image of a space scene is visible on the right. The browser's status bar at the bottom shows "Done".

**Improvement Needed: Space Science Portal**

**Headings and text too small, too much text**

**27 links to read and at least 3 clicks before image search can begin**

**Screenshot 5: This screenshot shows a web interface requiring improvements in order to be useful.**

that the “headings should be larger” and the “text [is] too small.” Several informants had issues with the content and organization of the site as well. The site has “no search feature” and “not all of the headings make sense.”

The participants became frustrated with the Resources page. One major frustration was the depth and complexity of the site: “This is the problem, ‘images’ gives you five sites.” One informant noted that after clicking on one of those five links, ‘NASA Space Science Images’ takes you to an additional 27 links in four different categories. Essentially, when starting at the Resources page, a person is three clicks away from a site where an image search can even begin. Many became “lost” as they tried to find a link that would lead to a page they could use to find information relevant to their task. Fewer than half of the key informants were able to complete their task starting at the NASA Space Science Portal Resources page. When participants appeared visibly frustrated or made a statement such as “[I am] out of patience,” they were asked to complete the same task using whatever resources they would typically use. Most proceeded to complete the task quickly and easily using a Google™ keyword search.

For a site such as the Resources page on NASA Space Science Portal to be of use to science center professionals in their search for space science media, the site needs to be much more intuitive and faster to navigate. Organizing information by category is helpful, but too much depth and too many options simply waste time. One link for each of three or four categories that provides images and

animations would be a quick way to serve the needs of a majority of media searches. Categories might include “Solar System,” “Galaxies and Beyond,” and “Miscellaneous” with representative sites being JPL’s Planetary Photojournal, Hubble Space Telescope site, and the NASA Image Exchange, respectively.

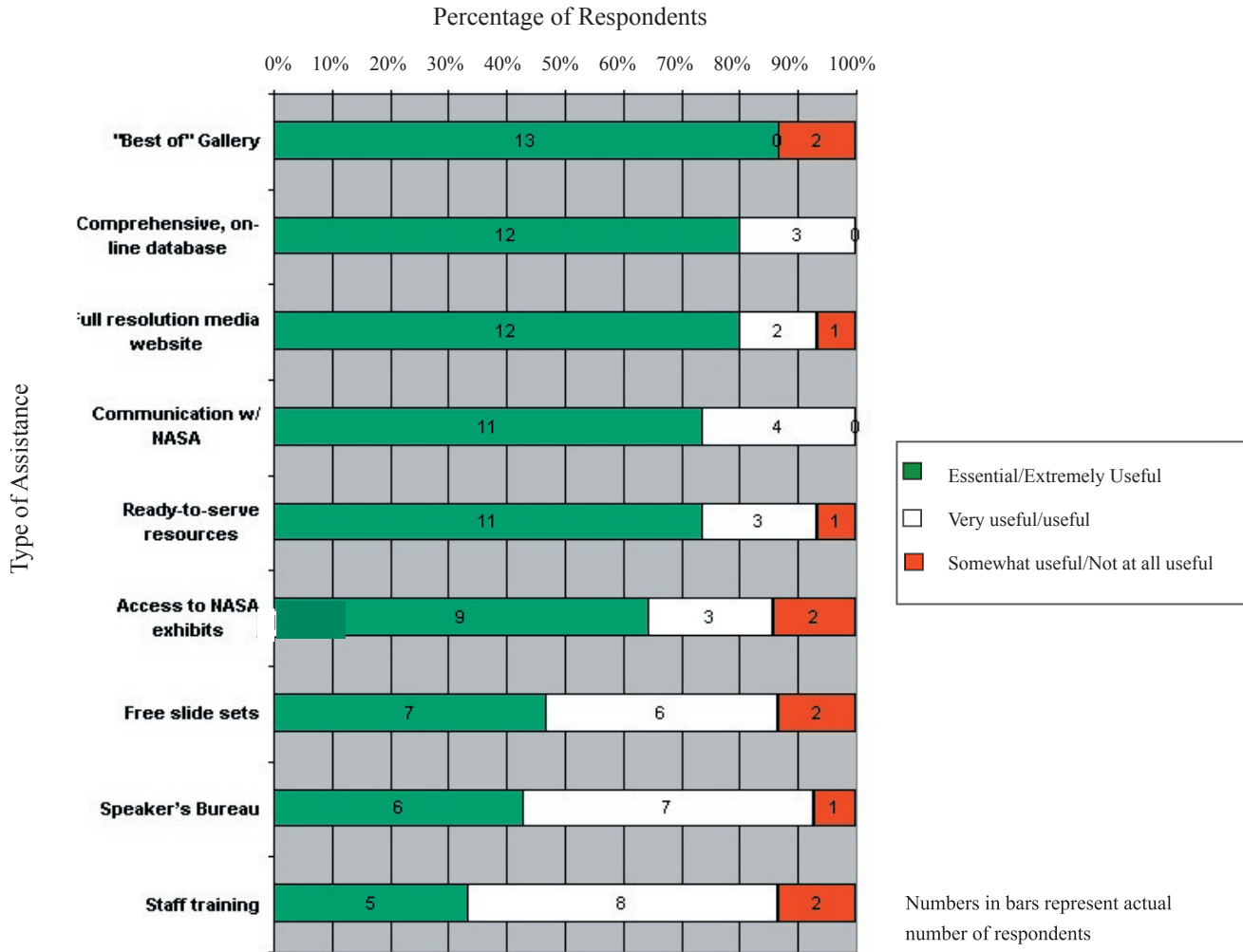
There were a few positive comments about the site. Two interviewees commented that the site “looks useful; [it has] many NASA sites together” and that it is “perfect for non-space professionals.” The “Best Practices” and “Project Sharing” headings intrigued many of the informants, although those sections were not explored since our research was focused on media.

## ***B. Other Types of NASA Assistance***

In order to discuss the relative priority of improving space science websites, we asked the interviewees to rate the usefulness of a variety of types of assistance (including websites) that NASA could provide them in preparing their institution’s products, programs and events. Respondents were asked to rate each according to how useful it is in ultimately presenting space science to their audiences. Responses are presented in Figure 6.

Overall, interviewees found all of the types of assistance to be useful. At least one-third of the interviewees rated each type of assistance as essential or extremely useful. A space science media website featuring a gallery of “the best” media, a comprehensive searchable online database, and a website with full resolution space science media were rated as

**Figure 6: Usefulness of NASA Assistance**



the most useful types of assistance, followed closely by increased communication with NASA, ready-to-serve resources for use in planetariums, kiosks, or on the science center floor, and access to low-cost NASA exhibits. Respondents were hesitant to say that any type of assistance would not be useful at all.

### 1. Space Science Media Website(s)

An interviewee from a large institution said, “The online database is really essential, because we would use it daily. The most important thing is a well organized, easily accessible media database, everything all

together.” Another interviewee stated, “The more the better, because we’re looking for different purposes. If we’re trying to generate ideas and angles and make sure to show topic divisions and have stuff to take back to our focus groups and stuff like that, the more we can sort through the better. We’re really looking for both those options to be available.” Many of those interviewed stated that the existence of an online searchable database of space science media would make their jobs easier and would save them time. An interviewee at a mid-sized institution said, “We use the website so extensively that the



more the websites come in line so you can easily move from one area of the organization to another and have similar kind of searches and similar kinds of content would be a huge help.” One interviewee summed this up by saying, “all of the information is out there; it is just a matter of finding it.” Several commented that, by saving time and providing high quality images, a database could improve both the quality and quantity of space science related products and programs produced at their facilities.

## **2. Communication with NASA and Professional Development Opportunities**

Although interviewees did not rank “training for your institution’s staff” as a high priority in the web survey, it became clear during the follow-up phone conversation that science center professionals consider various types of contact with NASA to be essential. In particular, our interviewees discussed: NASA mission personnel providing access to full resolution images, workshops wherein science center professionals meet directly with mission scientists and technicians, professional development workshops at professional society meetings, and one-on-one dialogues with NASA informal education leads.

Establishing contacts with key personnel at NASA was a topic that many interviewees emphasized. “We try to develop relationships with NASA whenever we can. We’re very active in many of the educational programs, the Solar System Exploration’s Explorer programs, we’ve been involved in several

different missions, and we’ve done shows with NASA before. What we find though, like any big organization, NASA is constantly changing, and there is really no single place for us to go for information. So it becomes a constant effort to keep a contact, to know somebody you can give a call to and find out what’s the latest data and what’s out there. And so I spend a lot of time doing that, trying to find out who’s the good video person to get a hold of, who’s got the best information on this particular mission or that mission. Of course, a lot of that stuff is starting to show up online, so that’s good, that makes life easier, but that doesn’t replace being able to get a hold of somebody...sometimes just a few minutes of someone’s time to direct you where you need to go or to send you better copies. We’re not necessarily looking for someone to explain images or research to us, we’re pretty good on that end, but it’s a question of getting a hold of the latest and greatest images in whatever format they may be.”

One interviewee pointed out the impact that exposure to space science researchers and technicians could have. “We have good people and we know our stuff and we do a lot of research but when you get a little bit of time from the people who are actually doing the project, it gives you a whole different perspective. Sometimes they point out things that you haven’t even thought of. And those are the most powerful things. My staff comes back from one of these sessions and say, ‘I had a chance to sit down with this technician or this scientist who is working

on this project and he or she said this, and boy, I hadn't even thought of that.' Now that becomes part of what we do, because we do not only our shows and it gets into there but we do classes and workshops and all of those things, so that goes a long way."

Regarding training, an interviewee at a large institution responded, "Better communication is most important. Training is the second most important. Almost anything NASA does, providing those opportunities, you have a lot of reach. You train a handful of people in the planetarium field and you're going to reach big numbers." Another interviewee said, "I just participated in NASA's workshop for museum educators [NASA's workshop at the International Planetarium Society Meeting] and it was the biggest shot in the arm I've had in a long time. I hope NASA will continue to do that. Museums touch so many people. We're a small museum and we touch a million people a year."

### **3. Ready-To-Serve Resources**

Interviewees from science centers of all sizes reported using a variety of types of raw and ready-to-serve resources for a variety of purposes. Interviewees reported using images for everything from creating postcards to projection onto a 50-foot planetarium dome. Therefore, multiple size and resolution options for media are useful for them. Most people use a combination of raw and ready-to-serve materials. Ready-to-serve materials are helpful when producing classroom activities or workshops for teachers. The interviewees who worked with teachers are also concerned that resources align with science curriculum

content standards. Three or four interviewees also mentioned purchasing pre-made planetarium shows.

A few interviewees spoke to the needs of classroom teachers. One interviewee serving a school district commented, "When I was doing the Solar System Ambassadors program, I received a bunch of postcards, they happened to be the moons of Jupiter, and I put them out at my public shows and people just loved them. They love the pictures, and I realize that there is a cost on NASA's part getting the nice, suitable-for-framing images, but just the small ones, the postcards, they really liked those, something that they can take home with them. Teachers like to have that to pass out to their students. Things that can be distributed to the public with explanatory text on the back." The text should provide explanation appropriate to the image (e.g., what is the significance of this particular image).

Another interviewee mentioned that posters or items on NASA letterhead make the connection between NASA and their institution more visible, which was valuable to them. "If they (the public) sees posters from NASA, or hard copies on letterhead, it makes a difference [in how we are perceived.]" Another interviewee, at a larger institution said, "We have good computers, technology, but the teachers, who have computers in their classrooms, have no time to use them. When we do teacher workshops, they have no idea of the things they can do on their computers; they lack computer savvy. They all know how to play a video or put up a poster."

#### **4. Access to Low Cost Exhibits**

In addition to increased communication with NASA and training opportunities, interviewees also spoke to the importance of exhibits. An individual from a small institution said, “The best thing they could provide me with would be clean active exhibitry they loan out to me, but beyond that, good, sound programmatic activities would be nice.” For small planetariums, access to low cost NASA exhibits is extremely useful. One example cited was Hubble’s ViewSpace. “There is an ongoing exhibit that the Space Telescope Science Institute produces that the images are provided by NASA, and is essentially a “best of the best” set of images. NASA produces this exhibit and the only requirement for a planetarium is to provide the equipment, and NASA provides the actual images and story lines. Something like that, low cost with fantastic images, a simple story, is perfect for the general public.”

#### **5. Speaker’s Bureau**

A NASA’s speaker’s bureau, while not essential, was rated as extremely useful or very useful by nearly half of the interviewees. One interviewee said, “Another useful thing is speakers. We think it’s really important for us to be able to tell the NASA story and do a lot of that interpreting, but it’s great to get a hold of the people who are actually doing the research and working the missions, who also feel comfortable about getting up in front of an audience and talking.” Two interviewees were unaware of the existence of the NASA Speaker’s Bureau, and a few others felt their

geographic or financial situations limited their ability to utilize this resource.

At the end of each telephone interview, interviewees were given the opportunity to provide additional comments to NASA. Many interviewees noted the work of John Stoke, the Hubble Informal Education Lead, Anita Sohus, JPL’s Informal Education Lead, the Office of Space Science’s Education Forums and Brokers, and NASA in general.

## **C. Recommendations**

This research explored how NASA's Office of Space Science could best address science center professionals' space science media needs. Interviewees expressed frustration at navigating the maze of NASA space science sites. Some requested that NASA create one website to provide "one stop" access to space science media. Others suggested that NASA streamline the various existing websites, allowing users to easily move from one to another, with similar kinds of searches and similar kinds of content on each site.

NASA Office of Space Science and the space science missions have the opportunity to serve the media needs of the science center communities through various solutions that include enabling comprehensive access to space science media (contained in Section 1, below), and the implementation of limited improvements in both design and content of existing NASA media websites (contained in Section 2, below). Regardless of scope, any sustainable response to the media needs expressed by this community will require NASA to develop a standard set of metadata for space science media. The following recommendations take into consideration existing NASA resources and capabilities.

### **1. Recommendations for NASA's Office of Space Science**

We explored two approaches to providing one stop access to space science media. The discussion of these approaches follows.

#### ***One Stop Access to Space Science Media Through a Centralized Approach***

"One stop" access to space science media could be accomplished through a centralized approach, which would require space science media archives to submit, or register, their media onto a central database that would have to be managed and curated by a NASA Center or NASA-sponsored organization. Science center professionals would then be able to go to one website and use a single search interface to obtain space science media. This approach would require extensive resources to set up, plus additional ongoing resources for maintenance and coordination. One of the difficulties of such an approach is consistently obtaining submissions from the various organizations involved. Another drawback to this approach is that curators of a centralized database would potentially be far from the missions, resulting in a delay in featuring current media.

#### ***One Stop Access to Space Science Media through a Federated Approach***

Another type of "one stop" access could be accomplished through middleware that integrates federated, distributed, and autonomous space science media archives. Metadata standards would be implemented locally within each space science mission and media archive. A single search interface would provide one stop access for the user. The advantage of this approach, which mimics the proposed architecture of the National Virtual Observatory, would be that the user would be accessing the media, in a transparent fashion, from the distributed archives. The fact that our interviewees prioritized access to current



images, videos, and associated information, points to the space science missions as the most appropriate and timely providers of this information, since much of the associated information that the science center community requires is best developed close to the missions, researchers and data. Another advantage to a federated approach is that the missions would be responsible only for maintaining their own archive, versus submitting entries into a centralized database. While this approach allows more of the media to be available to users, it will require buy-in from the missions to adhere to metadata and other protocols. We believe a federated approach would be more fruitful than a centralized one.

Only a subset of space science media is at a technical and/or aesthetic level suitable for, and appealing to, public audiences. Our interviewees identified a “Best of” gallery of media, featuring the most current, most unusual, most aesthetically pleasing, most popular, etc. media, as very high priority. We therefore recommend that the implementation of a federated approach begin with the development of distributed “Best of” galleries. This would avoid attempting to retrofit every existing space science media archive in a comprehensive manner. Furthermore, the metadata protocols resulting from the development of “Best of” galleries would allow any newly developed media to be accessible using the same federated architecture. Rapid prototyping of “Best of” galleries would allow quick definition of metadata and would be implemented within each media archive. A common search interface that integrates these federated archives could be implemented

using middleware developed by the National Virtual Observatory.

To develop the metadata standard, and “Best of” galleries, we recommend involving the following groups:

- Science center professionals
- Representatives from NASA missions who work closely with the media (this may include science visualization staff)
- National Virtual Observatory metadata development group
- Hubble Heritage Team and Hubble Informal Science Team
- JPL Planetary Photojournal Team
- National Space Science Data Center (NSSDC) Team
- NASA Image Exchange Team
- NASA Space Science Museum, Science Center and Planetarium Working Group
- NASA Earth Observatory Team

NASA Office of Space Science should also develop a tutorial on resolution and format, written with the specific job tasks of museum educators in mind. The Space Telescope Science Institute’s Informal Science Team is working on such a tutorial. NASA Office of Space Science should ensure that the resultant tutorial is posted on all NASA space science media websites.

Finally, while this research was primarily designed to address the media requirements of science center professionals, NASA Office

of Space Science should continue to invest in the science centers and in their professional organizations. One interviewee reflected, “I would encourage you to continue the formal links. The one-on-one with the planetariums and making those contacts are great, but it’s also great to just have a presence at an International Planetarium Society conference; that’s the first time I’ve ever seen that. Usually it’s just one or two NASA people. I lost count of how many NASA people were there; it was awesome and keep doing that too. Because if you work with our formal organizations, people will get the message.”

NASA personnel who have worked extensively with this community also point to the need for professional development of science center professionals. For example, for the upcoming Mars Landers, one NASA lead said, “the museum educators need to get up on the curve so that they have the background necessary when the news comes. We are thinking of establishing letters of commitment with museums, for some to be NASA’s voice at museums, to be alert to opportunities...we want a real relationship with them. They are also requesting synthesis, what does it all mean? This points to the need for professional development of this community.” Those professionals who have worked in both informal education and NASA echoed the need for more professional development of these educators.

One science center professional who has worked with NASA for many years, said, “I would love to communicate that this is a great thing, I’m glad that you’re doing this kind of

stuff, this research is being done. Clearly, we’ve seen some motion in the last couple of years. We love NASA, we really do. We’re the true believers but for a long time we were out in the wilderness because education was not a high priority for NASA and it’s great to see the change and it’s great to see that you’re worrying about things like this.”

## **2. Recommendations for NASA Space Science Missions**

We recommend that NASA space science websites consider revisions that will make their sites more useful to this community.

These include:

- Implement site search functionality on space science websites. Include an ability to search by target, keyword, mission, and subject. Missions could explore implementing Google™’s free “SiteSearch” service for educational websites that currently lack site search functionality. (Google™’s SiteSearch is free to educational websites and enables users to search the websites. It is also provided without advertisements and includes web traffic reports.) Missions should recognize, however, that the Google™ search would not be as useful as a site search developed with their particular website content in mind.
- Include an icon denoting full resolution media. If the media is not at full resolution, include information on how to obtain the full resolution media.
- Upgrade websites to include thumbnails

of images and videos.

- Where possible, add text written at a level suitable for the public as well as related links for each image or video.

In addition, we recommend that space science missions create new content designed with science center professionals in mind, using as models the exemplary web content cited in this research. One key element of creating new content will be to partner with science center professionals in the development process to ensure an end product that will be used. New content would include:

- Participation in the development of metadata protocols and implementation of a “Best of” Gallery for their media (see Section 1, above.)
- Development of current media products, in high or full resolution (with thumbnails for both images and videos, and low resolution preview options for videos).
- Video sequences, as well as video for electronic displays, using the Hubble Informal Sciences’ ViewSpace as a model. The Hubble Informal Science team is experienced in creating these videos, and including simple, engaging text on the “big idea” featured within the video.
- Resources that “hook” the public’s interest in space science through ties to culture and history
- Resources that allow the public to explore 3D data sets

We recognize that the implementation of these recommendations will be contingent on the availability of website resources and the priorities of the space science missions.

Finally, one service that emerged as important to these interviewees is early access to press releases, with associated images. The Hubble mission provides this service, and was cited as a model. However, as we explored the Hubble embargoed press release service, we learned that Hubble had received fewer subscriptions to this service than anticipated. Possible causes for the low subscription rate could include: difficulty in signing up for the embargoed press release service (the service requires an application and signed letter of agreement), lack of awareness, or lack of time on the part of the science center professionals. We recommend that the Hubble Informal Science Team try to identify the cause of this low subscription rate, since our interviewees indicated that such a service would be very useful to them. If the cause is the difficulty in the sign-up process, the Hubble team should modify the entry point to this service accordingly. If Hubble is able to achieve success, NASA Office of Space Science should consider how to broaden this service to all of space science. This may require coordination with NASA’s Public Affairs Officers at the Centers, Missions, and NASA Headquarters.

### **3. Recommendations for the Space Science Portal Site**

During Phase II of our research, we conducted usability testing on the Space Science Portal site. Recommendations that emerged from

this research include:

- Reduce the amount of text on the “Resources” page.
- Provide links to three or four robust sites that provide images and videos. This would be a quick way to serve the needs of a majority of media searches.
- Include the remaining media sites under one heading, which would provide the novice with a more comprehensive, annotated list of websites to explore.
- Add links to other space science news services (such as spaceweather.com), “Hot Topics,” and access to scientific expertise. One suggestion for “Hot Topics” for planetary research is the Planetary Science Research Discoveries site: <http://www.psr.d.hawaii.edu/>
- Add links to key space science personnel associated with the missions. We will work with the space science support network and science center professionals to identify which personnel should be listed. The list may include NASA Informal Science Leads, mission science visualization and multimedia staff, and mission education and public outreach leads.

We will share our results with the Space Science Portal website team. We suggest that creating very simple, rapid prototypes for the site and testing them with science center professionals would be an effective way of refining the interface and increasing the usefulness of this site. One site that should be

a reference point for the Space Science Portal is the Earth Observatory. This site contains many of the features important to science center professionals, and was pointed out by an experienced professional as “the best NASA site.”

## **V. Appendices**

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- A. Key Informant Protocol
- B. Pre-phone Interview On-Line Survey
- C. Phone Interview Protocol
- D. Participant List
- E. Institution List
- F. List of Websites Reviewed

## **A. Key Informant Protocol**

AMERICAN INSTITUTES FOR RESEARCH

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Usability Test Laboratory

### **NASA Sun Earth Connection Education Forum Usability Test**

Participant ID goes here

## Introduction

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### Session Process

- Session = 1.5 hours
- Participant is the **Evaluator**
  - ◆ **We'll ask you to tell us about how you locate and use space science related information and media on the world wide web.**
  - ◆ **Then we will look at some specific websites to get your feedback.**

### Information on Program

- Purpose of site and testing
  - **As you know, we're here to learn more about how space science related information and media are located and eventually used in programs and exhibits at [institution].**
  - **For our purposes, information and media refer to digital media such as images, animation, and simulations that are available on the world wide web, as well as the captions, background information, and other data associated with such media.**
  - **Your perspective and feedback will help inform NASA as to how they can present information that is useful for staff at places like [institution].**
  - **As you perform these tasks, we would like you to share your thoughts with us. That is, we would like you to think out loud.**
  - **During the session, and at the end of the session, we will ask you several more questions to get further feedback from you.**

**☐ Past, Present, or Future Products or Programs**

- **I'd like to find out about a few products or programs that incorporated space science that you have worked on recently. Can you tell me about a few of them?**

FOR EACH PRODUCT OR PROGRAM, ASK:

- **Target audience of the program?**
- **What was your role?**

**☐ Methodology**

SELECT ONE COMPLETED PRODUCT OR PROGRAM MENTIONED ABOVE.

- **What was your approach to [name of product]? That is, how did you go about designing this and getting the materials that you needed?**
- **What problems did you have to overcome, with respect to getting the materials that you needed?**
- **How did you decide what materials to use?**
- **Did you obtain any information or materials through the internet? IF YES: Tell me about it. For example, what web sites did you visit?**

FOR EACH SITE MENTIONED:

- ◆ **How did you find out about this site. IF A SEARCH ENGINE WAS USED: Which keywords or phrases did you use in your search?**
- ◆ **How useful was it for you?**
- ◆ **What, if anything, did you like about it?**

◆ **What, if anything, did you dislike?**

- **How did you decide you had enough information? That is, how did you decide when to stop looking for materials for [name of product].**
- **Which web sites or web resources, such as listserves, do you use to keep informed of current space science events or discoveries?**

□ **Think Out Loud**

**Please give us your feedback throughout the activities.**

Why?

- **We want both positive and negative feedback.**
- **We also want suggestions you have for making things easier.**

Example of thinking out loud: Finding a file

- **Suppose I was given this task: `find a file called “outlook.pst” on the computer’s hard drive using the Windows Find function located in the Start button.**
  - ◆ *Ad lib instructions. Be sure to do some things that are wrong, so that you can model “incorrect” as well as “correct” thinking. It would help to use a few “Now what is this? I guess it means...” “Let’s see” and “Whoops—I didn’t mean to do that.” Also, as you click the mouse, be sure to verbalize that you’re clicking or double-clicking or right-clicking the mouse.*
    1. *Click on the Start button.*
    2. *Select “Find.”*
    3. *Select “Find: All Files.”*
    4. *Type outlook.pst in the field “Named,” leaving everything else as is.*
    5. *Click on the “Find Now” button.*
    6. *List of files matching search criteria will appear under the search fields.*
    7. *Close dialog box.*
    8. **Any questions?**



- **Your turn: Find images showing different types of galaxies.**

**☐ Reminders before beginning**

- **Remember to think out loud.**
- **We're not testing you. You're the expert.**
- **We want your feedback, both positive and negative.**
- **If you have any questions at any time, please ask.**
- **Make yourself comfortable.**
- **At any time during the session, let me know if you need to take a break.**
- **Ready to begin?**

**Task One**

*Task Time: ?*

- **I'm going to ask you to complete a task however you would do it if I were not here. Please remember to tell me what you're thinking as you go through it.**

IF SUN-EARTH CONNECTION EXPERT, ASK RESPONDENT TO FIND: A PICTURE AND VIDEO OF A SOLAR FLARE AND REPORTS OF RECENT SOLAR FLARE ACTIVITY.

IF SOLAR SYSTEM EXPERT, ASK RESPONDENT TO FIND: A HIGH RESOLUTION IMAGE OF EUROPA AND INFORMATION ON CURRENT AND PROPOSED MISSIONS TO EUROPA.

IF GENERAL ASTRONOMY EXPERT, ASK RESPONDENT TO FIND: A RECENT IMAGE OF THE HORSEHEAD NEBULA TAKEN BY HUBBLE.

AFTER EACH SITE VISITED:

- **What did you like about this site?**
- **What recommendations would you have for improvement?**

**Task Two**

*Task Time: ?*

INTRODUCE SPACE SCIENCE ACCESS WEB SITE.

FOR SUN EARTH CONNECTION EXPERT:

- **Beginning at this web site, locate the first-ever movie of auroras occurring simultaneously around both of Earth's polar regions.**

AFTER EACH SITE VISITED:

- **What did you like about this site?**
- **What recommendations would you have for improvement?**

FOR SOLAR SYSTEM EXPERT:

- **Beginning at this web site, locate information on the comet that passed Jupiter in the mid 1990s and had fragments collide with Jupiter; find images of the fragment collisions.**

AFTER EACH SITE VISITED:

- **What did you like about this site?**
- **What recommendations would you have for improvement?**

FOR GENERAL ASTRONOMY EXPERT:

- **Beginning at this web site, find an image of a spiral galaxy that has been in the news.**

AFTER EACH SITE VISITED:

- **What did you like about this site?**
- **What recommendations would you have for improvement?**

### *Additional Sites*

*Task Time: ?*

A. Solar System.

- **I'd like you to browse a number of different sites. Some you may be familiar with. Others will be new to you. I'd like you to pretend that you want to familiarize yourself with the images and resources available from the site. So, if you were looking for pictures or resources in the future, for a specific purpose, you'd know what the site had to offer. Okay? Let's go to the first site.**

#### 1. NASA's Planetary Photojournal

HAVE PARTICIPANT CLICK ON A PLANET (OR OTHER); SUBMIT A QUERY, AND CLICK ON IMAGE. WHEN YOU GET TO THE CATALOG PAGE, ASK:

- **What do you think about the information on this page? That is, which, if any, of the information is important or relevant for you?**
- **Is there anything else you would like or need to know about the picture?**

HAVE THE PARTICIPANT CLICK ON "MORE OPTIONS." THEN, ASK:

- **What do you think about the information on this page? That is, which, if any, of the information is important or relevant for you?**
- **Is there anything else you would like or need to know about the picture?**

RETURN TO START PAGE. THEN ASK:

- **Is this a site you would bookmark?**

**Yes → Why?**

**No → Why not?**

- **Do you have any other comments about this site?**

## 2. Views of the Solar System

HAVE PARTICIPANT NAVIGATE TO AN IMAGE OR ANIMATION. AFTER THEY VIEW IMAGE OR ANIMATION, ASK:

- **What do you think about the information on this page? That is, which, if any, of the information is important or relevant for you?**

- **Is there anything else you would like or need to know?**

RETURN TO START PAGE. THEN ASK:

- **Is this a site you would bookmark?**

**Yes → Why?**

**No → Why not?**

- **Do you have any other comments about this site?**

IF NO COMMENTS ARE MADE ABOUT THE ADS, ASK:

- **What did you think of the advertisements?**

- **In what ways, if any, do the advertisements influence your feelings about the scientific accuracy of the information presented?**
  
- **Are you less likely to use the images or animations because of this? Why (not)?**
  
  
- **The first site you looked at had lots of images for each planet; this only has a few. In general, do you prefer having lots of choices or only a few? Why?**

### 3. The Nine Planets

LET PARTICIPANT NAVIGATE AROUND FOR 2 - 3 MINUTES. THEN ASK:

- **Is this a site you would bookmark?**  
Yes → Why?
  
  
- No → Why not?
  
  
- **Do you have any other comments about this site?**
  
  
  
- **What would you use this site for, if anything?**

### 4. Planetary Image Atlas

- **I'd like to remind you why you're looking at these sites. You're pretending that you want to familiarize yourself with the images and resources available from the site. So, if you were looking for pictures or resources in the future,**

**for a specific purpose, you'd know what the site had to offer. We're interested in how useful the sites are for this.**

LET PARTICIPANT NAVIGATE AROUND THE SITE. HAVE THE PARTICIPANT CLICK ON A "DATA ACCESS LINK." THEN, ASK:

- **Any comments?**

- **Is this a site you would bookmark?**

**Yes → Why?**

**No → Why not?**

- **Do you have any other comments about this site?**

- **What would you use this site for, if anything?**

#### 5. Solar System Simulator

- **Please click on simulator. Then, check it out.**

AFTER A MINUTE OR SO, ASK:

- **Is this a feature that you might use?**

**Yes → Why?**

**No → Why not?**

- **Please click on 'Maps of the Solar System.' Then, check it out.**

AFTER A MINUTE OR SO, ASK:

- **Is this a feature that you might use?**

**Yes → Why?**

**No → Why not?**



- **Please click on “Space Artwork.” Then, check it out.**

AFTER A MINUTE OR SO, ASK:

- **Is this a feature that you might use?**  
Yes → Why?

No → Why not?

- **Is this a site you would bookmark?**  
Yes → Why?

No → Why not?

- **Do you have any other comments about this site?**

- **What would you use this site for, if anything?**

#### 6. PDS Mars Explorer

LET THE PARTICIPANT NAVIGATE THE SITE FOR 2 - 3 MINUTES. THEN, ASK:

- **Is this a site you would bookmark?**  
Yes → Why?

No → Why not?

- **Do you have any other comments about this site?**



- **In what ways, if any, is it useful to have a choice between different types of images?**

HAVE PARTICIPANT SCROLL DOWN TO “RELATED INFORMATION” SECTION.

- **What, if anything, in this section that you would normally read? Why?**
  
- **What, if anything, should be added to this “Related Information” section?**
  
- **Is this a site you would bookmark?**  
Yes → Why?  
  
No → Why not?
  
- **Do you have any other comments about this site?**

## 2. Animations from Hubble Space Telescope

HAVE THE RESPONDENT CLICK ON AND VIEW AN ANIMATION.

- **In what ways, if any, would you use an animation like this?**
  
- **What else, if anything, would you like to know about this animation?**
  
- **How could you find additional information about this animation?**
  
- **Is this a site you would bookmark?**  
Yes → Why?

**No → Why not?**

- **Do you have any other comments about this site?**

3. <http://informal-sci.stsci.edu/resources/videos/index.html>

LET PARTICIPANT NAVIGATE AROUND. AFTER PARTICIPANT HAS CLICKED ON A AND VIEWED A VIDEO CLIP:

- **What, if anything, else you would like or need to know about the animation?**

IF FURTHER INFORMATION IS DESIRED:

- **How would you try to get this information?**

HAVE RESPONDENT CLICK ON AND VIEW AN “IMMERSIVE DOME VISUALIZATION.”

- **What, if anything, else you would like or need to know about this?**

- **In what ways, if any, would you use this visualization?**

- **Is this a site you would bookmark?**

**Yes → Why?**

**No → Why not?**

- **Do you have any other comments about this site?**

#### 4. Chandra Photo Album

- **I'd like to remind you why you're looking at these sites. You're pretending that you want to familiarize yourself with the images and resources available from the site. So, if you were looking for pictures or resources in the future, for a specific purpose, you'd know what the site had to offer. We're interested in how useful the sites are for this.**

LET PARTICIPANT NAVIGATE AROUND THE SITE. HAVE THE PARTICIPANT CLICK ON A "DATA ACCESS LINK." THEN, ASK:

- **Any comments?**
  
- **Is this a site you would bookmark?**  
Yes → Why?  
  
No → Why not?
  
- **Let's look at the section called "Photo Album Tutorial." Do you think you would use this?**  
Yes → a. Why?

**b. Which sections would you look at? Why?**

No → Why not?

- **Do you have any other comments about this site?**

- **What would you use this site for, if anything?**

5. Animations from Chandra X-Ray Observatory

LET PARTICIPANT NAVIGATE SITE FOR 2 - 3 MINUTES.

- **In what ways, if any, would you use these animations and materials?**
  
- **What else, if anything, would you like to know about the animations?**
  
- **How could you find additional information about the animations?**
  
- **Is this a site you would bookmark?**  
Yes → Why?
  
- No → Why not?
  
- **Do you have any other comments about this site?**

6. Astronomy Picture of the Day

LET PARTICIPANT CLICK ON A FEW IMAGES. THEN ASK:

- **Is this a site you would bookmark?**  
Yes → Why?
  
- No → Why not?
  
- **In what ways, if any, do you envision using this site in the future?**



- **The pictures from this site are JPEG images. Are JPEG images useful for you, or do you generally need higher resolution images?**

**JPEG are useful**

**Need higher resolution**

**→ How would you try to get a higher resolution image?**

- **If you were looking for a specific picture -- say, a picture of Mars -- how would you find it on this site? Please show me what you would do.**
  
- **Do you have any other comments about this site?**

### 7. Infrared Images

LET PARTICIPANT CLICK ON A FEW IMAGES. THEN ASK:

- **Is this a site you would bookmark?**

**Yes → Why?**

**No → Why not?**

- **In what ways, if any, do you envision using this site in the future?**
  
- **Suppose you wanted to use one of these pictures. What additional information, if any, about the picture would you like to have?**

- **Do you have any other comments about this site?**

### C. Sun Earth Connection

- **I'd like you to browse a number of different sites. Some you may be familiar with. Others will be new to you. I'd like you to pretend that you want to familiarize yourself with the images and resources available from the site. So, if you were looking for pictures or resources in the future, for a specific purpose, you'd know what the site had to offer. Okay? Let's go to the first site.**

#### 1. Solar and Heliospheric Observatory

LET PARTICIPANT CLICK ON A FEW IMAGES. THEN ASK THE PARTICIPANT TO CLICK ON A FEW OF THE LASCO HOME MOVIES. THEN ASK:

- **Is this a site you would bookmark?**  
     Yes     → Why?  
  
     No     → Why not?
- **In what ways, if any, do you envision using this site in the future?**
- **Suppose you wanted to use one of these pictures or movies. Are the captions useful to you? What additional information, if any, about the pictures and movies would you like to have?**
- **Do you have any other comments about this site?**

#### 2. Comprehensive List of Sun-Earth Connection Image Resources

HAVE PARTICIPANT BROWSE THE HOME PAGE FOR A MINUTE THEN ASK:

- **Do you like the way this page is organized? Are the captions next to each link useful to you?**
- **Which, if any, of these links would you click on to find images?**



- **Suppose you wanted to use one of these pictures. What additional information, if any, about the picture would you like to have?**
  
  
  
  
  
  
  
  
  
  
- **Do you have any other comments about this site?**

D. Other Useful Sites

1. National Space Science Data Center's Photo Gallery

- **Is this a site you would bookmark?**  
Yes → Why?
  
  
  
  
  
  
  
  
  
  
- **In what ways, if any, do you envision using this site in the future?**
  
  
  
  
  
  
  
  
  
  
- **Suppose you wanted to use one of these pictures. What additional information, if any, about the picture would you like to have?**
  
  
  
  
  
  
  
  
  
  
- **Do you have any other comments about this site?**

## 2. NASA Image Echange

- **Is this a site you would bookmark?**  
Yes → Why?
  
- No → Why not?
  
- **In what ways, if any, do you envision using this site in the future?**
  
- **There are lots of images on this site, do you prefer lots of images, or just a few?**
  
- **Suppose you wanted to use one of these pictures. What additional information, if any, about the picture would you like to have?**
  
- **Are the images you find on this site what you had expected?**
  
- **Do you have any other comments about this site?**

## 3. Great Images in NASA

- **Is this a site you would bookmark?**  
Yes → Why?
  
- No → Why not?
  
- **In what ways, if any, do you envision using this site in the future?**





- ◆ **Would it be much easier for you to prepare space science displays, exhibitions, or events?**
- ◆ **Would the quality of your displays, exhibitions, or events be noticeably improved?**

**Thank you for participating in this interview!**

## B. Pre-Phone Interview On-Line Survey

Pre-Interview Survey

# Pre-Interview Survey

Name:

Organization:

Thank you for agreeing to be interviewed.

We would greatly appreciate your answering the following questions prior to your telephone interview. This will reduce the time required to provide us with this important information. We would like to know more about how space science related information and media are located and eventually used at science centers, museums, and planetaria.

**For our purposes, media refers to images, animations, simulations and videos that are available to you via the World Wide Web as well as the captions, background information and other data associated with such media.**

As always, the information you provide is strictly confidential. Feel free to refuse to answer any item.

If you have any questions, please contact Karen Meyer at the Space Sciences Laboratory, (510) 642-4185, [karena@ssl.berkeley.edu](mailto:karena@ssl.berkeley.edu)

**1. The following are features you might find on a website containing space science related information and media. Please rate each feature according to how useful it is to ultimately presenting space science to your audiences.**

Multiple resolution options					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Site Search					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thumbnails of media					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Icon denoting a video clip					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Drop down search menus					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Related links for each subject (e.g., Moons of Jupiter)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A glossary of terms					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Content written at a level suitable for the public					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A NASA contact for more information					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

508 Compliant (accessible for disabled users)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Content written in other languages					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**2. The following are types of content you might find on a website containing space science related information and media. Please rate each according to how useful it is to ultimately presenting space science to your audiences.**

Cultural and historical information on various subjects					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Media-rich, interactive activities (e.g., for kiosks)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Media for use on electronic displays					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Video sequences for incorporation into planetarium shows					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

All sky survey in different wavelengths					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Mission patches/logo art					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Full resolution media					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Early access to press releases w/ media					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A "best of" gallery of media					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The newest media					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**3. The following is a list of ways you might search for space science related information and media. Please rate each according to how useful it is for you when looking for media.**

By keyword (encompassing the broadest range of search criteria, including searching by mission, by target, by subject, etc.)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

By mission (Hubble Space Telescope, Chandra, Mars Pathfinder)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

By target (Venus, Europa, horse head nebula)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

By subject (Astrobiology, comets)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

By date of creation					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**4. The following are types of information you might find associated with an image. Please rate each type of information according to how useful it is to ultimately presenting space science to your audiences.**

A press release					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Image FAQ					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Background information					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Cultural and historical information (e.g., when object was first observed & by which cultures)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Biographies of the astronomers who created the image					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

List of key scientists (e.g., lead scientist)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Related images (e.g., same object in other wavelengths)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Related links (e.g., animations related to this object)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Object name (e.g., Cassiopeia A)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Object classification (e.g., Supernova remnant)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pre-Interview Survey

Position (R.A., Dec.)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Constellation (e.g., Orion)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Distance (e.g., 1,500 light-years)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Size (e.g., .50 light years or 15 parsecs)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Size compared to more familiar objects (e.g., nebula compared to size of our solar system)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Apparent Magnitude (if applicable-how bright the object appears in the sky)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Absolute Magnitude (if applicable-how bright the object would appear from a standard distance)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Fascinating facts (e.g., Saturn is less dense than water, so it would float in a pool of water)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Instrument (e.g., WFPC2 of Hubble)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Type of data (e.g., images, spectra, photometric data)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Observation Date					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



Pre-Interview Survey

Exposure Time (length of exposure)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Image release date					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Filters (e.g., F502N ([O III]), F547M (Strömrgren $\gamma$ ), F656N (H-alpha), F658N ([N II]))					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Wavelength (e.g., infrared, x-ray, 4000 Ångstroms, etc.)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Information on how the image was made from the data, including significance of the colors					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Image credit information					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Copyright notice					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Contact email					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How to order hard copies					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**5. The following are downloading options associated with images. Please rate each according to how useful it is to ultimately presenting space science to your audiences.**

**Image Size Downloading Option**

The full size version of this image measures 1067 pixels in height by 1067 pixels in width, or 3.42 Megabytes in raw form. If you wish, you may choose to have this image reduced in size. (Please note that large images may take a long time to convert and download.)

full size    half size    quarter size    other (input scale factor, ex. 0.4):

Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Image Format Downloading Option**

Several image formats are available in addition to those listed on the previous page. You may choose from any of the following:

BMP    FITS    GIF    JPEG    PDS    PICT    TIFF    VICAR

Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Image Compression Downloading Option**

Some image formats store data in a compressed form. Default compression settings may result in some degradation of the picture quality. Normally, this degradation will not be noticeable, but if you wish to be certain that you have the fullest resolution possible, you may choose to use no compression. **Be aware that this may greatly increase the size of the image file!**

Default compression    No compression

Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**6. The following is a list of ways NASA could assist you in the preparation of your institutions' products, programs and events (e.g., exhibits, websites, teacher and student workshops). Please rate each according to how useful it is to ultimately presenting space science to your audiences.**

Pre-Interview Survey

Searchable, on-line database containing the breadth of space science media					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A space science media website featuring "the best" media					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A space science media website with full resolution media					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Free slide sets					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Increased communication with NASA (liaison program between NASA and science centers/ museums/planetaria; single point of contact to navigate NASA structure; mechanism for sharing ideas and materials with NASA and keeping up-to-date on NASA events)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ready-to-serve resources for use in planetariums, kiosks, or on the museum floor					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Access to low cost NASA exhibits (models of spacecraft, display materials, etc.)					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A NASA Speaker's Bureau to request speakers for your public events					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Training for your institution's staff on the latest discoveries in space science					
Essential	Extremely useful	Very useful	Useful	Somewhat useful	Not at all useful
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thank you very much for your help. When you have completed this survey, please send a copy to us by clicking on the "SUBMIT" button.

## **C. Phone Interview Protocol**

### **Phone Interview Questions**

Hi. My name is (NAME) and I'm calling to interview you for the NASA study you agreed to help us with.

This research is being conducted to find out more about how space science-related information and media are located and eventually used at science centers, museums, and planetaria. This interview will be recorded. Everything that you tell me is strictly confidential. That is, data will never be presented in a format that would allow responses to be associated with any individual or institution. This interview should take about 45 minutes. Feel free to refuse to answer any question. After the interview is completed, we will send you a check for \$100.

Do you have any questions? Let's begin.

1. On your application, you mentioned [types of media] as types of media you use in your space science programs, events and exhibits.
  - a. How are (MEDIA) incorporated into your programs, exhibits, or events?
  - b. How often do you use (MEDIA)?

Media	a) How used?	b) How often?

2. Raw materials refer to digital images, slides, animations, simulations, news releases, background information, statistics, and historical information. Ready-to-serve resources refer to activities, planetarium shows, demonstrations, lessons, and production videos.

- a. When are raw materials useful to you, and when are ready-to-serve materials useful to you?

Raw materials:

Ready-to-serve materials:

- b. For what purposes, if any, do you use space science animations and simulations?

- c. For what purposes, if any, do you use space science videos?

- d. In what programs, if any, do you use slide sets?

3. a. When searching for space science materials and information, do you typically use a general search engine such as Google, or go to specific web sites?

General search engine

Specific web sites

b. [IF THEY USE SPECIFIC SITES]

i. Which sites?

ii. How did you originally find this site?

iii. Do you have the site bookmarked?

i. Site	ii. How found?	iii. Bookmarked?

4. On the electronic survey, you rated [TOP RATED FEATURES IN Q. 1] as “essential” features on a website containing space science related information and media. NOTE: IF NO FEATURES ARE RATED “ESSENTIAL” ASK ABOUT “VERY USEFUL” FEATURES. Which of these is most important? Which is next most important? And, next most important? Why?

Feature	Importance	Why?

5. What information would you like to see presented with an animation or simulation?

6. On your electronic survey, you rated [RESPONSES TO Q. 2] as being “essential” content on a website containing space science related information and media. NOTE: IF NO FEATURES ARE RATED “ESSENTIAL” ASK ABOUT “EXTREMELY

USEFUL” FEATURES. Which of these is most important? Which is next most important? And, next most important?

Content	Importance	Why?

7. At what reading level would you like background information and captions presented? That is, for preparing exhibitions, demonstrations, and displays, is it better for you to have the materials written for scientists, high school students, 8<sup>th</sup> graders or 5<sup>th</sup> graders?

- Scientists
- High school students
- Eighth graders
- Fifth graders

b. Why?

8. When doing a search for an image of a particular celestial body or phenomenon, would you like to see all of the images that meet the search criteria, or a small sample of very good, representative images?

All images

Small sample of very good, representative images

9. When browsing -- that is when you are looking at sites to get ideas for future exhibits, demonstrations, or display, would you like to see all of the images, or a small sample of very good, representative images?

All images

Small sample

10. Several web sites have something that they call a ‘best of’ image gallery. What do you think they mean by this: the most spectacular images, newest images, most unusual images, or something else? Let me read the choices again: Do you think a “best of” image gallery includes the most spectacular, newest, or most unusual images – or something else?

Most spectacular images

Newest images

Most unusual images

Something else (SPECIFY) \_\_\_\_\_

Which of the above types of images would you find most useful – the most spectacular images, the newest images, the most unusual images, or some other kind of images?

Most spectacular images

Newest images

Most unusual images

Something else (SPECIFY) \_\_\_\_\_

11. On the electronic survey, you rated [Q. 3 RESPONSES] as being an essential way to search for space science media. NOTE: IF NO ORGANIZATIONAL SCHEMA ARE RATED “ESSENTIAL” ASK ABOUT “EXTREMELY USEFUL” SCHEMA. Which of these is most important to you? Which is next most important? And, next most important?

Search criteria	Importance	Why



12. What resources could NASA provide to help you reach your audiences with space science content more effectively?

13. Suppose NASA were to provide you with (RESPONSE TO PREVIOUS ITEM). In what ways, if any, would that affect your job? How would this resource ultimately impact your audiences?

Resource	Impact on job	Impact on audiences

15a. On your electronic survey, you rated [Q 5 RESPONSES THAT WERE RANKED ESSENTIAL] as essential downloading options for working with images. NOTE: IF NO TYPES OF OPTIONS ARE RATED “ESSENTIAL” ASK ABOUT “EXTREMELY USEFUL.” Which of these is most important to you? Which is next most important? Why?

a. Type of Downloading option	b. Importance	c. Why?

15 b. The image size tool allows you to control the size of the images you download. You can choose full size, half size, quarter size, or custom size images. Which setting of the image size tool would you generally use?

- Full size
- Half size
- Quarter size
- Custom size

15 c. Which of the image formats listed under the Image Format Tool would you generally download? Would you download: (CHECK ALL THAT APPLY)

- BMP
- FITS
- GIF
- JPEG
- PDS
- PICT
- RAW
- TIFF
- VICAR

15 d. . Some image formats store data in a compressed form. Default compression settings may result in some degradation of the picture quality. Normally, this degradation will not be noticeable, but if you wish to be certain that you have the fullest resolution possible, you may choose to use no compression. However, when you don’t use compression, the size of the file can be increased greatly. How frequently would you use the “no compression” feature, to reduce the time it takes to download images and the space it takes to store them? Would you use this nearly all of the time, most of the time, some of the time, almost never, or never?

Nearly all of the time

Most of the time  
Some of the time  
Almost never  
Never

15 e. Are there any additional image tools that you would find useful?

16. On your electronic survey, you rated [Q. 6 RESPONSES THAT WERE RANKED ESSENTIAL] as essential for preparation of your institutions' products, programs and events. NOTE: IF NO TYPES OF ASSISTANCE ARE RATED "ESSENTIAL" ASK ABOUT "EXTREMELY USEFUL" SCHEMA. Which of these is most important to you? Which is next most important? And, next most important? Why?

Type of Assistance	Importance	Why?

16 b. For the types of assistance most highly rated, are there examples of these that currently exist at NASA? Could you comment on how useful these existing resources are to you?

17. If NASA were to provide (PICK MOST IMPORTANT TYPE OF ASSISTANCE FROM ABOVE QUESTION), how would this influence your job? How would NASA's provision of this resource ultimately impact your audiences?

17 b. IF THERE IS TIME, PLEASE ASK THEM TO ELABORATE ON THEIR ANSWERS ABOVE. PLEASE ALSO ASK THEM TO DISCUSS HOW THEY RANKED WEBSITES COMPARED TO THE OTHER TYPES OF ASSISTANCE.

18. Do you have anything you'd like to communicate to NASA?

19. Where would you like the check sent? The American Institutes for Research will need your social security number in order to prepare a check. [IF THIS INCOME WILL BE REPORTED TO THE IRS, WE SHOULD INFORM THEM OF THAT.] What is your social security number?

Thank you. Your participation in this research will help inform NASA as to how they can present information and media that it is both useful and easy to access for staff at places like [INSTITUTION]. We will send you a copy of the report.

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## E. Institution List

<b>Institution List</b>		
<b>Name</b>	<b>Address</b>	<b>Website</b>
Adler Planetarium & Astronomy Museum	1300 S. Lakeshore Drive Chicago, IL 60605	<a href="http://www.adlerplanetarium.org">www.adlerplanetarium.org</a>
American Museum of Natural History	200 Central Park West, New York, NY 10024	<a href="http://www.amnh.org">www.amnh.org</a>
American Museum of Science & Energy	300 South Tulane Avenue	<a href="http://www.amse.org">www.amse.org</a>
Buhl Planetarium at Carnegie Science	One Allegheny Ave., Pittsburgh, PA 15212-5850	<a href="http://www.CarnegieScienceCenter.org">www.CarnegieScienceCenter.org</a>
Catawba Science Center	243 Third Avenue NE, Hickory, NC 28601	<a href="http://www.catawbascience.org">www.catawbascience.org</a>
Chabot Space and Science Center	10000 Skyline Blvd. Oakland, CA 94619	<a href="http://www.chabotspace.org">www.chabotspace.org</a>
Charles Hayden Planetarium	Museum of Science, Science Park, Boston, MA 02114	<a href="http://www.mos.org">www.mos.org</a>
Charles Horwitz Planetarium	222 Maple Ave. Waukesha, WI 53186	<a href="http://www.waukesha.k12.wi.us.org">www.waukesha.k12.wi.us.org</a>
Discovery Science Center	2500 North Main Street, Santa Ana, Ca	<a href="http://www.discoverycube.org">www.discoverycube.org</a>
Exploratorium	3601 Lyon Street San Francisco, CA 94123	<a href="http://www.Exploratorium.org">www.Exploratorium.org</a>
Fernbank Science Center	156 Heaton Park Drive NE	<a href="http://fsc.fernbank.edu">fsc.fernbank.edu</a>
Fort Worth Museum of Science and History	1501 Montgomery Street, Fort Worth, TX 76107	<a href="http://fortworthmuseum.org">fortworthmuseum.org</a>
Ideum	107 Caledonia Street Suite H Sausalito, CA 94965	<a href="http://www.ideum.com">www.ideum.com</a>
Lane Planetarium	2300 Leo Harris Pkwy., Eugene, OR 97401	<a href="http://www.laneplanetarium.org">www.laneplanetarium.org</a>
Lawrence Hall of Science	University of California, Berkeley Lawrence Hall of Science #5200 Berkeley, CA 94720-5200	<a href="http://www.lhs.berkeley.edu">www.lhs.berkeley.edu</a>
Madison Metropolitan School District Planetarium	201 S. Gammon Rd., Madison, WI 53717	<a href="http://www.mmsd.org/planetarium">www.mmsd.org/planetarium</a>

Maryland Science Center	601 Light Street, Baltimore, MD 21230	<a href="http://www.mdsci.org">www.mdsci.org</a>
Muncie Community Schools Planetarium	8701 North walnut Street, Muncie, IN 47305	<a href="http://www.muncie.k12.in.us/planetweb">www.muncie.k12.in.us/planetweb</a>
Rochester Museum & Science Center	657 East Avenue, Rochester, NY 14607	<a href="http://www.rmssc.org">www.rmssc.org</a>
The Tech Museum of Innovation	201 South Market Street San Jose, CA 95113-2008	<a href="http://www.thetech.org">www.thetech.org</a>
Waubonsie Valley High School Planetarium	2590 Ogden Ave. Aurora, IL 60504	<a href="http://planetarium.ipisd.org">planetarium.ipisd.org</a>

## **F. List of Websites Reviewed**

### **SOLAR SYSTEM**

- JPL Home Page: (<http://www.jpl.nasa.gov/>)
- NASA's Planetary Photojournal (<http://photojournal.jpl.nasa.gov>)
- Views of the Solar System (<http://www.solarviews.com/ss.html>)
- The Nine Planets (<http://www.seds.org/billa/tnp>)
- Planetary Image Atlas  
(<http://www-pdsimage.jpl.nasa.gov/PDS/public/Atlas/Atlas.html>)
- Solar System Simulator (<http://samadhi.jpl.nasa.gov>)
- PDS Mars Explorer  
(<http://www-pdsimage.wr.usgs.gov/PDS/public/mapmaker/mapmkr.htm>)

### **GENERAL ASTRONOMY**

- Hubble Heritage (<http://heritage.stsci.edu/>)
- Hubble Space Telescope (<http://osite.stsci.edu/pubinfo/pictures.html>)
- Animations from Hubble Space Telescope  
(<http://osite.stsci.edu/pubinfo/Anim.html>)
- Hubble's Videos and Immersive Visualizations  
(<http://informal-sci.stsci.edu/resources/videos/index.html>)
- Chandra Photo Album (<http://chandra.harvard.edu/photo/>)
- Animations from Chandra X-Ray Observatory  
(<http://chandra.harvard.edu/resources/animations/index.html>)
- Astronomy Picture of the Day (<http://antwrp.gsfc.nasa.gov/apod/astropix.html>)
- Infrared Images  
(<http://www.ipac.caltech.edu/Outreach/Gallery/IRAS/irasgallery.html>)

### **SUN-EARTH CONNECTION**

- Solar and Heliospheric Observatory (<http://sohowww.nascom.nasa.gov/gallery/>)
- SOHO movies: (<http://sohowww.nascom.nasa.gov/gallery/LASCO/>)
- Comprehensive List of Sun-Earth Connection Image Resources  
(<http://sunearth.gsfc.nasa.gov/edmulti.htm>)
- IMAGE Gallery: (<http://image.gsfc.nasa.gov/gallery/>)

- Yohkoh Solar Observatory Images of the Sun  
(<http://www.lmsal.com/SXT/Eimages.html>)

#### **OTHER NASA SITES**

- NASA Space Science Portal  
(<http://spacescienceportal.org>)
- National Space Science Data Center's Photo Gallery  
([http://nssdc.gsfc.nasa.gov/photo\\_gallery/](http://nssdc.gsfc.nasa.gov/photo_gallery/))
- NASA Image Exchange (<http://nix.nasa.gov/>)
- Great Images in NASA (<http://grin.hq.nasa.gov/>)
- Earth Observatory (<http://earthobservatory.nasa.gov/>)