

C C T R E P O R T S
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**LIVE @ THE EXPLORATORIUM:
ORIGINS**
FINAL EVALUATION REPORT

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EXECUTIVE SUMMARY

In the course of collecting data for the webcasts produced by the Exploratorium during the Origins project, we learned that it was important to have a stand-alone version of the online survey so that we could provide continuity in the collection and analysis of the responses to the survey. We also found that introducing the survey via a pop-up screen improved the response rate. For those webcast series where the studio audience was surveyed along with the online audience, we found that the visitors to the studio tended to be more spontaneous. This finding, however, was complicated by the fact that the studio survey polled a much more complete subset of studio visitors compared to the subset of respondents to the online survey (less than 1% of the virtual visitors). Because of the Exploratorium's privacy policy, the path and history of individual visitors to the webcasts was not tracked.

Our major findings for all the webcasts were:

- *The Origins webcasts are a part of the near recent history of science.* For example, the DNA webcasts with the pioneers of the Human Genome Project is of historical significance since it recorded the history, viewpoint, and vision of the pioneers of the genetic revolution at a critical juncture of history when the Human Genome Project had been completed by the same individuals who started it. The importance of the Origins project lies not just in the fact that it brought the ideas of science to the public, but rather that it brought the actual scientists doing the science at the moment that they were doing it to the public.
- *The nature of the audience changed with the webcast series.* Data from the surveys attached to the individual series of webcasts suggest that interest in the specific content of each series of webcasts were a stronger motivation for drawing online viewers to the webcasts than interest in anything the Exploratorium had to offer. Audiences for the different webcasts differed in terms of the principal way in which they identified themselves, gender, country of origin, and reactions to webcast. The audiences of the webcasts did not differ significantly in terms of age.
- *When the Origins website and webcast worked closely together, the online audience gained a stronger understanding.* Responses to the Antarctica survey suggested that the audience understood best those topics that were addressed in both the website and the webcast. Conversely where a topic was addressed in only either one form, their understanding was more limited. An alternative explanation, however, is that those visitors with greater interest and science acumen tended to watch the webcasts as well as visit the website.
- *By using onsite manipulatives, facilitation, and online media, the Origins staff demonstrated a deep ability to explain science in terms that could be understood by the layperson as well as an ability to design new media representations of science information.* In the Speaking of DNA webcast, for example, annotation of Crick & Watson's original paper on DNA made it possible for lay people to read and make some sense out of it. This also enabled online viewers to understand the terminology that the pioneers of the genetic revolution used during the webcast interviews.

During the Antarctica webcasts the Exploratorium had to mediate the experience of the webcast because the audience lived in the temperate climate and brought its conceptions of temperate zone life to the Antarctic images.

- *Webcasting on location raised the level of science literacy because the Remote Team was able to do more than simply describe what they saw.* Since so many of them were also explorers, they were able to compare their own past experiences, whether it was scuba diving, mountain climbing or spelunking in ice caves to the explorations in the various remote locations to give webcast viewers an additional scale by which to judge the uniqueness of the experience. In addition to the enriched personal reaction, the remote team was also able to apply their critical analytical skills to draw out the full implications of what they experienced. Creating a real-time connection to researchers in the field also opened a window into the current thinking of a live scientist or member of a Remote Team and provided a unique sense of place through real-time visual and aural signals. This sense of immediacy contributed to a feeling of actually being at the remote location.
- *The webcasts provoked many, many thoughtful reactions from the audience.* A small sampling includes: a child asking whether the lasers used to map Antarctica were measuring the height of the snow or the land; children asking a series of questions about ice, water and flow during a discussion about the movement of glaciers in the Dry Valleys; a researcher wondering about the genetic explanation of how a free swimming organism shifts to a sessile existence during the Unwinding DNA webcast; a viewer observing that the source of heat in the universe is stars but wondering what the source of cold is in the universe during the Astrobiology webcast.
- *The most interactive and engaging webcasts were helped by certain conditions.* These included: the personality and facilitation ability of the scientist (being knowledgeable, passionate, but also honest and humble); a sharp, engaged audience (providing interactive connectivity does not guarantee interaction because there has to be someone on the receiving end who engages the speaker -middle-school kids seem to be the perfect age.); moderation by the Origins staff that constantly corrects, explains, and amends what the scientist says so that the audience can understand scientist; promotion of a sense of exploration and discovery so as to engage the interest of the webcast viewer.

In our analysis of the log files for the Origins file we found that:

Over the three year period of the Origins project, there were over 3 million visits to the Origins section of the Exploratorium's website. A majority of the visitors (85.9%) came one time; 7.8% came twice and 2.2% came three times. For the vast majority of visitors (96%, 2,898,575 visits) the duration of their visit was 5 minutes or less. Only 4% of the visitors (118,601 visits) visited the Origins website for more than 5 minutes.

For the webcasts, the Hubble series were the most popular with 38,085 visits to the Hubble web-cast page. The CERN webcasts were the second most popular with 12,705 visits. The Belize-London webcasts were the third most popular with 11,049 visits. The Antarctica webcasts were the fourth most popular with 9,649 visits. The country with the most active visitors was the United States with 549,053 visits (87.3%). The United Kingdom had the second most active visitors with 13,271 visits (2.1%).

The top referring site was the Exploratorium's own main home page with 2,371, 283 visits (78.6%) of the total 3,017,176 visits recorded in the log file. 410,956 searches led to the Origins home pages. This represented 13.6% of the referrals to Origins.

We found some issues to be specific to the Origins project. They are the following:

- The Exploratorium's web audience is drastically different from its studio audience. The live studio audience included many families with young children. The web audience, on the other hand, seemed to be primarily male, older, with a large (30%-45) international component. However, the Web Trends analysis of the log files suggests those viewers who actually watched webcasts long enough to fill out a survey about them were in the top 4% of visitors in terms of the duration of their visit. Thus, the difference in character between the physical and the online visitors may simply reflect the fact that the onsite surveys and the webcast cameras captured a broader segment of the studio audience than the online surveys were able to.
- In order to acclimate the studio audience to concepts and terminology that was to be presented during the Web casts, The Origins staff developed preparatory sessions for the Hubble webcasts in Year One. These preparatory sessions included activities that engaged the audience through direct perception or physical activity that provided concrete experience from which they could extrapolate to understand the concepts that would be detailed during the webcast.

Our recommendations were:

As a result of this study, we recommended the following for those institutions that decide to use webcasting as a way to reach a broad clientele beyond the confines of their local geographic region:

- A privacy policy should be dynamic, comprehensive, and flexible while reflecting the overall needs and philosophy of the organization, technical changes in tracking methods, and the needs of individual departments to secure rapid and widespread feedback on site design. The privacy policy should be periodically reviewed to balance what may be opposing needs of preserving privacy and ensuring broadly-based timely evaluation.
- Utilize the unique strengths of webcasting as a medium of communication. These include the following: ability to be intensely interactive; ability to create a window into the current thinking of onsite researchers; ability to create a sense of place; ability to depict motion that reflects the behavior of local life.

- Build an online community of regulars that can be used to: inform museum patrons about upcoming webcasts, solicit opinions about project ideas, mockups, etc.; offer a higher level of membership that offers a greater inside look of the museum's work; encourage creative work around science to be shared with other Exploratorium patrons; provide the 'critical mass' needed to establish a robust level of interaction for online forums.
- Prepare for the future of webcasting by redesigning it so that the greater capacity for interactive interaction implicit in the growing penetration of broadband access can be tapped. Since broadband users are more likely to be creators and managers of online content than narrowband users, more likely to search for information online, and more likely to engage in multiple Internet activities on a daily basis, the format in which the webcast occurs should be even more interactive by creating a digital stage on which the broadband user can multitask – watching the webcast at the same time that he/she views high resolution images, sends questions via email, etc.
- Design the interactive content of the site in such a way that visitors can produce written or verbal artifacts (as in postings or questions or comments) or make decisions that are recorded (polls, games, branching, etc.) that are designed to reveal indicators of some interests or understandings of the participants.
- Embed the webcasts in surrounding material that contextualizes the webcasts and helps make them useful over a much longer term.
- Build a network of affiliated places (school classrooms, after school centers, adult education programs, senior centers, etc.) in which the institution can run real or virtual focus groups that can provide detailed feedback that can illuminate understandings and challenges to aid formative evaluation.

INTRODUCTION

In the summer of 2000, Education Development Center's Center for Children and Technology (CCT) was contracted to evaluate the LIVE @ THE EXPLORATORIUM: Origins project as part of the Exploratorium's three-year funding from the National Science Foundation. Evaluation planning and work began in August of 2000 and continued through December 2003. This report summarizes the evaluation activities, analyzes the findings, and reflects on the challenges and opportunities facing evaluations of this type in subsequent initiatives.

One goal for the evaluation was to produce evidence and analysis of how LIVE @ THE EXPLORATORIUM: Origins impacts visitors at the Exploratorium and those who visit online. The two main audiences for this work are the project staff and the broader community of museums and science centers. One significant objective of the evaluation work explores what tools, assessment processes, and promising evaluation practices might be useful in ongoing webcast and website development for promoting science learning online.

The evaluation work had two strands. The first provided rapid feedback during, and immediately after, each webcast to allow the project team to make modifications and adjustments. The second strand looked at the relative utilization patterns over time and the impact of the various project components

Evaluation Methodology

What have we learned about the methods of collecting data for the webcasts for the Origins Project?

Survey issues

Over the course of the three years, we used a wide variety of surveys including email-based, web-based, and web pop-up surveys. Surveys varied over time in the number of questions, the focus of the survey (on just the webcast, on just the website, and both), the placement of the survey within the website, and whether the survey was a pre-screener, leading for some respondents to a more extensive or specific set of questions, or whether it was a stand-alone event. Surveys were conducted for each webcast series, and we often did multiple surveys for an Origins series.

We used several survey generation, collection, and analysis tools. While it is technically possible to program surveys without using a third-party application, doing so is not usually cost effective. Given tight deadlines, the need to get several people to weigh in on a survey's questions before finalizing it, and the desire to blend the survey into the general graphic look of the rest of the website from which it links, one needs to be able to revise it frequently. Hand programming would not be efficient, especially if there are going to be multiple surveys generated over time.

There are many survey applications available – some fairly simple and some comprehensive. Key attributes that were found valuable include the following:

- Ability to import html and use cascading style sheets in order to conform to the rest of the site
- Support for branching (i.e. “if the answer to a designated question is some pre-set value, then branch to another section of the survey”)
- Support for pop up windows (the survey appears in a smaller box overlaying the page from which it was called (see below for discussion))
- Ability for a user to stop taking a survey midway and finish it at a later time
- Support for simple analysis within the tool, and the ability to easily export to analysis tool such as Excel or SPSS
- While there are hosted survey applications available for use without having to download or purchase a stand-alone application, a completely stand-alone application is preferred if the time-frame while surveys are collecting is long (greater than a few months)

Response rates to pop-up surveys were far greater than sending the visitor off to a separate page (or multi-page survey). However in the near future as ISPs and users react to over use of pop-up adds, and use blocking software for pop-ups, this technique may not be as useful as it was in the last two years of Origins work. See (insert citation for article on pop up surveys) for more information on using pop-ups.

During the course of the three years of this evaluation, we observed several companies that offered hosted web surveys merge, go out of business, or eliminate support for certain formats and versions of their software. Since some of the Origins surveys stayed “live” for the full term of the evaluation, it became important to have a stand-alone version so we could provide continuity in the collection and analysis of the surveys. By using a survey software application that is stand alone, the client sits on your computer(s) and, if there is a hosted web-component of it, that also resides on your own server. In this way, even if there are changes or discontinuation of support, one can continue using the existing survey.

The principal issue with the surveys we have conducted online for the Origins Project has been the overall low number of responses we have been able to collect using voluntary, opt-in methods for the websites’ visitors. The number of survey respondents consistently was a fraction of the overall visitors to the sites – usually under 1%. All told we collected 592 responses.

TABLE OF SURVEY RESPONDENTS PER ORIGIN SERIES

CERN:	34 responses
Hubble:	216 responses
Antarctica:	50 responses
Jungle to Lab:	22 responses
DNA:	87 responses
Astrobiology:	183 response

Discussion

In years 1 and 2 of the Origins Project, response collection was limited for the CERN and Antarctica webcasts because the link for the survey was not placed in a prominent enough position and because the presentation of the survey depended entirely on whether the web visitor clicked on the survey link which was located at the bottom of the splash page or second page. In year three, the Exploratorium staff corrected this by programming automatic pop-up surveys in a separate browser window that appeared on the visitors screen whenever a visitor entered the series website or webcast for the first time as determined by a reading of the cookies on the visitors' computer. Subsequent web visits from a computer which had visited before did not prompt a pop-up survey to appear on the visitor's machine. The introduction of the survey as a pop-up screen greatly increased the response rate. By the final series, we collected five times as many responses as in the first series.

In Year 2, we shortened the surveys (~15 items) and improved the appearance of the surveys by using a Cascading Style Sheet provided by the Exploratorium that matched the look and feel of the main website for each series. This, however, did not appreciably increase the number of responses (Antarctica and Jungle to Lab webcasts) compared to creating pop-up surveys in Year 3 of Origins (DNA and Astrobiology webcasts).

One difficulty the automatic pop-up surveys generated was respondent complaints that the surveys came up before they had finished looking at the website or webcast. In the future this might be corrected by programming the pop-up survey to appear when the visitor exits the website or leaves the relevant section of the site, or a pop-up that asks the user if they would like to take this now, later, or never. This may lead to a reduction in response rate, however, if the survey tries to retain the visitor's attention when the visitor wants to exit the section or the website. Alternatively, a preparatory message might suggest to the visitor that he/she keep the survey window open and fill out the survey after going through the website or watching the webcast.

A secondary issue related to the scope of the survey. In Year 2, we found that the combined survey for the Antarctica website and the Antarctica webcasts worked as effectively as separate surveys that addressed the website and the webcasts as two different topics. Previously, the audiences for the website and the webcasts were viewed as separate audiences. However, our survey indicat-

ed that the audience for the webcasts overlapped substantially with the audience for the website. In addition, data from the Antarctica survey indicated that the understanding of visitors to the Antarctica website was stronger on those issues that were addressed in the website as well as in the webcasts.

Log Analysis Issues

Because of the Exploratorium's desire to preserve the privacy of visitors, "cookies" were not usually attached to the browsers of visitors to the Exploratorium's website. A cookie is a piece of data given to the visitor's browser by a web server that identifies the computer that is accessing the web server, so that the visitor's browser will hand the identifying data back to the server with subsequent requests. Because cookies are not used at the Exploratorium's website (see Appendix for Exploratorium Privacy policy) we were not able to track an individual's path through a website or the pattern of repeat visits by visitors from the same IP address despite having full access to the Exploratorium's log file of visits to the websites and webcasts in the various series in the Origins Project. In Year 3, limited cookies were used solely to generate a pop-up survey for new visitors to Year 3 series website/webcasts (DNA and Astrobiology).

While we were able to look at unique visitors and review the general traffic statistics generated by the Exploratorium server-based tools, detailed analysis was not possible without either use of some level of cookies to track the user during a single visit and over multiple visits or a separate area in which a user would login into a parallel website for evaluation purposes. The issue of visitor privacy and cookies is discussed at the end of this report in greater detail as it is one of the areas that need to be thoroughly vetted and policies adopted when undertaking this type of web-based work. The Exploratorium did this and has understood the trade-offs of adopting a policy of low or no cookie use.

Incentives

To improve potential response rates, we explored using incentives. We planned to offer a small topic-relevant gift to respondents who volunteered to participate in more in-depth focus groups or add on surveys for the Hubble and Antarctica series of webcasts. However, for a variety of reasons, the Exploratorium was not able to implement this strategy. The Exploratorium project staff were concerned with the time and resources needed to airmail a gift to every respondent, since the anticipated number was unknown. In subsequent surveys we merely asked respondents if they were willing to answer additional questions as part of our research. Prior research, conducted in the business world, has also shown that return rates on surveys is much higher when incentives are provided before data collection has occurred.

Focus Groups

While we collected a sizeable number of respondents (288) who said they would be willing to participate in additional questions in the form of a focus group, when we emailed them, only 10 to 15 volunteers actually responded to the follow-up survey. In addition, we found that 34% of the

email addresses provided in the initial survey were not functional 9 to 12 months later. If there is going to be a follow up, our experience indicates that it must occur fairly close to web visit.

We attempted to carry out a focus group using a web conferencing tool, but only one volunteer actually signed up and participated. We encountered numerous technical difficulties and it was only after a second attempt that we were able to actually connect via our web conferencing tool in a three-way conference involving the participant, evaluators, and Exploratorium staff. The feedback from the volunteer was of limited use since he was more interested in the technical aspects of executing the web conferencing than in the content of the material on the website that was presented to him. Since the time of this pilot, web conferencing has gotten easier and more reliable. However, as it is largely geared toward the business environment, it is likely that many visitors to sites like the Exploratorium's will be unfamiliar with the tools. It is also the type of experience that will have a strong self-selection bias, limiting its utility. Still it may prove to be useful in certain specific contexts, such as getting users to provide formative input prior to finalizing a site.

Studio Audience vs. Online Audience

In Years 1 and 2 of the Origins Project, the Exploratorium staff was able to survey the studio floor audience for the webcasts. As opposed to the self-selecting nature of the online surveys, the floor onsite museum surveys were able to at least make contact with almost every visitor who entered the physical space of the Phyllis Wattis webcast studio. Thus, the results of the floor surveys were far more representative of the studio floor audience than the online surveys were of the online audience. This methodological issue of sampling makes it uncertain whether the differences we saw between the two audiences were due to differences in the representativeness of the samples or to inherent differences between the two audiences.

Responses to questions in both groups do lead to some general statements: the visitors to the studio were usually spontaneous – although some groups and families came for a specific event, most stopped in as part of their visit to the Exploratorium and had not known in advance that there was a webcast offering that day. Online webcast visitors, at least for the live events, came in to the website for the event. However, both of these behaviors were impacted by the amount of promotion and nature of the marketing. For example, in the first two webcasts, some funds were spent on marketing, but the studio interviews indicated that the majority of visitors were spontaneous and had no prior knowledge of the webcasts, so it was unclear if this had made an impact. In those webcasts where marketing pulled traffic from an existing web audience, the results from the online surveys indicated greater prior knowledge of the webcasts. For example, with the Cold Spring Harbor, the Origins link was placed at Nature.com, Cold Spring Harbor Labs' own webpage, and in Science magazine, driving these existing audiences to the Origins webpage. In the online survey for the Cold Spring survey, 31% of the respondents indicated that they had found out about the Speaking of DNA website via a link from another webpage.

Analysis of All Surveys

Major findings for all the webcast series

1) The Origins webcasts are a part of the near recent history of science.

Our most significant finding for the webcasts is not in the data from the surveys. It's in the way we view the significance of the webcasts and the evidence of steady traffic to the websites long after the "live" events are over. For example, the DNA webcasts with the pioneers of the Human Genome Project is of historical significance since it recorded the history, viewpoint, and vision of the pioneers of the genetic revolution at a critical juncture of history when the Human Genome Project had been completed by the same individuals who started it. In other words, the interviews at Cold Spring Harbor conducted by the Origins staff are an important part of the historical record of the history of science. In response to question 5 of the DNA survey that asked what was especially interesting about the Speaking of DNA website, respondents hinted at pieces of the critical significance of these webcasts when they talked about how the webcasts gave their students the opportunity to see Watson in person, gave them a global view on DNA, a more accurate view of the history of the discovery of DNA (including how Franklin Rosalind Franklin's contribution was overlooked), and how the webcasts occurred right after the release of the Human Genome Project.

To a lesser extent the same thing happened with the other webcasts because each of the webcasts didn't just interview the idea of a place but rather an actual functioning institute or center that was in the midst of real work and in an actual stage of development. In the case of the CERN webcasts, the staff interviewed researchers at CERN just as CERN was about to be shut down to make way for a larger accelerator even though researchers expressed the opinion that they were on the cusp of confirming the existence of the Higgs boson. As a result, this meant that the Higgs boson discovery would most likely happen at another Brookhaven or some other accelerator. This, in turn, meant that the Nobel Prize for physics would not go to a researcher at CERN. The expression of these sentiments made clear to the audience that the chance for fame was as strong a motivator for scientists as the chance to make money might be for those in a business setting.

In the case of the Hubble webcasts, the interviews with people in charge of the actual refitting of the Hubble Space Telescope whether they are addressing a new refrigeration for the NicMos unit or a more flexible glove for the astronauts, demonstrated the tremendous care and forethought that went into planning the refitting at the exact moment in time that it was being executed.

So in some sense, the importance of the Origins project lies not in the fact that it brought the ideas of science to the public, but rather that it brought the actual scientists doing the science at the moment that they were doing it to the public. That record can be accessed at any time - as long as the Exploratorium keeps the materials posted.

2) *The nature of the audience changes with the webcast series.*

One important finding about the online audience for the Origins webcasts may be that we are not looking at a homogeneous audience across the various series of webcasts in the Origins series, despite their similar structural themes. The limited returns to the Final Summative Survey suggest that online visitors who viewed more than one series of webcasts did so because of interest in anything the Exploratorium had to offer or, equally, interest in the content of each individual series of webcasts. Data from the surveys attached to the individual series of webcasts suggest that interest in the specific content of each series of webcasts were a stronger motivation. For example, the demographics for the online audience for the Jungle to Lab webcast and the Unwinding DNA webcast are dramatically different. The largest groups visiting the Jungle to Lab website were middle school children (35%, N=7/20), college students (10%, N=2/20) and interested individuals (10%, N=20%). Only twenty-five per cent of the Jungle to Lab online audience (N=5/20) was educational professionals or engineers or scientists. This is a very different from the Unwinding DNA webcasts audience where 69% of the audience (N=45/65) were educational professionals, graduate students, or engineers or scientists. Obviously the Unwinding DNA webcasts attracted a much more mature and educated audience. This audience might partially be accounted for by conference attendees who were interested in the topic or came to the Unwinding DNA webcast via a link at the conference website.

The difference between the audiences for each series of webcasts is also reflected in the difference in gender ratio. In the chart below, we note that the ratio of male to female respondents for the respective series varies from a high of 6.3 for the CERN webcast to a more equal 1.1 for the Antarctica webcasts. In a Chi-square test of the relation of sex to webcast series we found Chi-square equal to 29.4. This value was statistically significant for 5 degrees of freedom at the .001 level (probability of occurring by chance is less than 1 in a thousand) indicating that gender was definitely related to the webcast series.

GENDER RATIO CHART

Series	Males	Females	Observed ratio
CERN	25	4	6.3
Hubble	61	13	4.7
Antarctica	26	24	1.1
Jungle to Lab	12	9	1.3
DNA	38	30	1.3
Astrobiology	112	32	3.5

In addition to the differences in gender, the number of visitors from foreign countries varied according to webcast series. Sixteen percent of the Jungle to Lab visitors was from foreign countries whereas 50% of the Astrobiology visitors came from abroad.

The difference in the audience was also reflected in the perspicacity of the questions raised by the webcasts. There are several thoughtful responses as to what questions the webcast raised for the visitor as a result of the Unwinding DNA webcasts while the responses to the same question for the Jungle to Lab webcasts are inconsequential.

The difference in demographics and reactions between the webcasts suggests that the Origins Project attracted dramatically different audiences based on the nature of the material offered during the respective webcasts.

3) When the Origins website and webcast worked closely together, the online audience gained a stronger understanding.

DID YOU WATCH A WEBCAST?				
Series	No	%	Yes	%
CERN				
Hubble	55	71.4	22.0	28.6
Antarctica	34	69.4	15.0	30.6
Jungle to Lab	9	50.0	9.0	50.0
DNA	37	63.8	21.0	36.2
Astrobiology	84	63.6	48.0	36.4

The individual surveys indicated that anywhere from 50% to 71% of the respondents did not watch any webcasts in the respective Origins webcasts.

Detailed analysis of responses to the combined Antarctica survey detailed in our Year 2 Report suggested that the audience understood the substance of those topics where the Exploratorium addressed the topics in both the website and the webcast. Conversely where a topic was addressed in only either one form, their understanding was more limited. An alternative explanation, however, is that those visitors with greater interest and science acumen tended to watch the webcasts as well as visit the website.

4) By using onsite manipulatives, facilitation, and online media, the Origins staff demonstrated a deep ability to explain science (using both onsite manipulatives, facilitation, and online media) in terms that could be understood by the lay person.

Another significant finding is the deep strength of the Origins staff in being able to explain science in terms that ordinary people could understand as well as designing new media representations of science information. This came through in the responses to Q. 5A of the Unwinding DNA survey where five respondents mentioned the Annotated Crick and Watson paper as something especially interesting in the Unwinding DNA website. By annotating the paper, the staff made it possible for ordinary people to read it and actually make some sense out of it. At the same time, this helped lay the foundations for online viewers to be able to understand the terminology that the pioneers of genetic revolution would inevitably use during the webcast interviews.

This strength could also be seen during the Antarctica webcasts when the Remote Team and the Exploratorium hosts in the studio played an absolutely critical role in mediating the experience of the webcast for the audience. Because the audience lived in the temperate climate, it brought its conceptions of temperate zone life to the Antarctic images. The Remote Team had to connect to the underlying assumptions of its audience to illustrate how their concepts had to be revamped to understand the reality of Antarctica.

Of course the ideal situation would be if the scientists themselves could articulate their work to others as Dr. David Ainsley did during a webcast from Antarctica. Dr. Ainsley was authoritative, complete, comprehensive and yet never condescending in painting a portrait of the persistence of the Adelie penguin in the face of formidable obstacles. He was also able to draw analogies to life in San Francisco that helped the children tap their own experiences to understand the difficulties besetting the Adelie. Unfortunately, Dr. Ainsley is the exception to the rule and the role of the Origins staff in interpreting what the scientists were saying was critical to the audience's understanding.

This ability to translate science to a level that can be understood by a lay audience becomes more critical every day as more and more of the breakthrough discoveries of science happen on a micro or macro level far removed from the meso-level of everyday experience and over a broad range of discovery that encompasses whole laws and ways of understanding.

5) Webcasting on location raised the level of science literacy and connecting to researchers in the field added dimension.

Having the Origins team produce webcasts on site helped establish a high level of science literacy because the Remote Team did far more than simply describe what they saw. Since so many of them are also explorers, they were able to compare their own past experiences, whether it was scuba diving, mountain climbing or spelunking in ice caves to the explorations in the various remote locations to give the audience an additional scale by which to judge the uniqueness of that experience. For example, in a webcast from Mt. Erebus, Noel and Paul relayed in their own words what it was like physically and emotionally to actually climb in the heart of Mt. Erebus through the gateway of a fumarole:

- (29:31) Paul - down inside the fumarole. Moisture and humidity have turned lava into dirt. Did not expect to find dirt in Antarctica. Noel - amazing experience, like being in a sauna. The deeper you went, the warmer it got. Some of the geologists on Mt. Erebus actually use some of these caves as saunas. Depending on how hot you want to be, you just go deeper or shallower into this ice tube. Paul - way in the back, as deep as you can go, if you pause, you can hear this deep hissing noise, like some hidden dragon down there, reminiscent of the Lord of the Rings. It's like a dragon deep inside hissing its volcanic breath out at you. Noel - Melissa used the analogy it's like the continent breathing. That's very appropriate because when you're down inside one of these fumaroles you really feel like you're down inside the mouth of some great creature because it's hot and warm and breathy and you're being held between these jaws of ice and earth and it's really an amazing feeling.

There's a very high level of science literacy being promoted in this webcast. First there is a description of phenomena, and then there are personal interpretations and reactions based on personal experience. Finally there is a critical analytic phase in which the implications of a seismically quiet continent are drawn out.

Carla (12-13 yr., old girl) - Are there a lot of earthquakes there?

A. Paul - one of the great puzzles for Antarctica is that this is one of the quietest continents for earthquakes. There are no earthquakes at all and geologists would really like to understand why. Because there are two miles of ice pressing down on the continent? Seismographs on Mt. Erebus itself barely quiver with volcanic eruptions. Noel - one of the advantages here. Scientists are burying seismographs at the SP because it is so seismically quiet here to listen at low frequencies for earthquakes and other seismic events around the world. Also using it for listening to explosions from nuclear testing in order to be able to enforce the Nuclear Test Ban Treaty. Paul - world's biggest ear down here - two kilometers across. Giant ears listening to world - can also hear meteorites exploding, called boli's, and even able to hear the aurora when the wave of electrons that pushes on the earth's atmosphere pushes a sound wave ahead of it so that they were able to record the sound of an aurora for the first time.

In addition, by establishing connectivity and interaction with someone doing active research in the field, the discourse of the webcast is grounded in real work happening in real time. For example, during a webcast in the Astrobiology series on the life near deep-sea thermal vents in the Pacific Ocean, Breea Govenar, a biologist at Penn State University currently aboard a research vessel from Wood's Hole Oceanographic Institute, said that being at the site of the hydrothermal vents in the Alvin gave her a chance to connect to a 3-D space in which animals are interacting with each other in real time. In a similar way the online audience is given the opportunity to interact with someone who is right there in real time doing research, thus enabling the online audience to 'see' these new worlds through the eyes of the researcher. Or as one respondent to the Astrobiology survey put it:

"I felt as if I were actually there participating in the events as they unfolded. Riveting... absolutely riveting."

6) *The webcasts provoked thoughtful reflection from the audience.*

The webcasts in Origins provoked thoughtful reflection from the audience. Here are just a few examples:

Antarctica

Background: A geologist explains how math is used to make a map of Antarctica by comparing the time it takes a laser beam to be reflected off the surface and back to the surveying plane. Paul brings this technology home by reminding the audience that they could measure the distance of lightning from their location by timing how long it took the thunder to reach them after they had seen the lightning. Paul added that the precision achieved with the lasers was remarkable because each topographic line on the laser map corresponded to the width of a hand whereas each line on a USGS topographic map corresponds to the height of the Exploratorium building. This is the same technology used in MOLAR - the Mars laser mapping project. It is only now being used to map parts of the earth.

Q. One child asked whether the laser measured the height of the snow or the land.

A. The laser measures whatever is on top so it can be either. Other instruments can measure what is beneath the snow, but not the laser used in this project.

Background: In the same webcast, the geologist talks about the movement of glaciers in the Dry Valleys. This provokes a series of question about ice, water and flow from the children in the audience:

Q. Another child asked whether you can hear fast-moving glaciers.

A. (Paul) Yes you can. They're very noisy - tumbling, cracking, groaning - especially if it goes into water. Paul suggested that the kids in the audience put an ice cube in water and listen to the sounds it makes to get some idea.

Q. A child asked if glaciers are like avalanches only slower?

A. Paul said they were similar but of course avalanches are much more dangerous because of the speed with which they moved.

Q. How is the shape of the flow of ice different from the shape of the flow of water?

A. (Paul) Ice uphill is still attached to the hill until it breaks up. The snow at the top is brittle and breaks off. Lower down, the snow is under much greater pressure and the snow becomes compacted and starts to act like toothpaste. Imagine as toothpaste glaciers.

Comments from the Unwinding DNA survey:

"I watched Watson's webcast and was intrigued by his mention of behavioral studies in tunicates. I have been reading about Benzer's work and exploring some research done on mice and hamsters lately. The link between genes and behavior is most fascinating to me, and I would love to read about experiments leading to the genetic explanation of how a free swimming

organism shifts to a sessile existence"

"I wondered about the fairness and ethics of Watson and Crick taking information from Pauling, but not giving information back, and publishing Paulson's error prior to Paulson publishing anything. Watson and Crick come across as greedy and selfish scientists who manipulated people for their own gain, having not done any bench research themselves." "What other women scientists have made great contributions besides Ms. Franklin?" "Will DNA become the ultimate crime solver for forensic science and hold up as clear evidence in a court of law?"

Comments from Astrobiology survey:

"I am of the firm belief that the more I learn, the less I know!"

"Will we ever be able to contact life in other parts of the Universe if it exists?"

"Simply that of wonderment in face of the overwhelmingness of life on this small spaceship earth....but a mote in the vastness of lifelight"

"I wonder which new technology we will use to propel our future spacecraft."

"The cause or source for the heat in the universe is stars but what is the cause ro source for cold or ice in the universe?"

7) The most interactive and engaging webcasts were helped by certain conditions.

The most interactive webcasts in the Origins series appeared to share certain common characteristics. These were the following:

- Personality and facilitation ability of the scientist. During a webcast on 3/8/02 in the Hubble series, Keith Noll, head of the Hubble Heritage Project, was very patient, very approachable. He didn't know all the answers, but he wasn't upset when he didn't and was very frank about it. Some of the other scientists interviewed on previous days didn't have a very public personality. Keith was the sort of scientist - knowledgeable, passionate, but also honest and humble - you wish you had as a science teacher. I think the kids liked the fact that he didn't know everything and wasn't afraid to show his embarrassment that he didn't. This was a real person, not a computer.
- A sharp, engaged audience in the studio. Providing interactive connectivity does not guarantee interaction. There has to be someone on the receiving end who engages the speaker. Some kids are too young to understand, but middle-school kids seem to be a perfect age. Before that age, they don't really understand what they are seeing or the concepts that the scientists are using. After that age, it becomes 'nerdy' to show too much interest in science. We saw this also with the 6th grade class from Happy Valley in the Astrobiology Licancabur webcast that Paul and Ron hosted and also with the 8-10 old kids in the webcast that Mary and Ron hosted with Chris McKay. The questions they asked were so insightful, like how long the algae live in the rocks, that they were startling. The questions kids ask (if they are old enough to understand what is being said) are so elemental and obvious that they have universal appeal. Perhaps also what is appealing about their questions is the untutored intelligence that enables them to see and ask

about what is right before our eyes that we as adults accept unquestioningly. When the ‘monster’ streaked across the microscopic screen during an Astrobiology webcast with Chris McKay, a Planetary Scientist from the NASA Ames Research Center, it wasn’t clear until the questioning of one of the kids that what looked like a single-celled protozoa was probably a multi-cell animal.

- The moderation by Origins staff (Ron and Robyn during the Hubble webcast) constantly corrects, explains, and amends what the scientist (Keith) says so that the audience can understand him. An example was Ron’s explanation that a milliarc second is equivalent to seeing a quarter from a few miles away. Robyn asked a number of times what the practical implications were of different aspects of the new technology. I got the sense that Ron and Robyn were like cowhands nudging cattle in the right direction. Some scientists live their work and are so steeped in the details and terminology of their specialized areas that they can’t communicate to ordinary people what it is they are doing and why. What Ron and Robyn did not only assisted the audience cognitively, it also established emotionally that the webcast was happening on lay person’s territory and that things had to be explained in lay person’s terms. This, I believe, unleashed the audience’s willingness to ask questions about things they didn’t understand or wanted to know more about. If the abstruse explanations of the scientists aren’t explained, then the audience not only is left perplexed, it also is made to feel that the scientist is smart and they are stupid, so better not ask any questions that would expose their ignorance.
- A sense of exploration and discovery is promoted and established. This happened in all the webcasts broadcast from remote locations, but it also occurred in those that were hosted from the Phyllis Watt Studio in the Exploratorium. For example, in the Licancabur Astrobiology webcast this was accomplished with slides that Brian Grisby, a Mentor/Educator from Project Arise, shared and explicated based on his visit to Licancabur. Online visitors knew they were in strange new place when they saw pictures of flamingoes high up in the lakes of the volcano and heard about how the water freezes them in place at night and then frees them in the day when the sun came up. This was also done with the video of hydrothermal vents from the depths of the Pacific Ocean in the ‘Life at the Extremes’ webcast with Breea Govenar, a biologist at Penn State University, as well as with Jonathan Trent’s videos from within the hot waters of Yellow Spring. We also knew that we were looking at strange new things when even an expert like Chris McKay could not identify the microbial organisms that Mary Millar (Origins staff) scooped out of the hot sulfurous waters of the springs nearby.

Specific summaries of each of the individual Origins webcast series

CERN Summary

The number of responses to the CERN online survey remains at 34. Thus the update report from the Year Two report continues to be valid:

We still have a relatively low response rate to the CERN online survey. Despite having 6,601 visits to the CERN home page between January 1, 2002 and June 1, 2002, only three respondents filled out the survey during that time. From the original airing of the CERN webcasts on November 11-21, 2000 to May 24, 2002, thirty-four visitors filled out the CERN online survey.

The demographics of the online viewers remain substantially the same. Most come because they interested in science topics (57%, N=16/28), access the CERN website from home (72%, N=21/29), are overwhelmingly male (86%, N=25/29), and have never visited the Exploratorium in San Francisco before (59%, N=22/29).

A measure allowing respondents to chose multiple reactions to the webcast found that 89% of the respondents (N=24/27) found the site interesting and planned to come back. In a measure that ranked dissatisfaction, respondents were most dissatisfied with the too small/small size of the video window (75%, N=6/8). In a ranking of the most interesting features, respondents ranked 'Hearing from real scientists' and 'Learning interesting science' the highest. In response to the open-ended question about what they liked about the Webcast, one new respondent wrote:

"Educational and informative. Allows me to follow current events in fields that I am interested in. I really enjoyed the archived webcasts; this allows me to listen at my convenience. I view it as an educational radio station for those interested in learning outside the school setting. Keep them coming."

In the new responses to the question of how to improve the webcasts, one of the respondents wrote:

"Get the very best physicists and engineers to fire the interest of the audience. These chaps are at best talking down; they are not confiding. Check out David Attenborough's technique."

This is perhaps the most interesting of the suggestions on how to improve the webcasts because they coincided with this consultant's observation that the most successful webcasts seem to coincide with scientists who were as caring and confiding as they were authoritative. It seems that the qualities of good teaching are just as needed and just as welcomed in the webcast as in the classroom.

Hubble Summary

There were 216 responses to the Hubble online survey. The response rate for the Hubble survey was better than that of any other survey. The Hubble webcasts ran from April 19, 2001 to June 5, 2002. They ran at three separate times, but links to all the webcasts appear on a single page. The schedule of the Hubble webcasts was:

April 19-24, 2001	Original Hubble Program
March 2-9, 2002	Telescope servicing mission
June 5, 2002	Hubble Update

Of the 216 responses, twenty (20) were submitted after the last webcast ended on June 5, 2002. These twenty responses were sent in between June 15, 2002 and February 11, 2003. The large number of responses to the Hubble webcasts is consistent with the findings of the Web Trends analysis which indicates that the Hubble website had the most visitors over the three year period of the Origins project (182,511 visits to the Hubble Home Page). The Hubble series also had the most popular webcasts with 38,085 visits to the Hubble webcast page.

Given the absence of the use of tracking software cookies, it was not possible to tell whether visitors to the Hubble webcast were a subset of visitors to the Hubble website or an overlapping set. We also note that the Hubble webcasts spanned the greatest period of time of all the webcast series in the Origins project.

The main interest in the Hubble website was an interest in science topics (59%, N=122/207 responses). The second most frequently expressed interest was general like of the offerings of the Exploratorium's website (7.8%, N=16/207).

The online visitors still tend to be male (76.8%, N=159/207) and older between 50-70 (33.3%, N=70/210). Most respondents characterized themselves as interested individuals (58.1%, N=188/203). The second most frequently selected category was student (28.6%, N=58/203). Fifty-five per cent of the respondents were from the United States (N=119/215). Forty-five percent were from foreign countries with the most active countries being United Kingdom (9.3%, N=20/215), Canada (5.6%, N=12/215), Australia (3.7%, N=8/215), and India (3.7%, N=8/215). Also, whereas visitors to the Hubble website initially appeared to have come because of an address in a paper, most visitors now report to have found their way to the Hubble website via a search engine (32%, N=65/203).

The order of preference for the sections of the Hubble website remain the same (Ideas, Tools, Place, People). The Ideas section of the Hubble website was six times more popular than the People section (51% vs. 8.4%, N=97 vs. 16 out of 190). The most popular feature of the Hubble website was Hubble Photos with 73% of the respondents choosing the Sky Gallery (N=146/200). Practically tied for second most popular feature were Science Articles (39.5%, N=79/200) and Interactive features (N=38.5%, N=77/200). About a third of respondents report an interest in new technologies that come from science (28.6%, N=59/206). Sixty-nine percent report learning something they did not know (N=52/75).

Thirty percent of respondents reported watching a Hubble webcast (30.2%, N=65/215). What they most enjoyed about the Hubble webcasts were learning about scientific research ((55.3%, N=42/76) and getting a look behind the scenes at telescope operations (47.4%, N=36/76).

In terms of the Exploratorium' staff's questions about how things would change if they thought from the point of view of the audience, the survey indicates that 28% of visitors (N=37/133) either could not think of how to improve the site or said it was already an excellent site. However, 7.5% percent of visitors (N=10/133) report various problems with access. These range from site navigation difficulties to technical problems accessing the webcasts. There are also a number of suggestions about the program. Seventeen percent of respondents (N=23/133) asked for more pictures or to see real-time images from the Hubble. The latter request is technically not possible since the raw data from Hubble has to be processed to produce an image.

66 respondents enlisted to join our email focus group through the Hubble survey.

Antarctica Summary

Between December 15, 2001 and December 9, 2003, 50 web visitors filled out our online survey. According to a Web Trends analysis of the log files of the first five months of this year's online activity, 35,985 visits were made to the Antarctica website/webcasts. Over the three year course of the Origins project, 85,017 visitors came to the Antarctica website.

The results of our online survey suggest that the Exploratorium's web audience is drastically different from its studio audience. We know from our direct observations and Year 1 onsite surveys that the live studio audience includes many families with young children. The web audience for the Antarctica series, on the other hand, is primarily male (52%, N=26/50), older (24%, N=12/50 being between the ages of 36-49, 20%, N=10/50 between 23 and 35, and 18%, N=9/50 between 50 and 70), with two-fifths being international in origin (41%, N=18/44). Of course this may simply reflect the demographics of those with access to the broadband Internet access necessary to view live streaming video. Also, since the respondents are self-selecting, the older respondents may be the only ones willing to fill out an online survey.

There were eleven new responses on how the Antarctica website could be improved. Three ask that the site address things that would help them with a school assignment such as accurate information and information about Antarctica explorers. One respondent said there was nothing to improve. One respondent requested live chat with people from Antarctica. Another requested that the material related to the "Pangaea" theory be removed since the respondent felt this was not true.

The Fast Track observations of this consultant found that the Origins project staff established a safe, friendly, fun atmosphere in the webcasts that was critical to creating a supportive atmosphere for learning. This was accomplished through the Remote Team's and the Home Staff's connection to the children in the studio audience, through the tone of their language, through the mediation of the concepts relayed by the scientists, and through the establishment of an informal,

friendly atmosphere. This consultant noted the absolutely critical role the Origins staff played in mediating the discourse between the scientists in Antarctica and the audience since the audience, living in a temperate climate, tended to interpret the images and sounds of Antarctica through its pre-conceptions of temperate-zone life. The consultant also noted that the ability of the children in the studio to understand the content of the webcasts rested on the extent to which the staff was able to bridge the children's daily life experience to the tools and discoveries of science in Antarctica. Where the difference between the children's experiences and the science was small, on topics such as penguins, water or ice, and even laser pointers, the children were able to ask cogent questions. But when the gap between their experience and the science was large such as the webcasts on AMANDA, this consultant noted the need for a core bridging analogy to provide the children with an overarching explanation of how globes of glass in the snow could function as a telescope.

In terms of success in conveying the message, we have both general and detailed indications that the audience did get the message. A majority of the respondents (69%, N=11/16) indicated that website/webcasts changed their understanding of the nature of research in Antarctica. 77% of the webcast respondents (10/13) indicated that they learned something they did not know. Specific questions that tapped the web audiences understanding of major content points for both the website and the webcasts indicated that they learned either something or quite a bit in almost every category. Detailed analysis of the results show that the audience got the message on those topics where the Exploratorium addressed the issue in both the website and the webcast. Conversely, where a topic was not addressed in either one or the other, their understanding suffered. Finally, this consultant notes how during the 1/3/02 webcast the children asked questions about fundamental properties of matter and its behavior in different states that show they got it.

Jungle to Lab Summary

There were 21 responses overall. Fifty per cent (N=9/18) indicated they had not watched any webcasts. Half of those responding to the question of which webcast they watched report that they hadn't watched any (50%, N= 9/18). The most watched webcasts were the opening webcast on Oct. 26th and the 'Lab's Most Powerful Eye' on November 3rd. See Q. 14 of the Jungle to Lab survey report for more detail.

The top three reasons describing interest in science were the following: a general interest in science (71%, N= 15), a professional interest in science (38%, N= 8), and interest in new technologies that come from science (38%). Curiosity about how scientific research is done was also a major aspect of the interest in science (38%).

The top four reasons why people came to the Jungle to Lab website were the following: it was recommended to them, they were looking for something else and stumbled on the site, they wanted to see a webcast they wanted to see a webcast and they usually like the Exploratorium website. These reasons were cited with equal frequency (29%, N=6 for each reason).

The main way people found out about the Jungle to Lab website was through a recommendation from a friend or co-worker (33%, N=6/18). Secondly was the Exploratorium home page or newsletter (22%, N=4/18).

Most respondents (55%, N=11/20) looked at the website between 5 and 20 minutes.

The most appealing aspects of the Jungle to Lab website were the following: the photographs (44%, N=8/18), postings of the remote team (43%, N=6/14), and the interactive features (36%, N=5/14).

Thirty-five percent of the respondents (N=6/17) reported finding something interesting about the Jungle to Lab website. Some highlights were the electron microscope photographs of pollen and insects. Respondents also cited the quality of the live webcast as well as the design and photographs on the site. See Q. 10a for more detail.

Twenty-five percent of respondents (N=4/16) reported that the webcast raised more questions for them. These included web technology questions, whether it's hard to be a scientist and whether entymology would be a better job although the respondent was not serious. In general, the quality of the response on this question was low.

The three points of information respondents learned the most about the Jungle to Lab website and webcast were the following: Many organisms contribute to the health of the forest (40%, N=4/10), there's a lot left to learn about evolution and diversity (36%, N=4/11), and the range of tools scientist use to study life (36%, N=4/11). Since this question comes in the Webcast feedback section, these comments probably reflect reaction to the webcasts. See Q. 13 for greater detail.

Almost half (47%, N=8/17) of those responding to the question of whether there was anything confusing said there was. Two mentioned technical difficulties accessing the webcast. One mentioned that the audio from the remote stations was hard to understand. One mentioned that he did not know English well. One wanted to see zoomed-in versions of the detail of the photographs. Another said everything was confusing.

For those who responded to questions about the webcasts, 83% (N=10/12) saw things that interested them and learned something new, 82% (N=9/11) found the demonstrations to be helpful and that the interviews were informative. See Q. 15 for greater detail.

What respondents especially enjoyed about the Jungle to Lab website and webcasts were seeing what the research base in Belize and London really looked like (44%, N=7/16) hearing from real scientists (38%, N=6/16) and learning about interesting science (38%, N=6/16). See Q. 13 for more detail.

Seven respondents replied to the question of how the Jungle to Lab webcasts could be improved. Two respondents said there was nothing to improve because the webcasts were outstanding. One said she did not know. One said by having explanations of the topics as it was quite boring. One suggested something interesting for children. Finally, one suggested using more visual props for

the younger audience members to relate the photographs to something they know. For example, the photo micrographs of pollen could have been accompanied by pictures of the trees that the pollen came from as well as pictures of the flowers.

Jungle to Lab Demographics

The largest groups visiting the Jungle to Lab website were middle school children (35%, N=7/20), college students (10%, N=2/20) and interested individuals (10%, N=20%). 25% (N=5/20) were educational professionals or engineers or scientists. This is a very different audience from the DNA webcasts where 69% of the audience (N=45/65) were educational professionals, graduate students, or engineers or scientists. See Q. 1a for greater detail.

There were more male respondents (57%) than female (43%). The largest age groups was 12-18 year-olds (35%, N=7/20). Most respondents came from the Northeast (32%, N=6/19). Most of the online visitors were domestic (84%, N=16/19) with only 16% (N=3/19) coming from other countries (China, Cuba, and Spain).

Unwinding DNA Summary

There were 87 responses, of which 36% (N=21/58) indicated they watched a webcast while 64% (N=37/58) reported not watching any webcasts.

The top three reasons describing interest in science were the following: a general interest in science (61%, N=53/87), a professional interest in science (56%, N=49/87), and interest in new technologies that come from science (45%, N=39/87).

The top three reasons why people came to the Unwinding DNA website were the following: interest in the history of how DNA was discovered (59%, N=51/87), interest in issues around genetics (46%, N=40/87), and being an educator looking for curriculum materials (29%, N=25/87).

The main way people found out about the Unwinding DNA website was a link from another page (31%, N=26/85). Secondly was the Exploratorium home page or newsletter (22%, N=19/85).

Most people (60%, N=49/82) looked at the website between 5 and 20 minutes.

The most appealing aspects of the Unwinding DNA website were the following: The Annotated Watson & Crick research paper (49%, N=32/66), text or articles (38%, N=28/73), and the overall look and feel of the website (33%, N=23/69).

Forty-six per cent of the respondents (N=31/68) reported finding something interesting about the Unwinding DNA website. Some highlights were the Annotated Crick & Watson paper and the fact that it gave an accurate picture of the history of all the players not just Crick and Watson. One teacher noted that the interview with Watson gave her students the opportunity to see Watson in person as well as to read his actual paper. Respondents also said that the interviews were fascinating and well-streamed. See Q. 5a for more detail.

Thirty-seven percent of respondents (N=24/68) reported that the webcast raised more questions for them. Some highlights were the following: the role of Rosalind Franklin, how to use this material with middle school and high school students, the ethics of Watson and Crick in relation to Pauling, and how a free swimming organism shifts to a sessile existence. Note that the level of the responses to this question were at a very high level compared to the responses to the same question for the Jungle to Lab website/webcast. See Q. 6a for more detail.

The three points of information respondents learned the most about were the following: Understanding why the discovery of DNA was important (35%, N=19/54), one actual discovery can involve many people (30%, N=17/58), and historical information about the discovery of DNA (28%, N=16/58).

Seven respondents (12%) said some things were confusing. One point of confusion was why only parts of the DNA chain are used for identification. Another respondent said the background and text color were confusing. See Q. 8a for details.

For those who watched the webcasts and responded to questions about the webcast, 96% (N=21/22) found the content of the story engaging, 90% (N=18/20) found the quality of the image to be good, 86% (N=18/21) found that the interviews were informative and that they learned something new, and 85% (N=17/21) found the demonstrations to be helpful. See Q. 10 for more detail.

What respondents especially like about the webcasts were that they were able to see and hear scientists that they would normally only read about. See Q. 11 for more detail.

Six respondents made suggestions about how to improve the webcasts. These included the following: the addition of Power Point slides as a way of adding information and breaking up the talking-head quality of the interviews, better text, chaptered sequences, search options, being clear about the terminology used, and improving the audio for the British interviewees.

Nearly half the respondents (49%, N=32/65) reported accessing the Unwinding DNA website/webcast from home. A little over a third (35%, N=23/65) accessed it from work. See Q. 18 for more detail.

Unwinding DNA Demographics

The largest groups visiting the Unwinding DNA website were associated with education: College/University teachers (11%), high school teachers (11%), other educational professionals (9%) high school students (9%) and engineers or scientists (9%). In the other category (11%) educators and science professionals predominate. All told, 69% of the audience (N=45/65) were educational professionals, graduate students, or engineers or scientists. See Q. 13 a for greater detail.

There were more male respondents (56%) than female (44%). The largest age groups were 54-60 (14%) and 40-46 (14%) and 12-18 (14%).

Most respondents came from the the San Francisco Bay Area (15%) and the Northeast (10%). However, nearly half the visitors (45%) came from other countries. The largest group of international visitors was from Mexico (6%, N=4).

Astrobiology Summary

There were 183 responses, of which 36% (N=48/132) indicated they watched a webcast while 64% reported not watching any webcasts. A statistical analysis of the relation of demographic characteristics to whether respondents watched webcasts was performed but results were invalid due to low numbers in the comparisons.

The top three reasons describing interest in science were the following: a general interest in science (79%, N=144/183), an interest in new technologies that come from science (60%, N=160/183), and curiosity about how scientific research is done. (37%, N=67/160).

The top three reasons why people came to the Astrobiology site were the following: interest in how scientists were searching for life in the universe (53%, N=96/183), interest in how life arises in the universe (48%, N=87/183), and wanting to know if we are alone in the universe (47%, N=86/183).

The main way people found out about the Astrobiology website was a link from another page (60%, N=100/183) secondarily was the Exploratorium home page or newsletter (11%, N=19/183). Most people (53%, N=83/157) looked at the website between 5 and 20 minutes.

The most appealing aspects of the website were the following: images and photographs(44%, N=65/148), the overall look and feel of the site (39%, N=58/147), and the digital video webcasts (36%, N=52/144).

Fifty-one percent of the respondents (N=75/146) reported finding something interesting about the Astrobiology website. Some highlights were that the website provided a lot of information in a way that provided quick explanations that used to take a great deal of time to find. In addition, the website organized references to relevant material. Respondents also noted that it gave them the feeling of being on the cutting edge of exploration and that the content is up to date. See Q. 6a for more detail.

Thirty-five percent of respondents (N=50/144) reported that the webcast raised more questions for them. Some highlights were the following: the belief that the more one learns, the less one knows; would we be able to contact life elsewhere if its exists; wonderment in the fact of the overwhelmingness of life on our small earth. See Q. 7a for more detail.

The three points of information respondents learned the most about were the following: Finding out about actual research (27%, N=34/125), finding documents and images from NASA they didn't know existed (25%, N=31/122), and realizing that the search for life beyond earth may be a multi-generational endeavor (23%, N= 28/121).

For those who watched the webcasts and responded to questions about the webcast, 81% (N=47/58) found the content of the story engaging, 83% (N=50/60) saw things that interested them, and 76% (N=44/58) found the interviews informative, 78% (N=47/60) reported learning something new. 80% (N=48/60) found the quality of the image to be good, 76% (N=45/59) found the demonstrations to be helpful and 78% (N=46/59) found the topics were accessible and easy to understand.

What respondents especially like about the webcasts were its vividness, the presentation, the fact that webcasts were given by people who knew what they were talking about and the clarity with which complex concepts were explained, thus sparking further discussion. See Q. 11 for more detail.

Astrobiology Demographics

The largest groups were interested individual (21%, N=31/145), engineer or scientist (17%, N=25/145). There were far more male respondents (78%, N=112/144) than female (22%, N=32/144). The largest age groups were 47-53 (17%, N=24/142) and 33-39 (16%, N=23/142).

With the U.S., most respondents came from the Northeast (12%, N=17/143) and the Southwest (9%, N=13/143). However, half the visitors (N=72/143) came from other countries. The largest group of international visitors was from the UK (11%, N=16/143)

Forty-nine percent of respondents had a BA degree or higher (N=69/140).

The most frequently reported family incomes were 75-90K (14.5%, N=16/110) and 35K-50K (14.5%, N=16/110)

Fifty-four per cent of the respondents (N=99/183) reported their ethnicity as White/Caucasian/Anglo-Saxon.

Analysis of summative evaluation summary

The results of this survey have limited usefulness for several reasons:

1. Out of the 264 contacts for which we had email addresses, only 174 had valid email addresses. Of these, only 15 or less than 10 percent responded. This sample is thus a self-selection within a group that is already self-selected.
2. The main thing we wanted to learn from this summative survey was the pattern of viewer ship for the webcasts across the entire Origins site. However, only ten respondents watched any webcasts and only eight reported seeing webcasts from more than one series.
3. Three of the respondents stopped answering the questions midway.

The existing data for the summative survey, such as it is, suggests that interest in the content of individual series of webcasts is bound, or exists along side, with interest in anything connected to the Exploratorium. Thus we found that the respondents tended to watch different webcast series in the Origins program based on both general faith in anything produced by the Exploratorium as well as specific interest in the individual series of webcasts. Four respondents cited both reasons whereas only one respondent cited only interest in the content of the individual series. This pattern of response may, however, be an artifact of the self-selection since the responses to the surveys for the individual series of webcasts show a uniquely different audience for each of the webcasts implying that the unique content of each Origins series was pulling in different audiences.

All of the respondents expressed an interest in new technologies that come from science.

The largest group was retirees (20%, N=3/15) followed by high school teachers, interested individuals, and other (13%, N=2/15). The others were a journalist and a military drill instructor. No K-12 students filled out the survey.

The Hubble webcast series were the most watched with 40% of the respondents (N= 6/15) reporting that they had watched a webcast in the Hubble series.

The respondents reported learning the most about how scientific information is exchanged, hearing stories from real scientists, finding out about research projects scientists are working on, a context and setting for science research, and how one actual discovery can involve many people. Percentages varied from 50% to 75%.

In rating the Origins web as a whole, respondents somewhat agreed or strongly agreed to the content of the stories as being engaging, seeing things that interested them, the topics being accessible and easy to understand, the demonstrations being useful, and the interviews being informative. The percentages were all 91% (N=10/11) except for topics being accessible at 82%.

What respondents found very appealing about the features of the Origins website were the images or photographs (80%, N=8/10), the overall look and feel of the website (73%, N=8/11), the postings or updates from the remote team (70%, N=7/10), the digital videos (60%, N= 6/10), and the ability to email questions to the Exploratorium during the Webcast (75%, N=6/8).

One hundred percent of the respondents (N=13) said the Exploratorium should continue to produce web programs and web-based science content like Origins. The reasons they gave were the following:

- "There is much potential in them, especially when you have access to the primary researchers."
- "There is a need to have contemporary information accessible and with for it to have a range of interest topics to choose from."
- "Because it's good publicity for the Exploratorium, its good content, and because I hope that the next event will use less proprietary methods of netcasting. A more consistent/accessible website would be nice, too."
- "It is one of my major place for science informations and progress."
- "Because if there is anything needed in this world it is science divulgation."
- "Interest in science should be available to all in all forms of media and as a retired grandparent helping show these media is essential to their understanding of life as we know it."
- "It is a good possililti to visit the exploratorium work and spirit from countrys outside of SF - US. It is a good possibiliti to work together with people from other countrys. It is a part of peacework. Not the same what your president is doing!"
- "They introduce people to new places and experiences."
- "I wish to enrich my existing knowledge and to keep current with new discoveries/technologies taht might be of interest to my students. To participate in such a global undertaking was both exhilarating and refreshing! I want to reinforce my "lifelong learning" approach with my students by bringing interactive experiences (such as the opportunities provided by the Exploratorium) into my classroom. When I model this approach, they, in turn, cannot challenge my beliefs. Science is an exciting and ever-evolving enterprise. Your series provides me with concrete evidence to present my students in support of the need for a community of learners in their future. We need them to become "lifelong learners" so that scientific research can continue."
- "The Exploratorium is at the front of the field as far as this type of production goes. As an audience for this type of contnet grows I strong models will be important for other museums and learning institutions to follow. The Exploratorium offers this leadership in it's programs."

Demographics of summative survey

Sixty-four percent were male (N=9/14). Thirty-seven percent were between 40-46 (N=5/14). Seventy-one percent came from the United States (N=10/14) and 29 % from foreign countries. Thirty-eight percent had some college but no degree (N=5/13). The most frequently reported household income was 15-\$25,000 (29%, N=4/14). Sixty-seven percent reported their race/ethnicity as white.

Log Analysis

Summary across all the webcast series

The Web Trends analysis was done for each webcast and historically across all sites for the full three years. The latter covers the period from November 1, 2000 to November 24, 2003 and incorporates the log records for all the webcasts in the Origins project from the original CERN webcast through the final Astrobiology webcasts. Note: The log files for November 2001 were not included in this summary analysis since we were unable to decompress them.

Over the three-year period of the Origins project there were a total of 3,017,176 visits. Visits are the number of times a visitor came to the Exploratorium site. Of these, 42,890 were visits by spiders (an automated program that searches the Internet). There were approximately 107,969 visits to the top pages of the Accidental Scientist project (a separate NSF-funded project. Subtracting these we derive an estimate of 2,866,317 visits to the Origins project over its three-year span.

Over that time, 1,156,685 (85.9%) of the visitors visited just once, 104,625 (7.8%) of the visitors visited twice, 29,860 (2.2%) of the visitors visited three times and 18,964 visitors (1.4%) visited 10 or more times. However note that these numbers are not as reliable as statistics produced when using cookies that persist over multiple sessions. The unreliability is accentuated for visitors without unique IP addresses, such as those coming from the larger ISPs.

For the vast majority of visitors (96%, 2,898,575 visits) the duration of their visit was 5 minutes or less. Only 4% of the visitors (118,601 visits) visited the Origins website for more than 5 minutes. Of these, 41,313 or 1.36% of the total visits were for more than 19 minutes. In the Jungle to Lab and Unwinding DNA surveys, 53 and 60% of the respondents, respectively reported spending between 5 and 20 minutes at the website. This suggests that those visitors who responded to the online surveys were located in the top 4% of web visitors in terms of duration of their visits. Those who watched the webcasts in their entirety would be in the top 1.36% of web visitors by duration. Again, the statistics here are not as reliable as those produced when using cookies.

Using Top Pages as the metric of popularity, it appears as if the most popular website was the Hubble website (182,511 visits) followed by the Antarctica website (85,017 visits), then CERN (74,549 visits), Cold Spring (43, 282 visits), Belize-London (34,370 visits). It is likely that the Hubble website benefited from more publicity on other websites, in the Internet Scout reports, and in popular educator websites. In general we found that web traffic, as indicated by referring

websites listed in the log analysis, is directly linked to links on prominent websites and in placement on popular search engines.

Among the webcasts, the Hubble series were the most popular with 38,085 visits to the Hubble web-cast page (<http://www.exploratorium.edu/origins/hubble/live/webcasts.html>). The CERN webcasts were the second most popular with 12,705 visits. The Belize-London webcasts were the third most popular with 11,049 visits. The Antarctica webcasts were the fourth most popular with 9,649 visits.

For those visitors for which WebTrends could determine the geographic region, the majority (87.2%) came from North America. 5.8% came from Western Europe, 1.4% from Asia, 1.4% from Australia, 1.1% from the Middle East, 0.7% from South America, 0.7% from Northern Europe, and 0.4% from the Pacific Islands.

The country with the most active visitors was the United States with 549,053 visits (87.3%). The United Kingdom had the second most active visitors with 13,271 visits (2.1%). Based on the chart of the Most Active Countries below, we see that only 12.7% of the Origins visitors come from abroad compared to the 30-50% figures we were getting from the online surveys.

COUNTRIES	VISITS	% OF VISITS
United States	549,053	87.3%
United Kingdom	13,271	2.1%
Canada	12,469	2.0%
Australia	8,856	1.4%
Italy	4,639	0.7%
Japan	4,213	0.7%
Saudi Arabia	4,127	0.7%
Germany	3,815	0.6%
Netherlands	3,590	0.6%
Mexico	3,512	0.6%
France	3,467	0.6%
Belgium	2,749	0.4%
Brazil	2,617	0.4%
New Zealand (Aotearoa)	2,407	0.4%
Austria	2,346	0.4%
Switzerland	1,864	0.3%
Israel	1,805	0.3%
Singapore	1,488	0.2%
Sweden	1,419	0.2%
Spain	1,310	0.2%
Total	629,017	100 %

The top referring site was the Exploratorium's own main Home page with 2,371, 283 visits (78.6%) of the total 3,017,176 visits recorded in the log file.

410,956 searches led to the Origins home pages. This represented 13.6% of the referrals to Origins. The search engines with the most searches leading to the Origins home pages were Google (326,049 searches, 79.3%), Yahoo (61,154 searches, 14.9%), and Microsoft Network (9,190 searches, 2.2%).

The top twenty search phrases that led to the Origins website included 17 phrases related to the Hubble website and webcast, 1 related to Antarctica, 1 related to CERN and 1 related to cows!

SEARCH PHRASE	PHRASES FOUND	% OF GOOGLE
hubble	18,784	4.57%
galaxy	17,399	4.23%
hubble telescope	15,438	3.75%
eagle	14,894	3.62%
galileo	12,232	2.97%
antarctica	8,346	2.03%
shuttle	7,627	1.85%
space shuttle columbia	6,970	1.69%
hubble space telescope	5,823	1.41%
space shuttle	4,530	1.10%
marathon	4,361	1.06%
columbia space shuttle	4,257	1.03%
higgs boson	4,087	0.99%
pipes	4,000	0.97%
cows	3,857	0.93%
wires	3,540	0.86%
edwin hubble	3,028	0.73%
people	2,961	0.72%
particle accelerator	2,957	0.71%
columbia shuttle	2,782	0.67%
Total	147,873	35.98%
Total of Phrases Found in the Log File	410,956	100%

The most frequently used browser was Microsoft Internet Explorer with 2,569,718 visits or 84% of the visits of the top 17 browsers (2,924,769 visits). Netscape had 11.5% of the hits.

Windows 98 was the leading platform with 33.4% of the hits, Windows XP was second with 17.3%, Windows 2000 was third with 5.5%, and Macintosh PowerPC was fourth with 9.4%.

Issues specific to the nature of the Origins Project

Physical vs. online visitors to the webcast

The Exploratorium's web audience is drastically different from its studio audience. The live studio audience includes many families with young children as was evidenced in the Year One on-site survey results. The purpose and timing of their visit to the Exploratorium is framed by their pre-existing knowledge of the interactive exhibits so that extensive scaffolding may be necessary to lay groundwork for the webcast. The time needed to do this, however, can conflict with the families' preset schedule.

The web audience, judging by the results of the online surveys, seems to be primarily male, older, with a large (30%-45) international component. However, as the Web Trends analysis makes clear, the survey respondents are, for the most part, in the top 4% of visitors when it comes to duration of their visit. Thus, the difference in character between the physical and the online visitors may just be largely an artifact of a self-selection process. For example, the Web Trends Visitor by Country analysis suggests that only 13% of the online visitors come from foreign countries.

Despite these differences, the Fast Track observations in all three years of the Origins Project found that the Exploratorium established a safe, friendly, fun atmosphere in the webcasts that was critical to creating a supportive atmosphere for learning for the physical audience as well as the online audience. The ability of the children in the physical audience to understand the content of the webcasts rested on the distance between the children's daily life experience and the tools and discoveries explicated in the webcasts. Where the difference between the children's experiences and the science was small, the children were able to ask cogent questions and the online audience was able to follow the reasoning of the webcast. But when the gap between their experience and the science was too large, it was difficult for both the studio audience and the online audience to understand what the scientists were trying to convey.

The development of pre-webcast preparatory sessions

As part of the effort to acclimate the physical audience to concepts and terminology that was to be presented during the webcasts, the Origins staff developed preparatory sessions just prior to the first series of Hubble webcasts in Year One. These preparatory sessions included activities that engaged the audience through direct perception or physical activity that gave them some concrete experience from which they could extrapolate to understand the concepts that would be detailed during the webcast.

For example, during the Astronomy to Art Hubble webcast of April 22, 2001, Linda Shore, the Exploratorium's astrophysicist had a helper distribute balloons and stickers to the audience. While the audience blew up balloons and put on stickers, she had Kelsey, a younger member of the audience, come up to assist her. Linda blew up a balloon and had Kelsey put on star stickers. Linda then blew up the balloon to demonstrate how the distance between all the stars increases as the universe increases in size and how there is no center to the universe. Linda also pointed out that

creatures living on the surface of the balloon would live in a two dimensional universe (sideways movements) so that when someone from outside their universe tried to tell them there was a third dimension of up and down, they could not conceive of it. Similarly, we could not conceive of the notion that our three dimensional universe is expanding into a four dimensional one. Linda also went on to demonstrate the three rates at which the universe might be expanding by blowing up her demonstration balloon from a deflated initial size at different rates. The first was a relatively uniform rate. The second a rapid initial expansion (following the Big Bang) followed by a slow rate of expansion. The third was a slow initial rate of expansion followed by an increasing faster rate of expansion. This strange third pattern is, in fact the way scientists now believe the universe is expanding. Linda's graphic demonstration of the three different rates of expansion through blowing up a balloon at different rates gave the audience a direct tangible experience that they could extrapolate from in preparation for the interview with Dr. Susana Deustua when she talked about her study of distant supernovae as part of a team at Lawrence Berkeley Labs in order to establish the rate of expansion of the universe.

Recommendations

The following recommendations are for both the Exploratorium and for other similar institutions that are planning to use webcasts as part of their offerings.

Consider and implement a privacy policy in keeping with the needs and philosophy of your organization

This particular evaluation plan, while discussed and accepted by the Exploratorium, conflicted with the privacy policy implemented for the Origins site and was not able to produced the level of detail that was initially requested. There is no right answer to this set of conflicting needs – the institution needs to decide what trade-offs it is willing to make. The decision should be clearly understood at the outset as it has implications for the site design and its evaluation.

Also, such a policy needs to be reviewed periodically as technology changes, options or alternatives arise, and the requirements of a particular site may differ from the general policy for the overall home site. For instance, during the course of another web project of the Exploratorium's, pop-up surveys were introduced in order to increase the response yield for the online surveys. Since the pop-up surveys were dramatically more effective in securing response, the Origins project quickly adopted pop-up surveys, too. However, in order to not be needlessly intrusive for the web visitor on successive visit to the Exploratorium's website, cookies were used simply to note whether the web visitor had been to the site before. If they had, the presence of a cookie would indicate to the Exploratorium server that it was not necessary to generate another pop-up survey.

Cookies can be used in a wide variety of ways – from relatively benign and non-intrusive uses like the one described above to some that secretly collect user information without their knowledge. The level of privacy protection and intrusion vary - with many points on a continuum. The Exploratorium has decided to restrict the use of cookies in keeping with a strong privacy policy for

their online sites. While this limits how useful web analysis tools can be in answering specific formative evaluation questions, it is important that those wishing to develop and understand user behavior on websites thoroughly research and discuss options, benefits and drawbacks before deciding on the appropriate level of cookie use. While the level chosen for Origins was not good for formative or summative evaluation, the Exploratorium should be commended for considering the tradeoffs and deciding that maximum visitor privacy is paramount on its sites.

The Exploratorium's policy, in our experience, is stricter than most museums and other public web resources. However, with additional planning and design into a specific website so that users can opt in for a limited cookie with clear, informed consent, it may be possible to track enough users in sufficient detail to make generalizations for the larger population. Adding specific features that benefit users with limited cookies (as the Exploratorium already does for those sites that have online discussion areas) will also provide reasons for users to be willing to accept cookies with clearly articulated descriptions of what information they share with the museum

Unique strengths of webcasting revealed by Origins

During the course of the Origins project, the unique educational strengths of webcasting were revealed:

It provides a basis for intensive interaction (see Point 7 in Major Findings).

Since it creates a real-time connection, it opens a window into the current thinking of a live scientist or member of a Remote Team and conveys a sense of immediacy that contributes to a feeling of actually being there (see Point 5 in Major Findings).

It provides a unique sense of place. During the webcasts from the research station in the jungle of Belize, when the signal was clear, the quality of the audio was exceptional. In the first video of day 1 one could hear the friction of the knife cutting the chicken and the sound of spatula stirring some mixture (manoc?). Also when the video was broadcast, one had this overwhelming sense of being live in the location because one could hear the cacophony of insects in the background. This exceptional aural sense of place was clearest during the shot of the laundry hanging up under the main house (10/26/02 6:39). Also during the Local Knowledge Webcast with Chapel Bol on 11/9/02, we can see Chapel close up during the interview, but there's also a live shot from a second camera that shows Chapel as a small figure in a large clearing with the close-up camera in front of him. This is a great shot that gives the context in which this interview is happening, reminding the audience that this interview is happening live in the middle of a jungle.

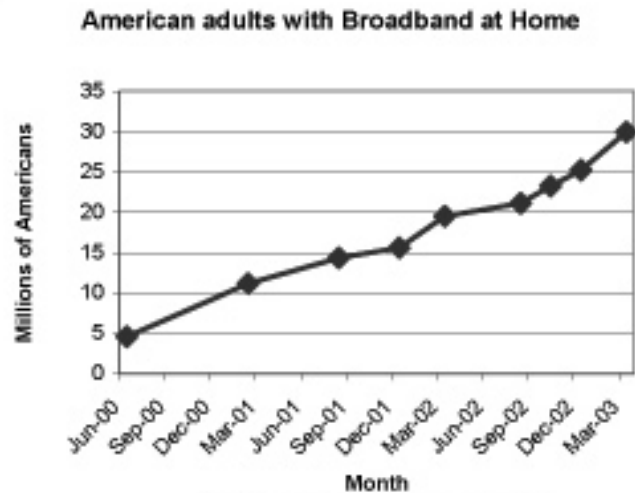
It depicts motion that captures the behavior of life. During an Antarctica interview with Art DeVries the camera shows the motion of the Creamontomus Nicholai, a direct leisurely movement toward Art's fishnet that shows a lack of fear, a naiveté not unlike penguins. With still pictures, we might have had a clearer image, but with the movement afforded by a webcast, we saw life in action.

Build an online community of Origins regulars

There are presently 288 contacts that have been derived from the responses to the online surveys. The Exploratorium may want to devote some resources to maintaining and expanding this list. Some things that could be done with the contacts are the following:

1. Inform people of upcoming webcasts.
2. Solicit opinions about project ideas, mockups, etc.
3. Provide a special level of membership that would offer them more of an inside look into the workings of the museum.
4. Provide a forum for them to share their own creative work around science with the Exploratorium.
5. If and when a site wishes to use some form of online community (the Origins series explicitly decided not to utilize online community discussions or contribution areas), these regular users can provide the base to establish a critical mass necessary for a robust area with enough exchange to attract other visitors.

Implications of broadband penetrations for future of webcasting



As of the end of March 2003, 31% of home Internet users had a high-speed connection at home (Broadband Adoption at Home: A Pew Internet Project Data Memo, May 18, 2002). This is up from 24% in October 2002 and 21% in March 2002. Today, approximately 30 million people – or 16% of all Americans – log on at home with a broadband connection. That is double the number who had a high-speed connection at home at the end of 2001 and, as noted, a 50% increase in the past year. In not quite three years, the United States has witnessed a five-fold increase in the number of people who go online with a fast connection at home.

Broadband access is a key variable that unlocks a host of changes in what the broadband user does on the Internet compared to the dial up user. Of course one is they are three times more likely to watch a video clip (21% of broadband users) compared to dial up users (6%). But a broadband connection also means that the broadband user is more likely to download files or music, create content, or share files compared to dial-up users.

For high-speed home users, broadband lets them use the Internet to become creators and managers of online content; For many broadband users, images and data on the Internet are not just things to be viewed passively, but things that these users download, recombine, manipulate, and share with others. Four in ten broadband users (39%) have created content for the Internet by creating Websites, posting their thoughts or other information to existing Websites, and creating online diaries.

Broadband users can satisfy a wide range of queries for information. About two-thirds (68%) of home broadband Internet users say they do more information searches online because of their high-speed connection.

Broadband users engage in multiple Internet activities on a daily basis. For example, on average they do 7 things online on a typical day compared to the 3 things a dial-up user does on a typical day online.

The Pew survey suggests that broadband is changing what people do online and how often they do it. Most broadband users — 61% — say they spend more time online at home since getting a high-speed connection, and one third say they do more work-related tasks since they obtained a broadband connection in the house. And they report that their information searches for random bits of everyday information have gone up because of broadband. Two-thirds (68%) of broadband users say that since they got a high-speed connection that have looked more frequently for such things as addresses, recipes, local events information and other facts they need.

The Pew study reports that 86% of broadband users say that the Internet has improved their ability to learn new things “a lot” or “somewhat”. Nearly half (47%) of broadband users say that the Internet has helped improve the way they get information about health care. Forty-two percent of broadband users say the Internet has improved how they manage their personal finances, nearly twice the rate of dial-up users. And 65% of broadband users say that the Internet has improved how they pursue their hobbies or interests, compared with 48% of dial-up users. The same share (65%) say the Internet has improved their ability to shop. The broadband household is not just home to its occupants, but, an active node on an information network.

Given that the broad band user produces digital output as well as consumes it, the format in which the webcast occurs could be even more interactive by creating a digital stage on which the broadband user can multitask – watching the webcast at the same time that he/she views high resolution images, sends questions via email. Software such as Caststream or Placeware can help accomplish this.

Produce user artifacts

Another technique that is now being developed in other Exploratorium projects involves designing the interactive content of the site in such a way that visitors produce written or verbal artifacts (as in postings or questions or comments) or make decisions that are recorded (polls, games, branching, etc.) that are designed to reveal indicators of some interests or understandings of the participants. This type of embedded evaluation is difficult, as it requires evaluators or some one familiar with evaluation to work closely with the design team early on in the development of a site.

Long-term usage

Webcasts and the websites that surround them will vary in their value as resources with long shelf lives. The Exploratorium's site designs for webcasts already reflect this – some webcasts have minimal surround, others, like the Origins sites, have a great deal of surrounding material that contextualizes the webcasts and helps make them useful over a much longer term. We urge the Exploratorium to continue tracking overall visitors to the sites over time for as long as possible to get a better sense of the longevity of these resources.

Target important audience subgroups

In order to establish a sense of how target groups use such a resource over time, the Exploratorium might build a network of affiliated places (school classrooms, after school centers, adult education programs, senior centers, etc. in which it can run real or virtual focus groups. Because of the bias introduced by explicitly asking these groups to provide feedback, they will not provide truly random experiences that can be used to map onto the category's representation in the larger mix of visitors. But they can provide detailed feedback that can illuminate understandings and challenges.