NETWORKING NATURE: BUILDING CYBERCABINETS OF DIGITAL CURIOSITIES

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Abstract.—In the age of the Internet, engaging the public online is critical to building audiences and broadening support for natural history. While collections managers have been providing online access to collections through sophisticated database search interfaces, less progress has been made to present these resources in a user-friendly framework. Some museums are thinking in terms of networked online knowledge and radically shifting the way they broker their digital content. This research examines ways natural history can be effectively presented online to the public by reviewing relevant literature, analyzing six model sites with a heuristic evaluation tool and a user survey, and exploring three case studies through project personnel interviews. Findings summarize important strategies for cultivating creative online access to natural history digital resources and culminate in offering guidelines for building these “cybercabinets” of digital natural history specimens.

INTRODUCTION

While natural history museums have maintained online collections resources since the early 1990s aimed at scientists and researchers, they are still exploring ways these resources can better attract wider audiences. As natural history collections custodians think more about designing collections Web sites that welcome the general public, they face a range of challenges, especially questions relating to online interpretation, scaffolding learning experiences, and user-centered design. These questions have not traditionally fallen to natural history collections managers, but have been explored by those leaders in the arts and cultural museum world who have been at the forefront of exploring online collections access.

Providing online access to digital natural history collections requires examining three largely separate topics in the literature: the importance of natural history, issues in digitization and collections accessibility, and the revolution in organizing information in the age of the Internet. Each topic will be addressed in sequence and then knit together to show why online access to digital natural history collections is important to a broad range of museum audiences. Lessons from this literature review will be used to analyze six model sites through an heuristic evaluation and a user self-study survey. Three case studies will be examined for issues relevant to online collections access primarily through personnel interviews. The results of this research culminate in the synthesis of eight guidelines aimed at supporting the development of creative online access to digital natural history collections or “cybercabinets.”

ACCESS TO NATURAL HISTORY

Simply put, there has never been a moment in the story of human existence when natural history was practiced so little.
Thomas Lowe Fleischner, 2011

Professionals in the natural history collections field agree that their collections represent an amazing resource for two reasons: their breadth and historical significance. Modern natural history collections now represent several hundred years of collecting and are the best existing record of biodiversity (Chapman 2005, Berents et al. 2010, Scoble 2010). Yet natural history professionals admit that few people outside their disciplines
have put natural history data or collections to use (Chapman 2005, Scoble 2010). The question natural history collections professionals are pondering is: How can access to natural history collections reach a greater diversity of people?

Increasingly, collections professionals are turning to the Internet to answer that question. In a presentation discussing the future of the Smithsonian Institution, Wayne Clough, the current secretary, relates an anecdote about a visitor who was a long-time Washington, DC, resident and Smithsonian member attending their first very-important-person tour. At the end of the tour, which included research facilities and collections storage spaces, the visitor declared that it was the first time they really understood the Smithsonian. Clough asks, “How can we use digital processes to allow people to connect to that experience?” (Brand 2009). Put another way: How can online access mirror the experience of a privileged tour of the collection with a knowledgeable curator?

Online access to natural history collections has mostly taken the form of an online search interface connected to a collection database. Users type in a keyword or some other piece of information in the available fields and some records pop out. Despite all the effort that has gone into honing these search engines and databases, library science researchers continue to find that people do their best to avoid using this type of search tool (Bates 2002). Additionally, the keyword search engine strategy makes the unjustified assumption that the user always knows what they are looking for (Bates 1989, Norris 2010, Stiller 2012). According to Chris Norris, senior collections manager in vertebrate paleontology at Yale University, online accessibility has been measured by numbers of specimens digitized and databased, but it’s time to question the value of more digital holdings if those resources cannot be found: “As far as public accessibility is concerned, one has to wonder what the point is of putting more stuff online when we do such a bad job of helping people explore what’s already there” (Norris 2010). The question here is: How can online access support the public finding what they didn’t know they were seeking?

It is an excellent time to be asking these questions, for even as collections managers are wondering how to reach the public, the public is losing access to science, including natural history. Standards for federal accountability focus on math and literacy, often to the detriment of other subjects, as time-strapped teachers focus on these rubrics instead of pursuing broader content (Center for the Future of Teaching and Learning 2011). Efforts to teach science tend to focus on science, technology, engineering, and math curricula, which can neglect nature-related subjects. Teachers say they want supplementary science materials they can easily add to their curriculum. They want these materials to be hands-on and to support inquiry-based learning (Center for the Future of Teaching and Learning 2011). What is notable about this teacher wish-list is that these resources are offered by natural history museums. For decades museum education departments have been offering hands-on, inquiry-based supplementary science materials that teachers may use at the museum or borrow for classroom use (Asma 2001, Schwarzer 2006). The limitations of these programs has been felt in their physicality: materials are available on a first-come, first-served basis, and programs are only realistically available to schools in the museum’s geographic vicinity. It is no great leap of imagination that online collections access could bring all the strengths of physical supplementary materials without these proximity or abundance limitations.

While education in all the sciences is important, it is critical that students gain a basic understanding of natural history. Without an understanding of nature, the environmental problems facing the world today would go unnoticed, unremarked, and ultimately
unaddressed (Louv 2008). Natural history advocates argue that the accumulated knowledge of naturalists can solve environmental problems: “Just as pure (or basic) science has come up with essential solutions at least as often as applied science, so has unpremeditated natural history revealed what we’ve needed to know again and again” (Pyle 2011). The first step for natural history museums, in an effort to connect the public with the natural sciences, is connecting them with the wonder and fascination that comes from experiencing a real natural history collection. Using an online database and search interface, while an efficient way to connect people with digital natural history collections, does not at all re-create the awesomeness of exploring a real collection—of hearing the unique stories only a curator can tell or the surprise of finding a personally significant specimen. Creative strategies for online collections access will be critical moving forward for natural history museums to use in engaging public audiences.

DIGITIZING MUSEUM COLLECTIONS

Museums are here for the public good and the public is online.
Nik Honeysett, 2007

Digital technologies allow an unprecedented ease of capture and copy dissemination for a wide range of object types, greatly increasing their accessibility (Conway 2000, MacArthur 2007). Consequently, digitization has become a central topic in modern collections management for museums of all types (UK Office of Library Networking [UKOLN], 2008). Yet while tutorials exist to educate collections managers in using digitizing technologies (http://www.library.cornell.edu/preservation/tutorial/contents.html, Moving Theory into Practice: Digital Imaging Tutorial from Cornell University Library is an example), good strategies for presenting digital resources remain nebulous. This does not imply that museum professionals have disregarded the importance of presenting their digital holdings, but rather that the issues surrounding good presentation are complicated.

Authors in the museum collections field and resource brokers like the UK Office of Library Networking or the Canadian Heritage Information Network have compiled large volumes of advice for projects across art and history disciplines that offer digital access to museum resources. Key advice and best practices include: project evaluation at all stages is critical; use Web design basics to be findable and fail gracefully; keep content, navigation, and presentation simple; provide multiple entry points to content; provide access to experts; and record user activity (Economou 1998, Kilbride 2004, Soren 2004, Cameron 2005, Dunmore 2006, Burnette and Lichtendorf 2007, Chan 2007, Howes 2007, MacArthur 2007, UKOLN 2008). Despite volumes of practical advice, online access to digital collections remains easier said than done. Nevertheless, museum collections professionals are clear about the importance of collections on the Web. For the past decade and a half, they have consistently identified the Internet as pivotal in defining how museums relate to their audiences. Increasingly, museums are recognizing the value of a Web presence and that that value can only come to fruition if their content can be found, accessed, and reused creatively (Woods 2007, Smithsonian Institution 2009).

ORDERING DIGITAL KNOWLEDGE

The world is not a structure built out of independently existing unanalyzable entities, but rather a web of relationships between elements whose meanings arise wholly from their relationships to the whole.
Stapp (Excel 1992)
The evolving digital world of knowledge on the Internet is challenging traditional perspectives on organizing information. Innovative ways to relate to knowledge and participate in intellectual endeavors are opening up through online platforms. It is increasingly apparent that digital knowledge changes with perspective and transcends the boundaries of separate Web pages to live in the links as “networked knowledge” (Weinberger 2007, 2012). Internet epistemologist David Weinberger (2012) has specific recommendations for taking advantage of this networked knowledge. He suggests institutions wishing to engage fully on the Internet embrace open access, be findable, encourage reuse of their intellectual resources, link to everything, and engage across institutional boundaries.

Museums have begun to adopt this way of thinking and are poised to build whole new types of networked Web presences. The Smithsonian Commons, an initiative in progress at the Smithsonian Institution, is an example of the new Web strategy. The commons will unite content across the Smithsonian’s daughter institutions, which have hitherto had separate Web presences, using the latest in search and navigation features, social media tools like tagging and sharing, and clear intellectual permissions with minimal restrictions. The idea is to reveal and connect content and commonalities between subject areas normally buried on disparate Smithsonian pages. The commons is less a site and more a way of linking information so that it is more findable (Smithsonian Institution 2009).

What networked knowledge is revealing should be no surprise to scientists: knowledge has always been the result of ongoing dialogue and is a living network of interpretations, not an inert accumulation of facts (Brown and Duguid 2000, Weinberger 2007). What the Internet has really done is welcome more voices to direct participation (Weinberger 2012). Networked knowledge allows creative ways to focus passionate amateurs and other stakeholders. In many cases, this takes the form of citizen science or massively collaborative data processing through crowd-sourced projects (Weinberger 2012). Some art collections Web sites have explored harnessing the enthusiasm of their amateurs with socially collaborative features, which provide a dialogue among their users and with museum experts. Here we begin to answer the first question presented in the natural history section: How can online access mirror the experience of a privileged tour of the collection with a knowledgeable curator? Users can have direct online access to open dialogue with museum experts through social tagging and commenting platforms.

At the same time, arts and cultural museum professionals interested in the potential of the Internet have been arguing for a decade that merely making collections databases available online does not allow them to sufficiently participate in the networked knowledge of the digital world. Howes (2007) accuses museums of presenting facts in favor of creative engagement and points out that connecting a database of facts to the Internet only facilitates the answers to simple, fact-based questions. Museum visitors, however, are looking for meanings, and meaning cannot be queried in a search engine. She advocates for incorporating serendipity into online collections access. Serendipity is when a visitor discovers something they had not been seeking, but are delighted to have found. Natural history museums are beginning to ask the question leaders in the arts and cultural museum field have been asking: How can online access support users finding what they hadn’t explicitly been seeking? The answer is, by providing collections browsing tools that encourage serendipitous discovery.

By providing answers to the questions natural history collections managers face, thinking in terms of networked knowledge reveals the importance of open access and
dialogue, increased linking, encouraging reuse of content through user participation, engaging across institutional boundaries, and promoting serendipitous discovery. As natural history museums move forward with creative collections Web projects aimed at the public, these are strengths in how networked knowledge behaves that natural history collections managers can take advantage of to create “cybercabinets” (Asma 2001) of digital natural history specimens.

METHODS AND FINDINGS

These findings are based on two investigative strategies: an analysis of six example collections Web sites and three case studies of current online digital collections projects. The Web site analysis consists of an evaluation of each site using an heuristic tool based on the literature and a user self-study survey of 190 responses. The goal of the model analysis was to critique six online digital collections Web sites for strengths and weaknesses in their user interface strategies. These sites were the Paleontology Portal, the International Quilt Study Center and Explorer, the Powerhouse Museum Collection Search, Artscope of the San Francisco Museum of Modern Art (SFMOMA), the Brooklyn Museum’s collection page, and the Encyclopedia of Life. The model sites analysis found patterns of user perception that are consistent with the issues discussed in the literature. In the case study section, each case study—based primarily on two to three interviews with key personnel—is presented separately before considering the combined lessons. The case studies were the Brooklyn Museum’s collection page, the Encyclopedia of Life, and Connecting Content: A Collaboration to Link Field Notes to Specimens and Published Literature. The case study interviews revealed consistent trends in thought across projects, match lessons from the model analysis, and support the themes identified in the literature.

Model Sites Analysis

Heuristic evaluation.—To systematize my analysis of the six model sites, I designed an heuristic evaluation checklist using criteria identified during the literature review as relevant to online collections access. An heuristic evaluation is a series of “rules of thumb” for evaluators to analyze a site without user input. The advantage of this strategy is that it requires minimal training, and representative test users do not need to be found (Soren 2004, UKOLN 2008). The heuristic employed here consists of 10 simple yes/no questions to use in analyzing each site’s user interface and includes a section for comments. The questions cover findability; site layout; multiple entry points to content; access to experts such as comment or chat features; personalization for the user; amount of content, sharing, linking, collaboration with multiple institutions; and serendipitous discovery. Since a Web site experience is subjective, the standardizing potential of the checklist was tested by asking three additional evaluators with disparate backgrounds to evaluate the sites using the heuristic tool.

The heuristic analysis revealed that all six model sites were easy to find, uncomplicated to navigate, had multiple entry points to their content, provided a lot of content, supported browsing and serendipitous discovery, which indicates that these are essential features of online digital collections access. All but one encouraged reuse of digital resources, which is therefore also considered an essential access element. The models were evenly split on whether they allowed users to personalize their experience. Most did not provide interactive access to experts, and the only two that collaborated across multiple institutions and included extensive external linking were the natural history sites.
**User self-study.**—A user self-study survey using SurveyMonkey was designed to gather qualitative user experience data. Survey participants were asked to look at all six randomized sites, choose one to browse, and then answer seven questions. The target audience groups for this survey were high school students, K–12 teachers, adults out of school with enough interest in museums to be potential visitors, and enthusiast-amateurs. The survey was accessible through a link posted to my Facebook feed, the University of Vermont’s School of Information Technology Listserv aimed at teachers, and the San Francisco Volunteer Managers Coalition Listserv aimed at museum educators and volunteers. One hundred and ninety responses were received across all six sites, which were analyzed by looking at the respondent profile, the breakdown and reasons for site popularity, user responses to multiple choice questions, and user comments.

The user self-study survey revealed attributes that users favor and were consistent with preferences discussed in the literature. Visual appeal is critical for first impressions, attracting visitors, and providing a positive experience and cannot be overemphasized. Users want a site to be useful, that is, one that is both easy to navigate and that presents a lot of content. Users like sites that are interactive, that allow them to do something, or participate in some way. Finally, they do not want those sites to be text-heavy.

**Case Studies**

The three case studies—Brooklyn Museum’s Collections Browse site, the Encyclopedia of Life, and Connecting Content—represent a range of project age, size, and prestige. Only one project (Connecting Content) is a true natural history collections digital project. The other two projects, an art museum site (Brooklyn Museum) and a species encyclopedia (EOL), are included because projects outside the natural history scope can have novel and important lessons to share. Case studies were conducted through a combination of interviews with key staff members and examination of project documentation, including grant proposals, published articles, and promotional materials. A brief description of each project follows with a summary of the combined lessons from these projects.

The Brooklyn Museum’s Collections Browse site is popularly regarded across museum professionals as a remarkable example of community building by uniting online collections access with social media. The site first went live in the summer of 2008. It has been officially recognized by the Museums and the Web “Best of the Web” award in the community category as an honorable mention in 2008 and as the winner in “online community or service” and “best overall” in 2009 (Museums and the Web 2012). The site features visual browse options, research tools, social media engagement revolving around the digital collections, and a high degree of transparency and access to staff through comment and chat posts.

The Encyclopedia of Life (EOL) is an “ecosystem of Web sites” that aggregates reliable biodiversity content on the Internet in a constantly evolving, up-to-the-minute, and free resource aimed at researchers, educators, students, and the general public (EOL 2008a). EOL was born out of E.O. Wilson’s 2007 Technology, Entertainment, Design (TED) prize talk, where he called for a tool to inspire appreciation, understanding, and preservation of biodiversity. He envisioned this tool as an online encyclopedia with a page for every species (TED 2007). EOL has six cornerstone partners who contribute to six “working groups” that run different aspects of the encyclopedia. EOL is a huge collaboration, with currently 259 content partners ranging from natural history museums, university collections, government agencies, and international research
consortia, to popular Web sites like Flickr and Wikipedia (EOL 2008b, 2012). The bulk of the site is individual species pages, which include media (photographs and videos), descriptive text, taxonomic nomenclature, maps, links to relevant institutions, and references from published scientific articles.

Connecting Content is an Institute of Museum and Library Services National Leadership Grant funded 3-year project led by the California Academy of Sciences’ Library. The overarching project includes pilot projects by seven partner institutions all focused on different challenges related to digitizing specimens along with related field books. According to the Connecting Content grant abstract, the pilot project at the California Academy of Sciences was planned for its novel goal of digitizing historically significant specimens and related field journals in order to reunite both with relevant published scientific literature in one data mash-up portal available to lay and expert audiences alike.

Despite the wide range of priorities, subjects, and sizes of the case studies, the same few themes were foundational for all three, themes that match advice from the literature. All the case studies emphasized the importance of sharing digital resources openly, keeping the online experience personal, community building, and ensuring resources and experts were easily accessible. The primary driving force behind all these projects is the desire to share digital resources as widely as possible. By releasing digital collections onto the Web under open access and Creative Commons policies, more users are able to benefit from those resources. The case study projects felt that keeping the online experience personal for users, both by allowing them to personalize their browsing and by providing a personal face to the institution, created a positive dynamic that encouraged engagement and a sense of community. Community building was a priority through other efforts, like transparent communication and social media features. Further, users benefit from and seek access to experts, which is supported by community building. Accessibility was perhaps the most important consideration for supporting content sharing. Users need to be able to find content before they can use it, which means making it findable and being flexible across multiple platforms. The case studies all recommended giving users as much control of the content as possible. If users feel they have real ownership of digital resources, they will invest greater creativity into reusing those resources in novel ways.

THE GUIDELINES

These eight guidelines are based on the combined conclusions of the literature review, model sites analysis, and case studies. They are aimed at assisting the development decisions of natural history collections professionals who wish to build cybecabinets: creative online access to their digital natural history content. The guidelines assume that such a Web site is intended to successfully engage the general public as the primary audience.

One: Be Useful

Comments from the user self-study survey made it clear that users want sites that are easy to use. Ease of use incorporates issues of findability, accessibility, flexibility across presentation platforms, intuitive navigation, and simplicity of layout. While all of these concerns would be handled by a Web designer, it’s important for collections professional involved with a cybecabinet project to understand them.

The first step for a useful site is that users be able to find it. On the Internet, findability often equates with googlability, and Web developers have learned how to work with
Google search algorithms to ensure a site is found and listed first in the results. All the model sites could be googled and found at the top of the search list. Accessibility is a broad concept referring to design strategies that put content within reach of users by incorporating the standards of the Americans with Disabilities Act, language considerations, and software availability. Cybcabinet developers must understand their target audience if they are to successfully address accessibility issues. Site flexibility overlaps with accessibility and refers to the ability of the site to function adequately across multiple viewing platforms as opposed to being well-tailored for only a single browser or viewing device. Users may be visiting the site from a desktop, ultraportable, or mobile device, each of which will alter their experience of the same site. Web designers speak of allowing sites to “fail gracefully,” meaning that a site is so well designed that even when it fails, it still allows users to access its basic functions. A flexible site can serve user needs no matter what browser or viewing device the user is employing and even if the site is not functioning at peak performance. Intuitive navigation and simplicity of layout and graphic design help a site to fail gracefully while supporting ease of use. Perhaps the most important take-home message for creating easy to use sites is to remember to keep them simple.

The other side of being useful is having deep content. Respondents to the user self-study survey were clear that they wanted access to a lot of content. The more digital objects—e.g., specimen photographs, locality maps, collection records—the more useful the site to more users. In a collection site, users want to see that they have a deep resource at their fingertips, that they can have as much content as they choose to explore. Do not limit the content of a cybercabinet unless there is a good reason to do so.

Two: Be Beautiful

Users in the self-study survey were unequivocal in preferring visually appealing sites. The number one reason survey respondents chose a site to browse was because it looked fun and interesting. Conversely, respondents were clear that they were put off by text-heavy sites. Again, this guideline would be handled by a Web designer, but it is important for collections professionals to understand how critical aesthetics are for winning over general audiences. A beautiful site will attract visitors even if they have little prior interest in natural history and have never heard of the host institution. The original appeal of cabinets of curiosities was the aesthetically enticing objects within them, and the same will be true of cybercabinets. Show off digital specimens aesthetically and users will be attracted to the site. Additionally, striving for visual appeal will align with the goals of accessibility and simplicity raised in the first guideline. Cluttered and convoluted sites are neither accessible, simple, nor attractive.

Three: Keep It Personal

The case study interviewees agreed on the importance of giving users a personal Web experience (Chan 2009, Bernstein 2011, Morin pers. comm., Castronovo pers. comm., Parr pers. comm., Studer pers. comm., Byrnes pers. comm.). By allowing site visitors to personalize their interaction with a digital collections site, they become more engaged. Personalizing provides a sense of ownership and control for users and supports online community building. Survey respondents confirmed their desire to customize their online experience. They sought out and favored sites that allowed interactivity and gave them the ability to contribute. Features like collecting favorite digital specimens and sharing them with friends or permitting users to comment and have social interactions with each other allows users to have their own personal versions of cybcabinets.
Four: Provide Serendipity

Serendipitous discovery is the unexpected discovery of something the user only knows they want after they find it. Authors from the literature were clear on the importance of serendipity to a collections Web experience (Bates 1989, Frost 2002, Chan 2007, Howes 2007, Norris 2010, Stiller 2012), and every model was employing some feature to support serendipity. Usually, serendipitous discovery tools are in the form of browsing strategies. There are many ways to support browsing, from simple similarity recommendations to algorithms that track and match user data to make sophisticated and personalized recommendations. Web sites like Amazon.com are excellent examples of recommendation-based browsing tools of different types. Sites like this also attempt to mimic real-life experiences, like browsing a shelf of like items, a search strategy known to be popular with users (Bates 1989). However, simple browsing strategies can be equally effective, such as the visual browsing represented by SFMOMA’s Artscope or the subject browsing favored by the Powerhouse Museum. Browsing by subject can use either an official taxonomy for the digital collections or a folksonomy, where user tags create the categories. Incorporating more than one browsing strategy has the happy result of providing multiple entry points into the content, which is always a good idea.

Guideline two, to be beautiful, highlights the importance of having a fun and delightful Web presence, which serendipity can support. Howes (2007) identifies “the joy of serendipitous discovery.” Users won’t necessarily realize they want serendipity as part of their online experience, and Howes declares that Web developers often overlook the importance of serendipity. Cybercabinet builders should avoid that mistake by keeping serendipity in mind when creating a site. Additionally, serendipity can tie in with one of Weinberger’s (2012) key recommendations, linking. Weinberger advises linking widely and often to other sites to fully take advantage of the networked knowledge ecology on the Internet. The two natural history model sites incorporated many links to external partners and resources. This linking strategy creates a different sort of serendipitous discovery in that it encourages users discovering related sites and resources, changing a collections site from a just a Web site to a resource broker. Linking also promotes sharing, the next guideline.

Five: Share

Weinberger (2012) saw sharing through open access to content and linking between sites as one of the primary advantages of the modern Internet, and indeed, all three case studies highlighted the importance of sharing digital resources. The Brooklyn Museum saw sharing their digitized collections as key to building community with online audiences. Connecting Content focused on the open access side of sharing, and the principle investigators on the grant were concerned with making their digitized specimens and field books available through multiple public platforms in ways that were standardized for easy access. Connecting Content’s principle investigators were clear that they hoped to see unexpected, creative, and unique results from public reuse of the project’s digital products (Morin pers. comm., Castronovo pers. comm.), a sentiment that was also expressed by the Brooklyn Museum in reference to their collections Web site (Bernstein 2011).

EOL, as a site that aggregates preexisting content, is built on the concept of sharing. It shares with existing sites in collecting content and then shares with users in making that content available in a public-friendly format. EOL is also heavily interlinked to the sites with which it shares data, such as the Global Biodiversity Information Facility or Animal Diversity Web. The EOL interviewees were confident that through free and open sharing users would come to rely on EOL as a trusted and reliable resource.
Six: Encourage Participation

Museum professionals have worried that hosting the unvetted contributions of random users will undermine the trustworthiness of their Web sites (Kilbride 2004, Cameron 2005, Burnette and Lichtendorf 2007, MacArthur 2007, Howes 2007). While museum professionals have perceived trust and participation as an either/or situation, users from the self-study survey saw them as complementary. In building cybercabinets, site developers should remember that users will trust sites that provide reliable and accurate resources while also allowing them to participate and make their own contributions.

Visitors to a site will engage more deeply if they are asked to actively participate in some way that revolves around the content. The Brooklyn Museum was using their folksonomy-generating tagging activity to foster participation, as well as supporting social features like posting collections-related comments. Shelley Bernstein advised seeing the museum Web presence as an ongoing online conversation (Agenda 2009) and as such an inherently participatory relationship with Web visitors. EOL encouraged participation by allowing members to join groups and post comments. Just as guideline three, keep it personal, identified user’s desire for interactivity and contributing, this guideline emphasizes the importance of encouraging people to become active participants on a collections site and not passive recipients of digitized data. Users from the self-study survey repeatedly stated they sought out interactive and participatory experiences on Web sites. Active participation will give users a sense of ownership in a cybercabinet, encouraging them to care about the natural history being presented.

Seven: Provide Access to Experts

Many authors in the literature review (Kilbride 2004, Cameron 2005, Burnette and Lichtendorf 2007, MacArthur 2007, Howes 2007) identified the importance of providing access to experts as part of the online museum experience. User evaluation reveals that Web visitors turn to museum resources because they give access to a knowledge source with respected experts. Yet only two of the model sites were supporting user engagement with experts: the Brooklyn Museum and EOL. In a paper published with Museums and the Web, Shelley Bernstein (2008) from the Brooklyn Museum explicitly advocated supporting access to experts through a collections Web site. Part of the reason Brooklyn Museum staff are active on the social media features of their collections Web site is to allow users to engage them directly in dialogue through the chat and comment tools. The Brooklyn Museum understood that fostering open dialogue between site visitors and experts creates an atmosphere of trust, benefiting the online community.

Interviewees with EOL did not explicitly cite access to experts as one of their Web strategies; nevertheless, EOL is built to support interaction between all its users, from credentialed scientists through amateur enthusiasts to casual browsers. In EOL’s case, access to experts is a by-product of their desire to create a global online natural history community by keeping the site experience personal, accessible, and engaging. EOL’s strategy can be considered in reverse; that is, cybercabinet projects should provide dialogue with experts in order to promote user engagement and trust.

Eight: Collaborate

Creating cybercabinets that truly capitalize on the networking advantages of the Internet requires multi-institutional collaborations. As cybercabinets bring together content from disparate sources in aggregations and mash-ups, the Web experience for users is enriched. Weinberger (2012) advocated for cross-institutional collaboration as
one of his five recommendations for taking advantage of the networking of knowledge on the Internet. Institutions, in defining themselves as distinct entities, isolate their members within knowledge microcosms that don’t readily allow communication across institutional boundaries. He says, “Institutions tend to become echo chambers, even if we call them ‘schools of thought’.” (Weinberger 2012:189). On the Internet, linking allows those boundaries to become permeable as institutions are woven into a network that is stronger from the participation of respected knowledge sources like museums. Increased linking allows for cross-fertilization of ideas nurtured within different institutional microcosms; ideas that the participating institutions can work on together and benefit from equally. While arts and cultural museums are still confining their digital collections to separate institutional Web sites, as seen from the model sites, the natural history field has a long history of collaboration on which to base cybercabinet projects. The two natural history model sites were both deeply collaborative across multiple contributing institutions. While users may not consciously ask for collaborative and highly interlinked collections sites, they did explicitly ask for deep content on the self-study survey, as discussed under guideline one, be useful. When institutions share through collaboration and linking, their pooled resources become a deeper source of content when combined, exactly what users will want in a cybercabinet.

**Final Thoughts**

Two of the model art sites had interesting and unusual interfaces that could be advantageously adapted by natural history sites. One was SFMOMA’s Artscope, a zoomable display of image thumbnails browsable with a virtual magnifier. Similarly, a grid of digitized specimen thumbnails could be laid out to mimic the organization of pinned insects or specimens in drawers, and users could use a virtual magnifying glass or microscope to examine specimens, pulling up collections records as they selected images. This strategy not only references some real-world practices of natural history, but also incorporates visual browsing for serendipitous discovery.

The second was the Quilt Explorer, which allowed users to create virtual quilts. Instead of quilts, users could pull specimen photographs, locality maps, scanned field journals, even published scientific articles, and create digital mash-ups in the form of virtual nature journals, scrap books, or their own imaginary collecting trip records. Both of these examples suggest possible aspects of a cybercabinet approach to online access to natural history that existing projects or institutions could consider adding as a facet of their access strategy.

**Summary**

To a person uninstructed in natural history, his country or sea-side stroll is a walk through a gallery filled with wonderful works of art, nine-tenths of which have their faces turned to the wall.

Thomas Henry Huxley

These eight guidelines for building cybercabinets—be useful, be beautiful, keep it personal, provide serendipity, share, encourage participation, provide access to experts, and collaborate—summarize the lessons from online digital collections projects and ideas anticipating the avenues along which the Internet is evolving. The goal is to foster for users the virtual experience of throwing open a collections’ doors and welcoming them inside to explore freely. Keeping these guidelines in mind will support that goal. Natural history is critical to human well-being on multiple levels, from personal happiness to
averting environmental crises. The public should care about natural history, and they should have access to knowledge resources about natural history. Natural history museums, as the stewards for our deepest source of knowledge about nature—the collections themselves—are the obvious advocates for public involvement with natural history. Many natural history museums have just begun to plumb the potential of the Internet for reaching far-flung and diverse audiences to advocate for nature and the sciences. In the age of the Internet, with so much of the modern public on the Internet, online access to digital natural history collections through cybcabinets will be an invaluable tool.

**Literature Cited**


APPENDIX A. MODEL SITES AND CASE STUDIES

The Paleontology Portal: http://www.paleoportal.org/


SFMOMA’s Artscope: http://www.sfmoma.org/explore/collection/artscope

Quilt Explorer: http://www.quiltstudy.org/collections/quilt_explorer.html

Brooklyn Museum Browse Collections (model and case study): http://www.brooklynmuseum.org/opencollection/collections/

The Encyclopedia of Life (model and case study): http://eol.org

Connecting Content: A Collaboration to Link Field Notes to Specimens and Published Literature (case study): in progress, no Web site

APPENDIX B. INTERVIEWEE LIST

Brooklyn Museum

Deborah Wythe: Head of Digital Collections and Services
Corresponded by e-mail 5 February 2012
Shelley Bernstein: Chief of Technology
Corresponded by e-mail 24 February 2012

Encyclopedia of Life

Breen Byrnes: EOL Outreach and Media.
Interviewed by phone on 8 February 2012 at 12:30 PST
Cynthia Parr: Species Pages Working Group Director
Interviewed by phone on 7 February 2012 at 10:30 PST
Marie Studer: EOL Learning and Education Working Group Director
Interviewed by Skype on 8 February 2012 at 10:00 PST

Connecting Content

Rebecca Morin: User Services Librarian and project principal investigator
Interviewed in person on 1 February 2012 at 11:00 PST
Danielle Castronovo: Archives and Digital Collections Librarian and project principal investigator
Interviewed in person on 1 February 2012 at 12:10 PST