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Sample Application MA-10-19-0539-19
Project Category: Lifelong Learning

University of California Museum of Paleontology

Amount awarded by IMLS: $122,485
Amount of cost share: $124,698

Attached are the following components excerpted from the original application.

- Abstract
- Narrative
- Schedule of Completion

Please note that the instructions for preparing applications for the FY2020 National Leadership Grants for Museums program differ from those that guided the preparation of FY2019 applications. Be sure to use the instructions in the FY2020 Notice of Funding Opportunity for the grant program and project category to which you are applying.

University of California Museum of Paleontology

Modernizing and enhancing *Understanding Evolution* and *Understanding Science* to serve the next generation of teachers and learners

The UC Berkeley Museum of Paleontology (UCMP) proposes modernizing and enhancing two STEM outreach products relied upon by teachers, students, and the broad public: the *Understanding Evolution* (UE) and *Understanding Science* (US) websites (understandingevolution.org, understandingscience.org), which provide engaging, user-friendly resources for learning and teaching about evolution and the nature and process of science that have proven their educational values through multiple external evaluations. They also play an important role in helping federally funded researchers share their broader impacts. These sites are vital resources for the education community, averaging ~6 million visitors annually, but they are at risk. The landscape of the Internet has changed dramatically in the last 15 years. For example, when UE launched, smartphones did not yet exist; today, 35% of the sites' visitors use a mobile device or tablet to access content. While the sites still boast a significant audience of learners, traffic has begun to taper. For example, UE pageviews in a single month peaked at 3.3 million in 2016 and dropped to 3.2 million and 3.06 million the subsequent two years. The changing code base of the Internet, as well as increased sophistication of user expectations, has made keeping the sites secure, functional, and appealing increasingly difficult to accomplish within UCMP's operating budget.

To keep pace with the changing Internet infrastructure, fulfill user expectations, and update content to reflect the latest science and pedagogical priorities, we propose upgrading UE and US along three dimensions:

- **Infrastructure.** We will 1) transition to a content management system (CMS), which will incorporate mobile-friendly templates, facilitate future design upgrades, incorporate the latest security measures, and take advantage of CMS support offered by UC Berkeley, making it feasible to repair, maintain, and expand the sites within UCMP's normal operating budget for another decade, and 2) replace Flash animations (for which Adobe has announced it will cease to support by 2020) with HTML5, the current standard.
- **Design**. While maintaining UE's and US's style and core branding, we will give the websites a clean, modern look and navigation system that conforms to expectations of today's users – e.g., by incorporating a horizontal mega-menu and breadcrumbs that allow users to know exactly where they are within the site and move to other sections of the site with minimal clicks and by integrating seamless links with social media.
- **Content**. In consultation with expert advisors, we will 1) review and revise the content and graphics on the 30 most accessed, high-content pages of each site to ensure that they reflect the latest research and perspectives in the field, as well as recent developments relevant to societal perceptions of science, and 2) explore, refine, and build one new feature type for each site aimed at facilitating visitor interaction with authentic scientific data and highlighting the relevance of site content to real world problems.

These upgrades will be informed by front-end and formative evaluation during the first nine months of the project, implemented over the second nine months, and disseminated to the STEM education community and evaluated over the last six months of the two-year project. The upgrades will also reflect input and review from our scientific and pedagogy advisors, user-centered design experts, and an external evaluation consultant. These upgrades are intended to 1) increase understanding of/interest in evolution/nature of science among teachers, students, and other learners, 2) increase confidence to teach these topics among teacher users, 3) improve the appeal of the sites, 4) expand the audience for the sites, and ultimately, 5) maintain these proven educational resources for another decade. Our success at achieving these results will be measured by extensive pre/post- and post only surveys of site users and by the collection of Google Analytics data. Making these upgrades will benefit the six million users that visit these sites each year from around the world, including the high school and college-level teachers and students that represent our largest audience segment from formal education, as well as the many federally funded researchers who rely on these sites as dissemination venues for their outreach products. Without these upgrades, the sites' dated appearances, clunky navigation, broken animations, and poor display on mobile devices will eventually outweigh the proven value of the sites' content, and learners will turn to less trustworthy sources of scientific information.

University of California Museum of Paleontology

Modernizing and enhancing *Understanding Evolution* and *Understanding Science* to serve the next generation of teachers and learners

Project Justification. The UC Berkeley Museum of Paleontology (UCMP) proposes to modernize and enhance two STEM outreach products relied upon by teachers, students, and the broad public: the *Understanding Evolution* (UE) and *Understanding Science* (US) websites (understandingevolution.org, understandingscience. org), which provide engaging, user-friendly resources for learning and teaching about evolution and the nature of science, respectively. These sites provide a wide variety of quality, vetted resources for use by learners directly (both in formal classrooms and informally on their own) and for teachers at the kindergarten through college levels—from science comics, to research profiles of diverse scientists, to online interactive investigations, to inquiry-based labs and lesson plans. All materials can be freely downloaded and adapted, facilitating use by individuals and educators with limited resources, including those in underserved urban and rural communities. These sites have won multiple awards (e.g., *Science Magazine*'s Prize for Online Resources in Education; see Supporting Document 1 for a list) and endorsements (e.g., the National Association of Biology Teachers, etc.), and represent major outreach initiatives, together averaging ~6 million visitors annually and >2.4 million pageviews per month during the school year.[1] See Supporting Document 2 for letters of support from key stakeholders in the STEM education community and descriptions of how UE and US materials support teacher professional development programs, online learning environments, and more.

UE and US were originally funded by NSF, with UE expansions funded by Howard Hughes Medical Institute (HHMI) and IMLS (*The Tree Room*, LG-26-12-0578-12, which incorporated new resources based on learning research). Those investments have paid off many times over. Multiple external evaluations have shown that site materials support STEM learning, that teachers view the sites as supporting hands-on, inquiry-oriented instruction, and that learners see the sites as clear, comprehensive, and helpful in facilitating their understanding (Kirtman, 2013; Rockman Et Al, 2005a, 2005b, 2005c, 2005d; Stuhlsatz, 2010). Site traffic patterns that triple during the academic year indicate that the sites have a significant audience in formal education, as well as a base that uses them informally. Scientific groups around the world have translated UE into Spanish, Turkish, Portuguese, and Hebrew. There is clearly a need for the sort of accessible, unbiased, scientific information that UE provides, particularly as evolution continues to face attacks aimed at pushing it out of science classrooms (Branch, 2018). The transformative, dynamic view of the process of science that US presents has been embraced by a generation of educators. The US model has been explicitly adopted by multiple textbooks, including the most popular high school and college biology texts (e.g., Miller & Levine, 2014; Urry, Cain, Wasserman, Minorsky, & Reece, 2017), and has informed the Next Generation Science Standards (NGSS). Based on this model, UCMP and HHMI have built an NGSS-aligned interactive journaling tool, which is being incorporated into HHMI's BioInteractive program. On a weekly basis, US fields requests from teachers, curriculum developers, authors, and others to reproduce and adapt US materials for classes, presentations, lab manuals, policy documents, and online learning environments (e.g., see Aldridge, Thanukos, & Bean, 2017).

UE and US also play an important role in helping federally funded researchers share their broader impacts. On a near monthly basis, scientists inquire about co-developing outreach products with UCMP and disseminating them to the sites' audiences. UE currently hosts outreach products funded by NASA and NSF with more in development for both sites. (See Supporting Document 3 for a complete list.)

UE and US are vital resources for the STEM education community, but they are at risk. The landscape of the Internet has changed dramatically over the sites' lifetimes. When UE launched 15 years ago, smartphones did not exist and Facebook had fewer than a million users. Today, 35% of the sites' visits come through a mobile device or tablet, and Facebook has more than two billion users. While the sites still attract a significant audience, traffic has begun to taper. For example, UE pageviews in a single month peaked at 3.3 million in 2016 and dropped to 3.2 million and 3.06 million the subsequent two years. The changing code base of the

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[1] For comparison, the National Science Teachers Association (NSTA) website receives ~300,000 pageviews per month. All web statistics were retrieved from Google Analytics on October 19, 2018, and reflect site data from the years 2016, 2017, and 2018.

University of California Museum of Paleontology

Internet and expanded user expectations have made keeping the sites secure, functional, and appealing increasingly difficult to accomplish within UCMP's operating budget. To keep pace with an advancing Internet, fulfill user expectations, and update content to reflect the latest science and pedagogical priorities, we propose upgrading US and UE along three dimensions: infrastructure, design, and content.

Infrastructure. To improve access and facilitate maintenance and future updates, we will make these upgrades:
- **Transition to content management system (CMS)** – UE and US were built using standard practices of the time: custom PHP-coded templates, resulting in >6000 individual HTML pages that are labor-intensive to update. Further, the version of PHP that existed when these sites were built cannot be upgraded without breaking the sites, is unsupported, and doesn't comply with modern code standards, making our sites and the hardware serving them vulnerable to hacking. Today, state-of-the-art websites rely on a CMS that separates content from design by combining a back-end database with a front-end user interface. CMSs have many advantages; they 1) incorporate mobile-friendly templates that automatically respond to the user's access device for optimal display and improve access for users with disabilities, 2) make future design upgrades less time consuming, 3) constantly incorporate the latest security measures and make it easier to upgrade code to respond to security concerns, 4) will allow more automatic upgrades of our lesson databases, eliminating UCMP's reliance on costly independent contractors that now maintain our aging, custom databases, 5) incorporate search engine optimization, making it easier for users to find our content, 6) allow access to thousands of plugins, including those that support social media integration, for added functionality that Internet users have come to expect, and 7) are supported by UC Berkeley campus technology resources, making it cost-effective to repair, maintain, and expand the sites in the future.
- **Replace Flash animations**. UE and US include many Flash animations and interactives. When they were developed, Flash was the most widely used platform for online animation. However, since then, Apple devices (which prohibit Flash) have increased their market share (~17% of visitors access the sites via an Apple device), and major browsers have dropped support for Flash. Adobe, Flash's creator, will stop supporting and offering the Flash Player by 2020. To address this forced obsolescence, we will transition all Flash animations to HTML5, the current standard, which operates on any browser and web-enabled device.

Design. Internet trends and capabilities move rapidly. Some industries recommend website redesign every 2-3 years (Reynolds, 2014); UE and US were last redesigned in 2010. While the current sites work for established users, their dated designs likely deter some new users (particularly Internet savvy youth and new teachers for whom the sites' content has only recently become appropriate). While maintaining UE's and US's style and core branding, we will give the websites a clean, modern look and navigation system that conforms to modern expectations – e.g., by incorporating a horizontal mega-menu and breadcrumbs that allow users to know exactly where they are within the site and move to other sections of the site with minimal clicks, by leveraging modern fonts to increase readability and visual interest, by integrating seamless links with social media, by using full screen design to make content feel less cramped, by transitioning to an up-to-date 2-D design aesthetic, etc. Formative evaluation will explore these upgrades with users, informing revamped designs that improve the appeal and usability of the sites for new visitors while maintaining continuity for our existing audience.

Content. While the scientific information the sites provide remains important and accurate, UE does not reflect the expanded knowledge that has come about in the last 15 years, particularly as a result of a newly available genetic data (e.g., Koboldt, Steinberg, Larson, Wilson, & Mardis, 2013), and US lacks examples and guidelines relevant to recent attacks on science and the role of social media in promoting science denial (e.g., Farmer & Cook, 2012). Also, since launch, several STEM education policy documents have emphasized the importance of reasoning with authentic scientific data (e.g., AAAS, 2011; National Research Council, 2012; NGSS Lead States, 2013). To respond to these needs and user requests, we will upgrade the sites' content as follows:
- **Update/revision** – In consultation with expert scientific advisors, we will review and revise the content and graphics on the 30 most accessed, high-content pages of each site to ensure that they reflect the latest

research and perspectives in the field, as well as recent developments relevant to societal perceptions of science. Additionally, all evolutionary trees on UE will be reviewed and updated based on the latest genetic and fossil data and on best practices for tree interpretation laid out in the IMLS-funded *Tree Room* project.

- **Expansion** – In consultation with expert pedagogical advisors, we will explore, refine, and build one new feature type for each site aimed at facilitating visitor interaction with scientific data and highlighting the relevance of site content to real world problems. For UE, this might take the form of a "Data Driven" feature – boxed content presenting authentic data from a recent study related to the topic of that page, along with discussion questions for classroom use. For US, this might take the form of a classroom activity addressing the claims of climate change denial from the perspective of the process of science.
- **Access** – Aside from requests to reproduce images/content, for mobile-friendly content, and for animations that work more seamlessly (the latter two of which are addressed by infrastructure upgrades), the most frequent user request is for printable content. A printable version of each UE/US page already exists, but users want to download entire sections of the sites—hundreds of pages. We will develop printable versions of each site's background content, *Evo 101* and *Understanding Science 101*, so that teachers and learners can easily print or download free, tablet-friendly, comprehensive, textbook-style guides to this key content.

Without these upgrades, the sites' dated appearances, broken animations, and poor display on mobile devices will eventually outweigh the proven value of the sites' content, and learners will turn to less trustworthy sources of scientific information. Making these upgrades will benefit the 6 million users that visit these sites each year, including the high school and college-level teachers and students that represent our largest audience segment from formal education (Kirtman, 2013). In addition, these upgrades will serve the many federally funded researchers who rely on these sites as venues for reaching students, teachers, and other learners with their outreach products. Input from these audiences will be incorporated through front-end and formative assessment and through the researchers and educators who will serve as project advisors (see Project Work Plan). This project promotes Lifelong Learning by maintaining, expanding, and enhancing proven STEM education resources used by millions of learners, some reached through teachers' use of site materials in formal environments and many others who use the site to support their own understanding informally.

UCMP is a university-based research collection without physical galleries. However, promoting STEM education is a key aspect of UCMP's mission, which we have fulfilled in a variety of ways, including teacher short courses, graduate and undergraduate training, and most impactfully, web outreach. UCMP has a long history of pioneering web outreach, starting in 1993 with one of the first museum websites in existence. Since we do not have exhibit halls, in a very real sense, our online audience *is* our public, and this project will significantly strengthen our ability to serve them and position us to expand that audience further. The importance of web outreach to UCMP is reflected in our strategic plan, which ranks leveraging our digital resources alongside our physical collections to promote STEM education. In addition, this project will advance elements of our strategic plan that call for expanding the resource base for museum activities by maintaining the UE/US platforms that attract collaborators and funders who wish to reach the sites' broad and diverse audiences to share their work. The extent to which this project advances these elements of our strategic plan can be measured through Google analytics and survey data collected in our summative evaluation (see Project Results).

Project Work Plan. This two-year mainstreaming project will be conducted in three phases: Discovery, Implementation, and Dissemination/summative. The plan incorporates front-end and formative evaluation to ensure the modernized websites effectively serve the learning/teaching needs of their existing and potential audiences and that upgrades improve user experience; this is formally evaluated with pre/post and post-only surveys (see Figure 1 for a summary). We will also incorporate iterative feedback from scientific experts, pedagogy experts, and user-centered design experts. Melissa Collins from the Research Group at the Lawrence Hall of Science will serve as an external evaluation consultant to the project, reviewing all survey instruments and advising on evaluation design. For a detailed timeline, see our Schedule of Completion.

University of California Museum of Paleontology

Figure 1. Summary of development and evaluation plan
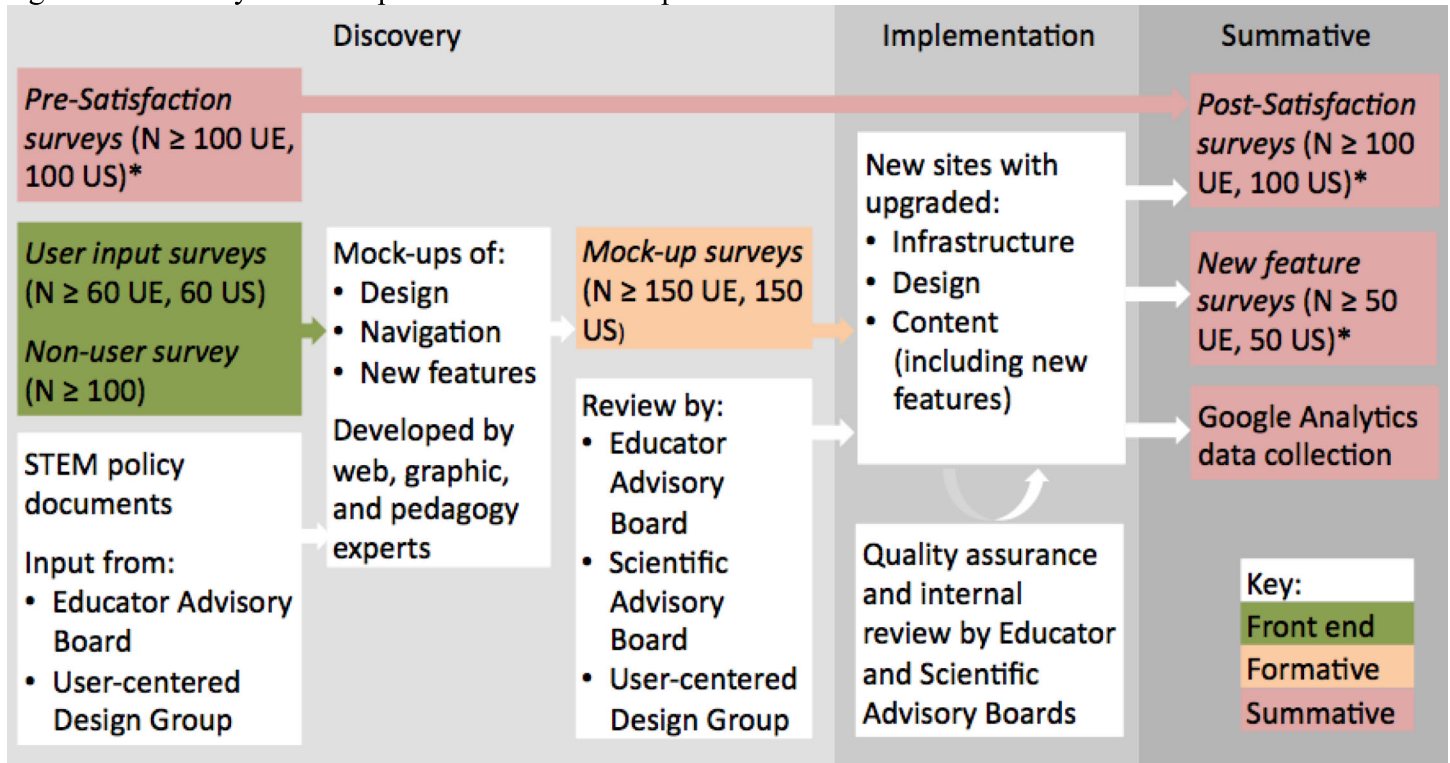
* IMLS Performance Measures included

During Discovery (Year 1, Quarters 1-3; Y1Q1-3), we will undertake activities that gather input from stakeholders, shape design decisions, and position us to assess the impact of upgrades. We will first convene a meeting of our Educator Advisory Board (see below) to provide input on pedagogical priorities for the sites and then conduct a series of online surveys. All surveys (except the *Non-user survey* below) will be implemented as pop-ups, with visitors entering an email address for a survey link to complete after their visit:

- *Pre-Satisfaction surveys* will gather data on users' current perception of the sites' functionality, appeal, and relevance; motivation for visiting; Performance measures; demographics; access device; and user type (whether the user is a teacher, student, or other learner), establishing a baseline for our summative work.
- *User input surveys* targeting each user type (teacher, student, or other learner) will gather broad, open-ended input on the sites' design and navigation (e.g., "Describe any trouble you had finding a particular resource."), as well as the need for and desired traits of a to-be-developed feature type (e.g., "Rank your interest level in the following types of features that could be added to this website.").
- *Non-user survey* will solicit suggestions from educators and learners who don't currently use our sites about resources that might attract them to the sites. The *Non-user survey* will be distributed to potential users via the networks of supporting organizations (e.g., Smithsonian, HHMI; see Supporting Document 2).

The *User input* and *Non-user surveys*, input from the Educator Advisory Board, established guidelines for user interface design (e.g., Garrett, 2011), and priorities outlined in STEM education policy documents emphasizing engagement with scientific data (AAAS, 2011; National Research Council, 2012; NGSS Lead States, 2013) will inform the development of mock-ups for new feature types, site designs, and navigation systems. The design and navigation mock-ups will also be reviewed by the Campus User-Centered Design Group, a consultancy offered by user interface design experts at UC Berkeley, before gathering on-the-ground feedback from users:

- *Mock-up surveys* targeting each user type will then gather feedback on the mock-ups, calling out specific features of the design (e.g., "Where would you click if you wanted to find a lesson plan?") and resources (e.g., "If prompts for essay questions were included, how likely you would be to use them?").

The final design of the new features and sites will be based on those results, as well as an additional round of feedback from our Educator Advisory Board and the Campus User-Centered Design Group. In addition, a Scientific Advisory Board will review and make recommendations for the 30 most accessed, high-content pages on each site. A biology graduate student will review and update all evolutionary trees on UE to align with recent research. Improvements in our work plan that fit in our budget will be made at the end of this phase.

During Implementation (Y1Q4-Y2Q2), we will update content, develop the new resource types, implement the site redesigns, make the infrastructure upgrades outlined in the Project Justification, and develop printable versions of *Evo 101* and *Understanding Science 101*. All content revisions and new resource types will be reviewed by scientific and educator advisors before posting. All infrastructure/design changes will first be built into development sites and will go through extensive quality assurance before launch in Y2Q2.

During Dissemination/summative (Y2Q3-4), the upgraded sites will be disseminated to the STEM education community through a campaign that includes: 1) a kick-off talk, poster, and booth at NSTA (~10,000 attendees) immediately after launch, where teachers can interact with the sites via a tablet computer in our booth and take home promotional material; 2) a Facebook and Instagram ad campaign targeting the STEM education community, as well as a social media campaign through UCMP's, HHMI's, and other supporters' Facebook and Twitter accounts reaching > 200,000 potential users; and 3) promotion in the back-to-school editions of the UCMP, UE, and US newsletters/listservs, which collectively reach >4100 teachers, students, researchers, and learners. We will seek additional dissemination opportunities (e.g., listserv announcements, newsletters, etc.) through the National Center for Science Education, NSTA and state affiliates, National Association of Geoscience Teachers, American Institute of Biological Sciences, Society for the Study of Evolution, and Philosophy of Science Association. Summative evaluation during this phase will consist of 1) administering **Post-Satisfaction surveys** (identical to the *Pre-Satisfaction surveys;* see Fig. 1) to assess changes in perceived functionality, appeal, and relevance resulting from upgrades, as well as **New feature surveys** to assess satisfaction with new features developed, and 2) collecting Google Analytics data on traffic and new site features, and comparing those to a comparable historical period to assess the reach of new features and the impact of infrastructure/design changes. The results of our summative evaluation activities (see Fig. 1) will appear in our final IMLS report, on InformalScience.org, and on UE/US alongside our other evaluation reports.

We will track the progress of our project by our success at meeting the following milestones:
- Y1Q1 – Pre-*Satisfaction/User input/Non-user input surveys* complete
- Y1Q2 – content reviews and mock-ups complete
- Y1Q3 – *Mock-up survey* complete
- Y1Q4 – design/navigation plan and content updates complete
- Y2Q1 – development sites ready for content and printable versions complete
- Y2Q2 – new sites, features, and animations go live
- Y2Q4 – dissemination and summative evaluation activities complete

UCMP's experienced team of web and content developers will carry out the bulk of project activities. PI, **Anna Thanukos,** holds a Ph.D. in Math and Science Education, has been the principal editor of UCMP for 10+ years, is the primary author of UE and US, has training in educational assessment, and has substantial pedagogical expertise as a former biology teacher and professional development educator. She is responsible for ensuring all milestones are met, developing and implementing surveys, developing new content and resources, leading dissemination activities, and reporting to IMLS. Co-PI **Lisa White**, Ph.D., is Assistant Director of Education and Public Programs, led the IMLS-funded *The Tree Room* project, and is the Project Manager of the US and UE websites. She is responsible for reviewing all materials, managing UCMP staff, liaising with the university on grant administration, overseeing budget expenditures, and coordinating project meetings. Webmaster, **Patricia Roque**, has developed professional websites for 10+ years for a range of clients from Fortune 500 companies to small businesses. She has a deep knowledge of CMSs and web design, as well as competency in HTML, PHP, CSS, jQuery, MySQL, and Javascript. She is responsible for implementing the CMS, design, navigation and Flash transitions, and collecting Google Analytics data. Programmer, **Linda Joyce Gross,** is an

Applications Programmer and website administrator, with significant experience in database development. She will advise on the configuration, administration, and moving of UE and US, and will carry out server and development site set-up, as well as security checks. Graphic designer, **Helina Chin**, is a graduate of the Scientific Illustration Program at California State University Monterey Bay with significant experience performing design work for private industry, non-profits, and academic institutions. An advanced user of Adobe CC Photoshop, Illustrator, and Indesign, she is responsible for development of graphic elements for new designs and printable content. An undergraduate will assist with data entry associated with the CMS transition.

Our Scientific Advisory Board specializes in topics addressed by UE and US and is drawn from the prestigious faculty of UC Berkeley (Caroline Williams, evolutionary ecology; Michael Nachman, population genetics and microevolution; Charles Marshall, paleontology and macroevolution; Carl Rothfels, phylogenetics) and the University of Pennsylvania (Michael Weisberg, the history and philosophy of science), and Villanova (Deena Weisberg, development of scientific reasoning, public understanding of science). Our Educator Advisory Board consists of a range of master educators whose specialties reflect the diverse initiatives site materials support: Betsy Barent (middle school science), Nicoline Chambers (high school science), Stephanie Keep (educational content development), Allison Kittay (AP and high school science; teacher professional development), Andrew Petto (undergraduate science education), Judy Scotchmoor (middle school science), Sarah Soule (informal education, teacher professional development), and Calvin Young (community college science education). See Supporting Documents 4 & 5 for letters of commitment and educator bios. Melissa Collins, Ph.D., will bring her extensive experience with educational research and evaluation to the project as an external evaluation consultant. A biology graduate student will be employed to review evolutionary trees.

Most of the resources required to carry out this project are human ones. Our budget includes $166,689 in salary/benefits to fund 68 weeks of staff time – roughly 40% will go to infrastructure/navigation upgrades, 30% to content upgrades, 15% to evaluation/dissemination, 10% to coordination/administration, and 5% to design. We request $1000 for honoraria for advisors, $950 for evaluation incentives, and $9100 for dissemination. All work can be carried out on existing hardware with open source software. UCMP and Berkeley Natural History Museums will continue to provide server maintenance, back-up, and administration at no cost to this project.

The goals of this project are to upgrade UE and US to better serve teachers, students, and other learners with accessible, accurate educational materials about evolution and the nature of science. UE/US have a proven track record of supporting STEM learning through multiple external evaluations (see Project Justification), suggesting that the upgraded sites, which will engage the same approach with many enhancements, will as well. This project entails minimal risks. The biggest challenge will be customizing the open source CMS to have a similar function to our lesson databases; however, Roque has analyzed the flow of the current databases and determined that this will be possible within a CMS. In addition, the project risks neglecting to convert sections of the sites or leaving links broken. We will manage this risk by tracking workflow in a spreadsheet and focusing on the quality assurance period that is built into our Schedule of Completion. The project runs the risk of making design, navigational, and resource changes that are unappealing or unhelpful to users. We have managed this risk by building extensive opportunity for stakeholder input into our Discovery phase and incorporating review by pedagogy and user-centered design experts. Finally, the transition to a CMS inherently mitigates another risk—that the sites will require another redesign 2-3 years as user expectations shift—by making it possible to redesign the sites easily and cheaply within UCMP's normal site maintenance budget.

Project Results. The problem we have identified is that two STEM outreach products with large audiences and proven learning benefits are becoming outdated and risk technical obsolescence. In response, we propose developing two tangible products: upgraded versions of (1) UE and (2) US with expanded content, modern design, improved functionality, and flexible back-end infrastructure. In the short term, we expect these products to support understanding of and interest in evolution/the nature of science and teachers' confidence to address these issues (our three Performance measures), as well as to improve the sites' appeal and attract new users. We will assess our success at meeting our short-term goals through data collected during the Dissemination/ evaluation phase (Table 1). Data on user type, demographics, and access device will be used to examine how

outcomes differ based on other audience traits. As indicated below, we will collect data on our three Performance Measures from ≥300 users across both sites and will include results in our final IMLS report.

Table 1. Evaluation strategy. Multiple survey items/statistics will be used to assess each indicator.

Indicators	Example survey item/web statistic	Data source (N)
Goal: Increased understanding of/interest in evolution/nature of science among teachers, students, and learners		
Users perceive sites as contributing to learning/interest	My understanding has increased as a result of this website.* (Likert rating)	*Post-Satisfaction survey* (≥100 UE, 100 US)
New features are perceived as useful and to support learning/interest	(for teachers) Rate how likely you would be to use this feature with your students or recommend it to another teacher.	*New feature survey* (≥50 UE, 50 US)
Goal: Increased confidence to teach these topics among teacher users		
Teachers users report increased confidence/preparedness	(for teachers) I am confident I can apply what I learned from this website.* (Likert rating)	*Post-Satisfaction survey* (≥100 UE, 100 US)
Goal: Users perceive upgraded sites as more appealing/current/useful		
Infrastructure upgrades result in improved, more functional display	Rate how well this site displayed on your device.	Comparison of *Pre/Post-Satisfaction survey* results (≥100 UE *Pre*, 100 UE *Post*, 100 US *Pre*, 100 US *Post*)
Design/navigation upgrades make sites more appealing/navigable	Rate how easily you were able find what you wanted on this site.	
Content upgrades increase perception that sites are relevant, up-to-date, useful	Rate how well this site informed you about recent advances in the field.	
Upgrades increase overall user satisfaction	Rate how likely you are to recommend this site to a friend.	
More pages visited	Pages/session and time/session are greater than in a comparable previous period.	Google Analytics (~2.4 million sessions for UE and ~610,000 for US during data collection)
More time spent on sites		
Goal: New users are attracted to sites and use their resources		
New users find useful information/tools	(for first time visitors) Rate how likely you are to revisit this site to access information and resources.	*Satisfaction* and *New feature surveys* (≥150 UE, 150 US)
Sites' audience grows	Visitors/month is greater than in a comparable previous period	Google Analytics (see above)

* = IMLS Performance Measures (All three relevant measures will be used each time.)

Ultimately, these upgrades will position us to provide the STEM education community with effective, accessible learning resources for another decade. Notably, the infrastructure upgrades will increase our capacity to make *future* design and technical updates. These changes will also help attract the next generation of users who expect seamless mobile access, growing our audience and increasing the sites' utility for collaborators developing new outreach products. See logic model in Supporting Document 6. Ongoing data collection via Google Analytics and internal record keeping post-grant will allow us to assess our success at meeting these long-term goals.

UCMP is committed to sustaining these sites long term, annually investing a minimum of $30,000 from our endowment to staff time and technology that directly support UE/US (in addition to outside grant funding for new site resources, which we will continue to seek). However, UE and US are approaching a crucial moment as the Internet advances around them: without a major round of upgrades (with a one-time cost that exceeds our annual maintenance budget for the sites), the future of these valuable digital resources is at risk.

University of California Museum of Paleontology

Modernizing and enhancing *Understanding Evolution* and *Understanding Science* to serve the next generation of teachers and learners

Schedule of Completion

Phases: **Discovery** (Year 1: Q1 Oct–Dec, Q2 Jan–Mar, Q3 Apr–Jun) · **Implementation** (Q4 Jul–Sep; Year 2: Q1 Oct–Dec, Q2 Jan–Mar) · **Dissem/Summ** (Q3 Apr–Jun, Q4 Jul–Sep)

Task	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Evaluation																								
Pre-Satisfaction survey	■																							
User input/Non-user surveys			■																					
Mock-up survey							■																	
Post-Satisfaction survey																						■	■	■
New feature survey																						■	■	■
Analytics data collection																			■	■	■			
Summative data analysis																							■	■
Infrastructure upgrades																								
CMS transition																								
Prepare CMS database										■														
Create development sites											■	■												
Populate CMS database													■	■	■									
Quality assurance																	■							
Launch new sites																		■						
Flash replacement																								
Port to HTML5																	■							
Quality assurance																		■						
Post new animations																		■						
Design/navigation upgrades																								
Develop mock-ups				■	■																			
Input from educator advisors	■					■																		
Input from user-centered design experts						■				■														
Develop final design										■														
Content upgrades																								
Update/revision																								
Content review by scientific advisors				■	■												■							
Input/review from educator advisors	■												■											
Tree review by grad student									■															
Develop revised content										■														
Post revisions																								
Expansion																								
Develop feature mock ups				■																				
Draft new features													■				■							
Input/review by educator advisors	■					■																		
Review by scientific advisors																								
Finalize and post features																		■						
Access																								
Develop printable versions											■													
Post printable versions																								
Dissemination																								
Promote at NSTA																			■					
Facebook/Instagram ad campaign																						■	■	
Social media campaign																								
Announce in UCMP and other outlets																			■					
Post evaluation report																								■