

Cal Poly Humboldt Library Planning Grant Proposal
LG-255157-OLS NLG to IMLS National Leadership Grant Program
3D Digital Herbarium & 3D Exhibits4Learning
Narrative

Introduction

After a year of photogrammetry research and software development, the Cal Poly Humboldt Library launched the world's first 3D Digital Herbarium (library.humboldt.edu/3d-digital-herbarium) encompassing over forty 3D models, with the release of the Version 1 [open source](#) software on January 24, 2024. Our 3D Digital Herbarium showcases 3D specimens, relevant 2D digitized herbarium specimen sheets, botanical and location information, and student annotations. Our initiative was to create an immersive 3D web-based interface that inspires and improves botanical education to all ages by making herbarium information more accessible, and connecting botany students, faculty, citizen scientists, and community to learn about native plants in California. The project provides an engagement framework for students to develop their skills with 3D modeling and communicating science worldwide, while also expanding learners' access to specialized collections within an immersive learning experience.



Interest in the 3D Digital Herbarium has steadily grown since our presentation to the Access Conference (October 2023), Canada's premier library technology conference, and the presentation at the forthcoming Coalition for Networked Information's spring meeting on March 26, 2024. In addition, this project is being honored with the 2024 ALA RUSA Best Emerging Technology Award (BETA) in the original technology category.

Our goal is to leverage our initial botany system design and expertise, analyze the needs and feasibility for 3D exhibits as learning environments, and plan the programming of 3D Exhibits4Learning, a flexible open source immersive platform. The 3D Exhibits4Learning would provide a simple and powerful open source and hosted platform for galleries, libraries, archives, and museums to publish 3D digital collections with rich annotations and interactive online exhibits for learning in any discipline. Through these 3D exhibit projects, we are also preparing students to develop future skills in 3D modeling and simulation tools that have tremendous potential to advance teaching and learning, research and scholarship.

The Cal Poly Humboldt Library seeks support from the Institute of Museum and Library Services' National Leadership Grant Program in the form of a Planning Grant for \$149,869 to expand the codebase of the 3D Digital Herbarium and to create 3D Exhibits4Learning. Planning will include consulting with stakeholders in various disciplines and further research and testing 3D project ideas with an array of institutions, as we build a prototype immersive learning software to meet the needs of galleries, libraries, archives, and museums. Institutions using the 3D Exhibits4Learning will be able to host interactive 3D exhibits of specialized collections, engaging learners' curiosity of disciplines from Archeology to Zoology. The 3D Digital Herbarium, and future 3D Exhibits4Learning, are specifically designed to advance and share 3D photogrammetry methods, provide open source and hosted 3D exhibition tools tailored for engaged learning, and provide hosted and archival options for galleries, libraries, archives, and museums.

The IMLS NLG Planning grant award would enable the Cal Poly Humboldt Library to plan and refine the 3D Digital Herbarium based on research detailing how institutions are currently exhibiting 3D models for teaching and learning, and to test a prototype with 4-5 pilot collaborating institution types and disciplines, such as project partners' the Cal Poly Humboldt's Vertebrate Museum and the Empire State University Library in New York. In order to create a flexible platform called 3D Exhibits4Learning, this planning grant will provide the research and testing of a variety of disciplines, including an institution that serves diverse communities, and to plan the roadmap of 3D Exhibits4Learning prototype to a Version 1 that can be easily adopted and adapted to any disciplinary 3D exhibit. During the grant period, pilot libraries, museums, and other cultural institutions will have the opportunity to host their own exhibits or cooperate with shared exhibits and provide feedback on our development site. The IMLS support for planning would also enable the Project Team to research and plan for digital archive service options that meet various needs and align with FAIR (Findability, Accessibility, Interoperability, and Reusability) data principles.¹

Project Justification

The 3D Digital Herbarium & 3D Exhibits4Learning planning project is most aligned with IMLS Agency Goal 3: Advance Collections Stewardship and Access; Program Goal 3: Improve the ability of libraries and archives to provide broad access to and use of information and collections; and Objective 3.3: Support the design and development of online library and archives services that meet user expectations for operating in an online environment.

Preparing students for the future workforce includes fluency with 3D modeling and simulation tools and associated visualization skills that are increasingly expected by learners in our schools, colleges,

¹ Wilkinson, M., Dumontier, M., Aalbersberg, I. *et al.* The FAIR Guiding Principles for scientific data management and stewardship. *Sci Data* 3, 160018 (2016). <https://doi.org/10.1038/sdata.2016.18>

and worldwide. The 3D Digital Herbarium and proposed next generation software, 3D Exhibits4Learning, are related 3D frameworks to reimagine disciplinary learning with specialized collections as immersive digital exhibits that enable interactive discovery of collections that would otherwise not be accessible. This planning grant is aligned with promoting advancing collection stewardship and access, and since the COVID-19 pandemic, we see a strong need for immersive online interactives, and a need to improve the ability of GLAM institutions to provide access and use of their unique collections. Traditional herbarium collections are not easily accessible because of their storage requirements and contain dried flattened specimens that lose their color and shape. Digitized herbariums are simply digitized photographs of the 2D specimen sheets. Due to their flat and complicated geometries, plants prove to be the most challenging specimens to scan and model in three dimensions in the exploratory work to date, involving considerable photogrammetry and 3D modeling research. As of February 27, 2024, we have successfully published, as new forms of scholarship, forty-one 3D models with student botany annotations in an online environment that connects with digital herbarium and other botanical datasets. Included in the 3D Digital Herbarium Version 1 is an experimental model of the internal layers of a pine tree, allowing end users to explore interior cellular structures, such as the phloem and xylem. The 3D Digital Herbarium exhibitions offer augmented and virtual reality views, as well as an inspirational and interactive touchscreen kiosk experience that gives a very authentic representation of the colors, characteristics, and structure of the plants, so crucial to plant identification. Few GLAM institutions have created 3D digital exhibits, and often they are simply a 3D model embedded in a website. This project will provide GLAM institutions the opportunity to expand access to their collections, inspiring learners worldwide with 3D immersive access to unique collections and information, while also enabling student assistants to learn powerful skills that support libraries and archives digitizing often hidden collections.

The research on digital 3D models in teaching effectiveness or learner motivation has been extensive, (Castro, Amazon, Bidau, Martinez 2022; Di Serio, Ibanez, and Kloss 2013; Ho, Sun, and Tsai 2019; Williams and Williams 2011; Yair, Mintz and Litvak 2001). Imagine the importance to learners accessing 3D models representing art, artifacts, geology, plants, or wildlife that would require expensive travel to see. Of particular relevance to the importance of the 3D Digital Herbarium is the research by Kathleen Mahra da Silva Aclantara Casto and colleagues on the impact of 3D models in teaching, learning, and motivations. In 2022, they identified the importance of access to natural history museums for student learning along with a scarcity of natural history museums. The COVID-19 pandemic showed the importance of student access to virtual representations of biological specimens. The results of their study show that students using 3D digital models had a significant positive difference in knowledge than the practice and control group. "...the use of three-dimensional models seems to be an excellent teaching tool for students' learning... Motivation is one of the most important factors that can influence the students' learning process. Therefore, motivated students become more interested and engaged, increasing their learning outcomes... Moreover, we showed that 3D models of amphibians are equivalent to real biological specimens and can be used in zoology teaching."² Similar findings from an earlier study by chemical education researchers Amal Fatemah et al., in their 2020 publication showed a positive effect on students' test results from using 3D visualization of chemical structure diagrams.³ Alexandra Hain and Sarira Motaref's study of augmented reality as a visualization tool for undergraduate engineering students provides an excellently designed study of the learning impact of 2D representations compared to 3D, and their findings. "Students who had access to 3D models performed better in identifying failure modes and project geometry compared to those who had access to 2D models. The improvement was particularly evident for students who had lower scores on Exam 1."⁴ This planning grant will enable the Project Team to plan the designs with feedback that can successfully guide the code expansion using the 3D Digital Herbarium as a

² Castro, Kathleen Mahra da Silva Alcântara et al. (2022) "Studying Natural History Far from the Museum: The Impact of 3D Models on Teaching, Learning, and Motivation." *Journal of biological education* 56.5: 598-608.

³ Fatemah, Amal, et al., (2020) "Interactive 3D Visualization of Chemical Structure Diagrams Embedded in Text to Aid Spatial Learning Process of Students," *Journal of Chemical Education*, 97:992-1000.

⁴ Hain, Alexandra, Sarira Motaref, (2023) "Evaluation of Augmented Reality as a Visualization Tool to Enhance Undergraduate Engineering Students' Performance in an Entry-Level Course," *Journal of STEM Education*, 24.1: 23-30.

prototype. The 3D Exhibits4Learning prototype will support galleries, libraries, archives, and museums with the tools and methods to create or collaborate on hosting 3D models for effective teaching and learning interactive and immersive learning environments.

This ground-breaking project serves as a uniquely engaging learning environment available on the open web, and helps expand our understanding of botany. It also serves as a project or classroom for students creating these exhibits. This project involves creating an open source presentation tool that enables linking 3D models with annotations and integrating other resources using APIs, including services such as [iNaturalist](#), [Global Biodiversity Information Facility](#) (GBIF), a network of over 2,285 publishers, and other participants aggregating biodiversity data. The 3D Digital Herbarium currently connects with iNaturalist, a community of over 7.3 million biologists, citizen scientists, and naturalists, provides an extensive network of approximately 175M observations of biodiversity across the globe and is currently used in Cal Poly Humboldt's Botany assignments. For the purpose of visualizing concepts, testing designs, and developing solutions, 3D modeling has emerged as a crucial skill and competency in many professions. Libraries play an important role in inspiring and encouraging learning 3D modeling techniques across all academic fields. In creating a 3D Digital Herbarium, we discovered how our research advancing photogrammetry and software development advances botany education, while creating a powerful collaboration with computer science and botany students. Cal Poly Humboldt has a strong botany program with a greenhouse and herbarium facilities which is important for the continued growth of the 3D Digital Herbarium. With support from IMLS, the Cal Poly Humboldt Library will expand the codebase of the 3D Digital Herbarium to serve as a 3D Exhibits4Learning tool, adding features such as class assignment and citizen science roles for contributing 3D models and annotations. A hosted version that scales as a library cooperative framework will be provided for California State University Libraries, other libraries, museums, and pertinent cultural organizations to host and share their 3D exhibits. In addition, this project plans to test multiple disciplines to enhance the functionality to meet a variety of needs for tailoring exhibits to illuminate learning with and across disciplines, from Archeology to Zoology.

After extensive research, we have not found an existing open source platform that combines the features of a library of 3D models with integrated rich annotations comparable to the 3D Digital Herbarium. Of great interest to the roadmap planning for 3D Exhibits4Learning will be researching the interoperability with [Omeka](#), an open-source web publishing platform for online exhibits. Cal Poly Humboldt Library currently has 15 Omeka.net sites, including [The Gasquet Orleans Road](#). The degree of integration may enable strong connections to a significant community of online exhibit curators and projects. That said, to specifically address our IMLS preliminary grant proposal peer reviewer comment about Omeka as a duplicate exhibit platform, we reached out to Omeka.org about the use of their platform for 3D exhibits, and their staff identified the [Eel River Archaeological Omeka 3D prototype](#) published by the Plimoth Patuxet Museums that has ceased as a project. The Eel River Archaeology prototype lacks the 3D model annotation and detailed interactions demonstrated by the current [3D Digital Herbarium](#); for instance, using the experimental slider for the *Pinus* enables learners to discover the internal structures of the tree, phloem, and xylem. The spatially specific annotations with the 3D Digital Herbarium enable user interactivity to open text, photos, videos, maps, and 3D models. According to staff at Omeka.org, there is only one example of a viewer plugin that enables Omeka S (Not Omeka.net or Omeka Classic) to show a 3D model, however, this combination of Sketchfab and Omeka S does not provide detailed annotations and additional information that interact with the 3D models. That said, institutions may be interested in using the Omeka Universal Viewer plugin to access 3D Digital Herbarium to interact within an Omeka exhibit.

Cal Poly Humboldt Library has an extensive and successful record of prototyping open-source software through collaborating with the Computer Science Software Engineering class, hiring students and staff to build prototypes to Version 1 and 2 releases, and hiring Botany students to write annotation and 3D modeling. As a real-world project-based learning initiative that starts in the curriculum and continues as a co-curricular experience, we provide students amazing opportunities to have an impact on advancing their learning by opening learning globally with new forms of discovery

and scholarship. The 3D Digital Herbarium provided the initial use case for opening up traditional herbarium collections to learning botany in an immersive environment. We are eager to expand this tool and practice to meet the needs of many disciplines, such as: agriculture, anthropology, archeology, art, geology, history, soil, wildlife, and zoology.

Schedule of Completion

Schedule of Completion	Grant Period: 8/1/24 - 9/30/2025			
	Pre-Grant	Phase 1: Aug. - Dec. 2024	Phase 2: Jan. - June 2025	Phase 3: July - Sept. 2025
Continue researching 3D practices across disciplines.				
Recruit institutional and partner advisory collaboration				
Hire 3D Digital Herbarium Project Team, Library Scholar Internships, etc.				
Research and identify data sources for selected discipline				
Develop interactive features and engagement strategy				
Design Prototype Testing Plan				
Refine code for testing prototype 3D Exhibits4Learning				
Test Iterative Prototypes & Seek Feedback				
Finalize Prototype Release: refine code, debug, and known issues				
Develop and Implement Dissemination Plan; documentation, training, feedback				
Release Prototype: GitHub & shared instance trial; zoom workshops for GLAMs interested in launching prototype				
Project Evaluation: Analyze feedback and suggestions, community interest, and determine sustainability requirements				
Roadmap: seek and identify feedback for Version 1, community contributors for programming, photogrammetry, etc.				

Project Work Plan

Phase: Pre-Grant Activities January 2024 - August 2024

The Project Team consists of existing library personnel with an open invitation to faculty and staff from various disciplines to collaborate. Cyril Oberlander, Library Dean, is Project Sponsor. AJ Bealum is the dedicated, full-time Project Manager and Programmer, providing overall project management for

the 3D Herbarium project. There is also support from additional library personnel, including Botany and Computer Science Student Assistants and Library Scholar Interns. Botany Student Assistants focus on the 3D Photogrammetry of specimens they gather, while the Computer Science Student Assistants assist with 3D Photogrammetry of various disciplines, code refinement, and debugging. The grant funding will be dedicated to funding the Project Manager & Programmer position (\$99,106), with the remaining funding going to Sponsored Programs (\$48,263) for administering the grant, and \$2,500 for ten advisory stipends. The considerable in-kind contribution includes the Project Sponsor, Library Staff, paid Student Assistants, and paid Library Scholar Interns.

Since releasing Version 1 of the 3D Digital Herbarium on January 25, 2024, our ongoing research and development plans continue with engaging a variety of stakeholders to understand their interest and work with 3D models. In fact, the launch celebration gathered suggestions from approximately 80 attendees from the campus community on what they would like to see in 3D exhibits. The Cal Poly Humboldt Vertebrate Museum indicated strong interest in a vertebrate 3D exhibit, and after viewing their specimen collection, we have made some preliminary 3D models and trained their staff on photogrammetry techniques. As indicated in their Letter of Support (see Appendix A) dated March 15, 2024, Dr. Silvia Pavan, Curator of the Vertebrate Museum, and Alyssa Semerdjian, Collection Manager, are planning to collaborate by providing zoology expertise and feedback on the future of the 3D Digital Herbarium as a 3D Exhibits4Learning. We have also received two Letters of Support from libraries in New York, as well as the IDS Project, a library cooperative of 120 libraries across the nation. Important notes concerning the library letters of support: Mark Sullivan, Executive Director of the IDS Project, is an extraordinary programmer and will be instrumental in providing prototype feedback and suggestions for developing an open source system and building a community of contributors. In addition, to support the development of immersive instructional interactives, we are honored with the support of SUNY Geneseo Library and Empire State University Library, each having a distinguished record of library instruction leadership and innovation. Lastly, Dr. Mark Strover, Dean of CSU Northridge Library's Letter of Support dated March 18, 2024, indicates "This initiative holds great promise for advancing education and innovation within the California State University system and beyond... also paves the way for innovative methods of rendering specialized collections more widely accessible through immersive learning experiences." Most recently, a preliminary conversation with Dr. Zack Lischer-Katz and Matt Cook, Co-PIs for the IMLS implementation grant ([LG-254830-OLS-23](#)), a partnership of University of Arizona and Harvard Library to study 3D data content creators to develop a digital curation framework, were impressed with the pedagogical approach of the 3D Digital Herbarium project, and expressed interest in continued conversations and the possibility of serving as potential advisors.

The pre-grant phase will include researching interactivity and gameflow to expand learner engagement strategies, researching various institutions advancing 3D modeling for teaching and research, and reaching out to learn of their plans for curating and providing access to the 3D models. Some of the foundations for development of interactivity will be informed through leveraging a taxonomy of interactive/gaming elements⁵, and related research in the effectiveness of interactivity. Building on research in interactive learning environments by Baginda Anggun Nan Cenka et al., we see our work advancing exploring Activity Theory as engagement strategy in personal learning environment technologies.⁶ Important pre-grant research will focus on relevant interactives in prospective disciplines, and any related assessment of learning results.

Currently, our Botany students are developing basic anatomical models that represent typical plant cells and structures to become a botanical reference point for learning basics from microscopic and

⁵ Toda, A.M. et al., A Taxonomy of Game Elements for Gamification in Educational Contexts: Proposal and Evaluation, 2019 IEEE 19th International Conference on Advanced Learning Technologies, (ICALT).

<https://ieeexplore.ieee.org/document/8820847> or <https://durham-repository.worktribe.com/output/1142410/>

⁶ Baina Anggun Nan Cenka, Harry B. Santoso & Kasiyah Junus (2023) Personal learning environment toward lifelong learning: an ontology-driven conceptual model, *Interactive Learning Environments*, 31: 10, 6445-6461. <https://doi.org/10.1080/10494820.2022.2039947>

macroscopic perspectives, and across lifecycles. In addition, our Botany student assistants will continue photogrammetry and create 3D plant models to expand the collection in the 3D Digital Herbarium to 100 specimens. Lastly, the Project Team will develop many resources to be implemented during Phase 1 activities, such as identifying data sources and existing projects in potential disciplines such as the comprehensive list of Anthropology sources and techniques in Markus Bastir et. al. article “Workflows in a Virtual Morphology Lab: 3D scanning, measuring, and printing”.⁷ The Project Team will also research 3D models and interactives currently used by GLAM institutions.

Phase 1: Research August 1 - December 2024

The Project Team will expand by inviting students from various academic disciplines to apply for a Library Scholar Internship to research and mock up interactive exhibits to showcase discipline collections, annotation structures, and relevant resources. The Interns will also test iterations of the prototype and provide additional outreach to faculty and assignments where 3D modeling may be of great interest. Outreach for recruiting partners and advisors will include other California State Universities through the CSU Library Network, as well as outreach to various galleries, archives, and museum organizations. The Project Team will select a multidisciplinary partner and advisors of academic college faculty, library, and museum representatives. The Team will present mockups and models for feedback, and gather feedback for design and features of the 3D Exhibits4Learning, as well as relevant data services that will be crucial to student learning in those disciplines or exhibits. Our collaborative partner advisors will include institutions already identified in the pre-grant phase: Cal Poly Humboldt Vertebrate Museum, Empire State University Library, IDS Project, and SUNY Geneseo Library, as well as others yet to be determined and confirmed in Phase 1.

The Project Team will research interactivity features for feedback and review by institutional and advisory partners, develop mockups and prototype various disciplines’ 3D Exhibits use cases, provide sprint presentations, and gather design and testing feedback. Critical to this phase, is the design and testing of workflows using the exhibit tool as classroom activities and internships. The Project Team will design the prototype testing plan for Phase 2 iterative build out and feedback using a periodic sprint refinement of the code and testing methodology. Documentation for testers will include varied techniques and workflows including photogrammetry, creating 3D Exhibits, and design of annotation interactivity.

Phase 2: Testing and Refinement January - September 2025

The Project Team will focus on testing various iterations of the prototype, seeking feedback for future sprints in an agile software development process. Phase 2 requires seeking and incorporating feedback on several testing instances or features that the Project Team will be building into the code. The feedback will range between discipline exhibit features and data, photogrammetry techniques required to produce desired 3D models, and end-user features. Communication about the project will include monthly zoom or face-to-face meetings with partners to gather feedback. Additionally, periodic emails will be sent asking for feedback on interface design and interactive behaviors. The Project Team intends to understand the types of interactive quizzes, puzzles, or activities that the libraries and museums see as engaging learners in their selected discipline. Similarly, the Project Team will invite partners and advisors to share examples and provide feedback on various student submission systems and workflows.

The Project Sponsor, with additional support, will gather feedback from collaborative partners and advisors, providing the results to the Project Team. The Programmer and Project Manager will direct all technical aspects of the project and the Student Assistants will provide much of the photogrammetry testing and documentation of methods. The Computer Science Student Assistant will provide web development support and usability testing, working collaboratively with the Accessibility

⁷ Bastir, Markus, et al., (2019) Workflows in a Virtual Morphology Lab: 3D scanning, measuring, and printing,” *Journal of Anthropological Sciences*, 97, 1-28.

Technology Initiative's Academic Resource Center staff at Cal Poly Humboldt. Library Student Assistants will work approximately 30 hours per week for the duration of the grant. Funding will come from existing Library Foundation funds and the library's fundraising to support this project starting on April 3, 2024, with a Giving Day campaign.

Feedback will be primarily addressed in the release of the Prototype 3D Exhibits4Learning by July 2025, while other suggestions may become enhancement features for a future Version 1 full release. Phase 2 includes substantial refinement of code, debugging, and identifying known issues to prepare the release in Phase 3, as well as preparing documentation and training materials. Important to this phase of development is designing for usability and testing for compliance with WCAG 2.1 level AAA, and periodic review by the Cal Poly Humboldt Accessibility Resource Center. New features to be added in Phase 2 include adding various submission workflows, user roles, and authentication schema (such as CAS, LDAP, Shibboleth). We are considering an integration with Omeka's submission workflows as a potential integration and sustainability strategy, however, evaluating possible use cases with partners will determine the most appropriate requirements. Phase 2 will also include evaluating at least three archival models (likely Digital Commons, GitHub, and Internet Archive), so that contributing partners or locally hosted sites will have effective options to store 3D models and the hundreds of digital photographs that are required to build a 3D model. The Project Team will also ask the partners to review the training documentation for publication, to be finalized and released in Phase 3.

The Project Evaluation and Roadmap to Version 1 begins late in Phase 2. In order to prepare the launch, the Project Team and partners will reflect on the development and implementation in order to determine the customizations and fine-tuning necessary for the prototype, or for the future Version 1 release. This reflection will be important also to evaluate an implementation grant proposal that we intend to submit if successful. Lastly, to prepare for the release of the prototype, and to attract potential early adopters and collaborators in Phase 3, the Project Team and partners will outreach with their existing prototypes to gauge interest and feedback.

Phase 3: Provide outreach and training for the 3D Exhibits4Learning July - September 2025

The Project Team, in collaboration with Partners, will publish the prototype 3D Exhibits4Learning on GitHub, sharing the open source software and documentation as open access for libraries and other organizations interested in using the 3D Exhibits tool. The Project Team and Partners will provide outreach to various library, gallery, and museum listservs, as well as submitting conference proposals. Project papers and presentation recordings, and project updates will be made available free online from our project page: <https://library.humboldt.edu/3d-digital-herbarium>

The Project Team will provide face-to-face and online zoom workshops for implementing the 3D Exhibits4Learning either as a hosted or local installation, while also gathering questions and feedback for the Roadmap to Version 1, while forming the project evaluation, determining community interest, and developing sustainability requirements for a future implementation plan. Documentation will be revised as needed. Sustainability planning is integral to every phase of this timeline, including the stability and documentation of the open source code, photogrammetry, and 3D modeling. It will be crucial to develop a community of users and support which is one reason we plan to host the 3D Digital Herbarium for other institutions that are interested in a collaborative instance and in integration opportunities with Omeka and other projects. Cal Poly Humboldt Library will continue developing this platform and intends to reintroduce the project to the software engineering capstone course as an opportunity to develop features as needed.

Diversity Plan

To make the 3D Exhibits4Learning a highly usable resource for GLAM institutions and learners, we must ensure diverse perspectives and usability is well integrated into the project design. Current team includes BIPOC members, and we have reached out and are seeking opportunities to collaborate and include indigenous knowledge and underrepresented expertise for annotations, research, and testing.

We will seek potential contributors and Library Scholar Internships with diverse backgrounds, status, and abilities to provide a broad perspective. One faculty member teaching Critical Plant Studies, has reached out to the Project Team to discuss their idea of connecting the project with their research of Black farmers as an ecology project involving heirloom collard greens and pairing literature with botanical history. Lastly, Cal Poly Humboldt is a Hispanic Serving Institution (HSI) and Minority-Serving Institution (MSI), and we will be reaching out to our [Office of Diversity, Equity, and Inclusion](#) for feedback on our Library Scholar Internship and project design. We will also be collaborating with the Cal Poly Humboldt's [Accessibility Resource Center](#) to support the accessibility of 3D Exhibits4Learning platform. Universal learning design and web accessibility are crucial to ensuring access for everyone, and the 3D exhibits themselves increase learner access to authentic representations of collections that are often inaccessible or unavailable without travel.

Project Results

This planning grant enables the Project Team to research disciplinary 3D exhibits and learning environments in order to refine and test the 3D Digital Herbarium software as an interactive curated framework for any discipline. The 3D Exhibits4Learning will serve as a prototype for institutions to customize interactive exhibit software, showcase specialized collections with interactive stunning exhibits and important information, while also fostering skills development in 3D modeling, and communicating science and other disciplines to the public. As such, the 3D Exhibits4Learning will expand access to library and archive collections for learners, connecting students, faculty, citizen scientists, and community.

This planning grant enables the Project Team to gather critical feedback and testing of the 3D Exhibits4Learning to better understand galleries, libraries, archives, and museums (GLAM) prospective uses of a powerful prototype open-source 3D exhibit tool for the web, as well as augmented and virtual realities. With the feedback and research over the course of the planning grant, we will have more certainty in the design of configuration features that a variety of institutions seek in customizing 3D exhibits for a discipline and institution. It is important the prototype provides some clear examples of adaptable, generalizable, and usable features across institutions and communities.

With the training documentation, GLAM institutions will be able to easily implement a free 3D exhibit tool, learn a variety of photogrammetry methods and archival strategies, and also have an opportunity to cooperatively exhibit on a hosted version. With the prototype, libraries and museums will be able to create and curate 3D models for immersive learning environments that effectively engage and motivate learners in new ways. The Project Team will publish their prototype as open source on GitHub, including the photogrammetry methods and steps, creating exhibits as class assignments or projects using the 3D Exhibits4Learning tool. The Project Team will also provide galleries, libraries, archives, and museums a free online workshop on photogrammetry methods and creating 3D exhibits with the workshop recording available open access. We believe that planning and piloting a 3D Exhibits4Learning platform in this way will ensure the promise of profoundly advancing learner access to specialized collections and increased digitization of rare collections effectively supports GLAMs, and this infrastructure supports students with real-world projects that can innovate scholarly communications and community engagement.

Lastly, in terms of sustainability, launching the prototype as open-source software and hosted option is a crucial step in the planning process, and building community interest in features and feedback for a future implementation project of a Version 1 software development and release, as well as prospective contributors.

Advance 3D Digital Herbarium & 3D Exhibits4Learning				
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Continue researching 3D practices across disciplines.				
Recruit institutional and partner advisory collaboration				
Hire 3D Digital Herbarium Project Team				
Research and identify data sources for selected discipline				
Develop interactive features and engagement strategy				
Design Prototype Testing Plan				
Refine code for testing prototype 3D Exhibits4Learning				
Test Iterative Prototypes & Seek Feedback				
Finalize Prototype Release: refine code, debug, and known issues				
Develop and Implement Dissemination Plan; documentation, training, feedback				
Release Prototype: GitHub & shared instance trial; zoom workshops for GLAMs interested in launching prototype				
Project Evaluation: Analyze feedback and suggestions, community interest, and sustainability requirements				
Roadmap: seek and identify feedback for version 1, community contributors for programming, photogrammetry, etc.				

Digital Products Plan for 3D Digital Herbarium & 3D Exhibits4Learning
LG-255157-OLS NLG Planning Grant
Digital Products Plan

Type

This grant will fund the planning for developing the 3D Digital Herbarium, currently available as open source at: <https://github.com/CPH3DH/3dHerbarium> to be transformed into a 3D Exhibits4Learning prototype for creating digital collection exhibits that include an editorial submission process, and extensible exhibits to support learning a variety of disciplines. Digital products created by this grant project will include:

- 3D Exhibits4Learning prototype source code, the framework includes sets of javascript files and libraries, JSON, MySQL/Prisma, HTML, and other templates and modular components.
- Documentation and training materials, for example: [Photogrammetry and 3D Modeling Details and Workflow](#)
- Various papers, presentations, videos, will be hosted at: <https://library.humboldt.edu/3d-digital-herbarium>
- Photos and 3D models will be created and available with a Creative Commons License Attribution-ShareAlike 4.0 International (CC BY-SA 4.0) and also made available in an open access repository, such as: https://digitalcommons.humboldt.edu/herbarium_photos/

Availability

The 3D Exhibits4Learning, as with the 3DHerbarium.org is an open web environment that makes the 3D models, interactives, and annotations available online free of charge. In addition, the open source code and various training and documentation will be available using GitHub. Hosting the source code and documentation in a public GitHub will allow all of the code and materials to run the prototype available free of charge to everyone. The collaboration and community features will also enable expanding potential contributors and a source of feedback.

The 3D models will be available freely from the 3D Exhibits4Learning, and the photos and 3D models will also be available with a Creative Commons License Attribution-ShareAlike 4.0 International (CC BY-SA 4.0) available in an open access repository, such as: https://digitalcommons.humboldt.edu/herbarium_photos/ and from Sketchfab: <https://sketchfab.com/humboldtlibrary> a 3D repository widely used by libraries and museums.

This project is dedicated to publishing open access any papers, presentations, reports, and videos, making them available hosted or linked from: <https://library.humboldt.edu/3d-digital-herbarium>

The planning grant would enable evaluating the web accessibility of the 3D Exhibits4Learning and ensuring the future Version 1 is as universally accessible as possible. Although the annotations themselves serve as the alternative text for the 3D models, more can be done in the design and development, such as print 3D on demand, or other options to explore usability services. Periodic review by the Cal Poly Humboldt Accessibility Resource Center will be a crucial part of the planning process.

For one of the repositories we currently utilize, according to bepress' Digital Commons accessibility standard: <https://bepress.com/accessibility-statement/>

bepress endeavors to meet all guidelines and standards established by the [Web Content Accessibility Guidelines \(WCAG\) 2.1](#) at level AA conformance, and [Section 508 of the Federal Rehabilitation Act](#). These guidelines define how to make web content more accessible to people with disabilities, and conformance to them improves the web's usability for all people. Digital Commons is partially compliant with WCAG 2.1 at level AA, and we make continual improvements with the aim of achieving full compliance. In certain areas, Digital Commons implements level AAA success criteria. For a detailed review of how Digital Commons conforms with WCAG 2.1 success criteria, please refer to our Voluntary

Product Accessibility Template (VPAT) document. This document was produced by the members of the Elsevier and bepress internal accessibility teams.

Access

The 3D Digital Herbarium is open source using the MIT License, Copyright (c) 2024 CPH3DH with the following terms and conditions:

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We plan to release the 3D Exhibits4Learning prototype under the same MIT License, free of charge.

No privacy concerns or cultural sensitivities exist in the software, however, they may arise from the content and annotations created and curated by galleries, libraries, archives, and museums that utilize the software to create exhibits. Each institution is guided by copyright, policies, and regulations that regulate their online content, one feature to be added to ameliorate this is a take down notice that is part of the configuration setup, as well as a submission notice for adding models and annotations. This planning grant enables us to understand the issues from a variety of institutional perspectives.

Sustainability

The Project Team will plan the building of the 3D Exhibits4Learning from all standards-based files, and analyze archival options that fit various needs from GLAM institutions. In addition to utilizing GitHub and institutional repositories, such as Digital Commons, we will evaluate options, such as CSU's [ScholarWorks](#), [Internet Archive](#), and consider various workflows from advice from our partners and advisors. Hosting services will be offered to the planning partners, as part of the testing of shared instances and editorial workflows; this feature ensures GLAM institutions with fewer system resources can participate in the future.

The Cal Poly Humboldt Library is committed to continuing to maintain and refine the 3D Exhibits4Learning as part of their Library Innovation Hub Project-Based Learning Initiative. This initiative includes voluntary periodic review of Library software by the software engineering capstone course each Fall semester.

Building interest from a broad GLAM community of users and contributors will be key to the planning grant and continued growth of support to maintain and develop the 3D Exhibits4Learning. Consideration of integrating with Omeka and other projects and communities will be one of the sustainability strategies, and certainly, a future IMLS implementation grant application to release Version 1 would be a tremendous step towards sustainability.