Arizona State University

ABSTRACT

Led by Arizona State University (ASU), a collaboration between Arizona State Library, Archives and Public Records (ASL), SciStarter, the National Informal STEM Education Network (NISE Net), and six public libraries, under the guidance of state and national library and museum program directors, proposes a National Leadership project, *Libraries as Community Hubs for Citizen Science*.

The central goal of the project is to enhance libraries' capacity to serve their communities' growing need to gain experience, knowledge, and skills in science, technology, engineering, and math (STEM) domains by developing a scalable toolkit for engaging patrons in citizen science. The increasing demand for science literacy, in both STEM and non-STEM related occupations, is well known, and libraries have always been important anchors for serving their communities with resources and guidance necessary to an evolving workforce and lifelong learners. This project positions the libraries as community anchors, empowering them to promote civic engagement, cultural opportunities and economic vitality by encouraging their patrons to take an active role in finding solutions, alongside scientists, around the science-based community issues. Citizen science enables people of all ages, cultures, and skill sets to engage in real scientific research by collecting or analyzing data that is shared with professional scientists, and it has also been shown to increase public understanding of science. In so doing, the project is meeting the IMLS agency-level goal of placing the learner at the center and supporting their ability to contribute to the collection of data and issues that are relevant and meaningful to them. Distinct from popular STEM activities designed for libraries, like robotics and maker spaces, citizen science advances scientific research across many disciplines and doesn't require significant up-front investment in STEM expertise or technical equipment. Some citizen science projects require the short-term use of low-cost, instruments such as a rain gauge, a clip-on magnifying glass for smart phones, or a water quality sensor. Pilot tests with one project demonstrated increased levels of engagement when public libraries made low-cost tools, bundled with instructions, available for lending using the libraries' existing infrastructure. Still, most projects do not require instruments so using available online resources, even libraries with minimal budgets for STEM programming can engage their communities in authentic science experiences, and connect those experiences with the library's other existing STEM resources.

Libraries as Community Hubs for Citizen Science is a two-year project to develop a field-tested, replicable toolkit of citizen science resources for six public libraries. The toolkit will be scalable so that all libraries, regardless of their financial resources, can offer patrons an effective engagement with authentic science through participation in citizen science. The project team, which has proven expertise in creating kits for hands-on programming, producing STEM resources for libraries, creating and sustaining online communities of practice, and understanding the landscape of citizen science projects and tools, will use those skills to design, prototype, test, and evaluate a scalable citizen science toolkit that offers libraries a range of options for engaging their patrons in citizen science. In particular, the project will leverage SciStarter, an online community that brings together science researchers and citizen scientists, with a database of over 1600 citizen science projects used by over 75,000 citizen scientists to discover projects that match their interests and abilities. Ten kits will be produced for testing and evaluation, which will be conducted in a series of three 12-week cycles during which two libraries, each with five kits, will offer citizen science programming and resources to their patrons. The six participating libraries represent a range of urban and suburban communities, and have demonstrated capacity for offering STEM programming. Summative evaluation will assess the libraries' staffs' knowledge of citizen science and their capacities and sense of self-efficacy in engaging patrons in citizen science activities, and will also measure the extent of patrons' participation in citizen science as a result of the library's programming. The outcomes of the pilot program will be shared among the library, museum, and citizen science communities, and will also inform the project team's planning to refine the toolkit and scale its dissemination, initially to more Arizona communities, through the AZ State Library Association, and then nationally. We intend that the project's activities will increase a library's capacity to engage their community in STEM activities and learning, and will extend and strengthen the library's role as a community anchor by effectively serving community needs for STEM knowledge and skills.

STATEMENT OF NATIONAL NEED

Evidence of Need

The increasing demand for science literacy, in both STEM and non-STEM related occupations, is well known, (National Science Foundation 2009; American Association for the Advancement of Science, 2012) and libraries have always been important anchors for serving their communities with resources and guidance necessary to an evolving workforce and lifelong learners. (IMLS Convening on STEM Learning in Libraries, 2014)

As part of these efforts, libraries want low-cost, turnkey programming that align with their capacities and the interests of local patrons, to support or introduce patrons to hands-on science and technology experiences focused around STEM learning. (The STEM Education Movement in Public Libraries, 2013) IMLS itself promotes libraries as strong community anchors that enhance civic engagement.

Citizen science may hold the key. Citizen Science has emerged to enable people from all walks of life — of varying ages, experiences, skill sets, and interests — to partner with professional scientists to engage in and advance real scientific research: from tracking the migratory path of a species, to measuring air pollution, to ground-truthing satellite data. Typically, citizen science projects include collecting or analyzing data, observing and recording natural phenomena, or developing software or instrumentation (Cohen et al. 2015), then remotely sharing data and developments with professional scientists. Citizen science has been proven to increase public understanding of science (e.g., Jordan et al. 2011, Brossard et al. 2005), is a rapidly growing practice across disciplines (Bonney et al. 2014), and advances authentic scientific research. Citizen science also leads to "contributions to environmental and health research that would otherwise be impossible." (NACEPT 2016) In short, citizen science is serious science that can be done by non-STEM experts of all ages. The Federal Citizen Science Act of 2015, a Federal Citizen Science Community of Practice supported by 48 federal agencies, and a new PBS TV series about citizen science, signal this is much more than a passing fad.

There is no shortage of projects to choose from on SciStarter.org, an online citizen science hub where more than 1600 projects-representing expansive breadth and depth of topics, national and local relevance, and interest- are registered online. SciStarter is a research affiliate of Arizona State University and a popular citizen science portal with an active community of more than 75,000 citizen scientists and millions of additional site visitors.

While millions of lay people are involved in citizen science projects supported through research programs in academic institutions, government agencies, and nongovernmental organizations (NGOs), very few are supported locally. Long-term volunteer participation is key to the success of citizen science research projects yet attrition rates range between 80 to 95 percent. (Rothman et al. 2014) Three main factors cited (Rothman et al. 2014) for this include 1) no opportunity to form relationships with other volunteers or scientists, 2) lack of access to/understanding of required technology, and 3) lack of time.

A small but growing number of libraries recognize that by "connecting researchers with eager citizen scientists, the library becomes a conduit for citizen science projects as well as an intellectual hub: a place to consume scientific information as well as to create and engage in scientific endeavors" (Cohen et al. 2015) and access the instruments and instructions needed to fully engage in projects. Those libraries, including Apache Junction (AZ) and Fontana Library (NC), currently **leverage their existing infrastructure** to lend instruments, such as digital scales and sensors, to local citizen scientists who expressed interested in joining a local project. Other libraries, including Kathleen Clay Edwards Library (NC) host events to introduce their communities to citizen science. These libraries use the SciStarter portal to find and/or share projects, events, and instruments with patrons and community members who may or may not already be involved in citizen science. They also use the SciStarter platform to attract new members by promoting their events, programs and lending libraries to people who visit SciStarter. These pilot, ad hoc projects are catalyzing new opportunities in local communities and hold the potential to become critical citizen science hubs in their communities.

However, as we discovered through our experiences with libraries (see above) information about projects and instruments and access to our community alone is not enough to enable libraries to integrate citizen science programming in any sustainable or scalable manner. This alone will not situate libraries as community hubs or catalysts for citizen science. Despite growing interest from public libraries (see Letters of Collaboration) to incorporate citizen science programming and become go-to community hubs, there are no documented road maps, best practices, or scalable models to follow for citizen science in public libraries.

Citizen science programming offers accessible, affordable hands-on experiences with authentic scientific research, sparks interest in science even and helps develop STEM interest and skills. It establishes a new approach for libraries to strengthen their position as community anchors that addresses the communities' needs for knowledge and skills in science, technology, and 21st century skills.

Libraries as Community Hubs for Citizen Science will provide approaches for how libraries can improve engagement with their communities and help position libraries as citizen science leaders and conduits within their communities by providing a toolkit that addresses:
- the libraries' desire for meaningful, turnkey, customizable, innovative, and locally situated STEM programming relative to their capacity and infrastructure;
- the citizen scientists' growing interest in learning about and joining local projects and their need for short-term to access related low-cost instruments and resources;
- the scientists need to recruit, train, equip and sustain citizen scientists;
-and Starter as a digital tool to support libraries as they bring these communities together

Libraries as Community Hubs for Citizen Science will, in the process, target two de-motivating factors of sustained engagement by providing physical space for local citizen scientists to meet and do science, and short-term access to the instruments, instructions, literature, and related programming to deepen and sustain their engagement. Through citizen science, libraries can leverage their existing infrastructure, build upon their STEM programming capacity, increase relationships and collaborations with patrons and community members, and develop "responsive models and tools that engage communities and provide learning experiences for patrons across the lifespan." (IMLS National Leadership Grants 2017) *Libraries as Community Hubs for Citizen Science* adds a new arrow to a library's quiver, a way to add participatory learning to existing STEM programs without the high, up-front costs and extensive technical training of other hands-on approaches (Lego Mindstorms or Makerspaces for example).

This strategy of offering a variety of ways for libraries to participate in a broader movement has proven successful for the National Informal STEM Education Network, which includes hundreds of museums, libraries, and other organizations dedicated to informal learning. (Bequette, M., et al 2017) We will model this strategy through the development, testing, and roll out under the guidance of NISE Net's director and project co-PI.

The project will produce toolkits that enables libraries to offer a wide range of citizen science programming with training materials and instruments. The toolkits will be developed and tested with six libraries to understand what characteristics of citizen science projects, instruments, and resources align with interests and capacities of libraries and patrons to support the national scaling of *Libraries as Community Hubs for Citizen Science*. We aim to strengthen the role of libraries as partners in addressing the needs of their communities.

It is worth noting that every public library we reached out to expressed great interest in the proposed project:

"At Scottsdale Public Library, we know that our seniors have a desire to continue learning and to engage with science as well as with other seniors. The Citizen Science program and SciStarter kits will benefit our patrons as well the library itself. By providing a kit with information and instructions, this program will allow our staff members to learn along with patrons while engaging in important scientific processes and data collection, among other things. This is a great programming opportunity for the library that requires little in the way of staff time researching and preparing. It is a great opportunity for civic engagement for our patrons to meet other patrons and to participate in an activity that has meaningful outcomes. ***I have no doubt that this will be a very popular program to the benefit of not only our patrons, but also the library itself."***

Katie O'Connor, Adult Services Coordinator at Scottsdale Public Library - Scottsdale Public Library

BUILDING ON PAST PROJECTS:
We will build on previous work of our project leads, partners, and advisors focused on citizen science projects, volunteers, and instruments, as well as national and regional library and museum partnerships for lifelong STEM learning. Our PI, Co-PIs and advisors led the following, related projects which will be used as beacons for this proposed project:

SciStarter 2.0: A Dashboard to Drive Research, Participation, and Community-building in Citizen Science (NSF #1516703); Exploring a Taxonomy for Citizen Science Tools (NSF #1644554); Satellite Science (IMLS #NL-30-00-0044-00); ME State Library and Cornerstones of Science's Empowering Public Libraries to be Science Resource Centers for Communities (IMLS #LG-80-15-0041-15); STAR_Net STEM in Libraries (NSF #1413783 and #1421427). Each of these programs changed the way STEM programming is integrated into communities on regional, national and global scales. (See *Appendix A Related Projects* for additional projects.)

We will partner with six Arizona public libraries representing a mix of urban and rural, youth/senior populations. They were selected because of their experiences with STEM programming and their own desire to implement, turnkey and locally relevant, citizen science programming in their libraries (see Letters of Collaboration). (Their diverse patronage demographics are detailed in *Appendix B Partner Libraries*.)

1. Maricopa County Library District, Southeast Regional: loans telescopes; offers STEM programming
2. Maricopa County Library District, White Tank: offers stargazing and nature programs
3. Mesa Public Library, Main Library: Weekly Code Club, Maker space (Jan. 2018)
4. Pinal County Library District, Apache Junction: loans NASA citizen science tools
5. Scottsdale Public Library, Appaloosa: IMLS-supported seniors Maker space, STEM programs
6. Scottsdale Public Library, Civic Center: IMLS-supported seniors Maker space, STEM programs

This project will be largely informed by librarians familiar with STEM programming (see above), advisors who have developed citizen science kits for individual museums, advisors who have developed professional development support and STEM kits for a network of libraries and museums, and internationally recognized citizen science experts. (See "Project Resources.")

The project team holds substantial expertise in citizen science (SciStarter), developing and implementing kits for hands-on programming in libraries and museums (NISE Net, ASU, LA Museum of Natural History, NCSU, Science Museum of Calif.), producing STEM resources for libraries and training staff (STAR_Net, Cornerstones of Science, ASU), creating and sustaining online communities of practice (SciStarter, NISE Net, STAR_Net, Cornerstones of Science), and experience in state-wide library programming (AZ State Library). These collective experiences will inform kit and program development, instructional design, library program management, evaluation, implementation, and scaling.

PROJECT DESIGN: Our goal is to offer libraries an effective, affordable new way to meet community needs for STEM programming, that are increasing as the percentage of 21st century jobs that draw on STEM knowledge increases and as more people citizen scientists seek community support and access to instruments.

The scalable toolkit will offer multiple entry points that acknowledge varying capacities of libraries:

- A tutorial for librarians that introduces the concept of citizen science and how to use SciStarter to help patrons discover projects of interest to them;
- A beta SciStarter Library Kit with everything citizen scientists would need to participate in a representative set of citizen science projects with national and local relevance. The kits will include guides for getting started and any low-cost instruments and collateral (e.g., forms) necessary to participate in the projects. A librarian could use the Library Kits to explain and demonstrate citizen science to individual patrons, and also during citizen science programming events. The kits will be packaged in a way that lets libraries lend them to patrons to do citizen science at the library, at home, as an individual or in a group.
- Programming Guide(s) that outline standardized practices (which will emerge during this project) of the range of ways that libraries can engage in citizen science programming.

- A new section on SciStarter for Libraries where they can acquire all of the above and also share their experiences in citizen science programming with other libraries.
- A new map-based feature on SciStarter to help millions of citizen scientists learn about and find local libraries that have citizen science kits (instruments, events, and programs) related to projects of interest to them.

The project team of librarians, informal STEM educators, practitioners, and scientists, will: 1) develop and evaluate citizen science toolkits that will be available for and through the public library partners; 2) create associated resources to train, support, and communicate with librarians and citizen scientists; and 3) work with stakeholders to create a plan to scale the model among interested libraries, statewide then nationwide. *Libraries as Community Hubs for Citizen Science* will enable libraries to build upon their existing, successful STEM programs, capacity, and infrastructure to offer their communities sustained, engaging and meaningful opportunities to participate in scientific research through citizen science. In addition to empowering librarians and their libraries to serve as leaders and community hubs for STEM learning, this project addresses known critical barriers in citizen science infrastructure, including lack of access to necessary instruments, and opportunities to connect with other citizen scientists, which prohibits sustained participation in citizen science.

Libraries as Community Hubs for Citizen Science is planned as a two-year project beginning on November 1, 2017, with three primary phases. ASU seeks IMLS support to achieve the following project objectives:

Objectives	Key Activities	Measurable Outcomes
increase library staff awareness of citizen science	develop librarian-oriented introduction to citizen science	librarian ability to explain citizen science to patron
enable librarians to introduce patrons to citizen science	develop librarian-oriented introduction to SciStarter	librarian ability to discover patron's interests, find citizen science projects to match
develop scalable group programming to introduce diverse patrons to citizen science ("What is Citizen Science?" program.)	- convene design team of citizen science project owners, citizen scientists, and librarians to develop prototype program - conduct and evaluate test offering of program in each library - develop librarian's guidebook for offering "What is Citizen Science?" program	Prototype program attendee's awareness, understanding, and interest in citizen science
enable libraries to perform and model citizen science participation for patrons	- develop turnkey, all-you-need kits for participating in select citizen science projects - develop training guidebook for participating in citizen science projects, and modeling citizen science participation for patrons	- frequency and quality of library participation in select citizen science projects - number of new citizen science participants recruited through libraries
enable libraries to establish loan program for citizen science kits	- develop turnkey, all-you-need kits for participating in select citizen science projects	- number of turnkey kits distributed - number of kit loans to patrons - frequency and quality of participation by patrons who borrowed kits (participation

	- develop criteria and guides for loan programs with project's library partners	can also be measured using SciStarter's online analytics to track frequency and duration of contributions to projects, which typically require participants to enter or analyze data online).
enable librarians to support patrons as citizen scientists	- develop training guides for librarians to connect citizen science activities to other library resources	- increased usage/circulation of STEM-related library resources; - number of visits to SciStarter library subsite
lay groundwork for scaling nationwide	- in considering varied needs of libraries—rural, urban, languages, etc., we will: - develop librarian-oriented subsite of SciStarter for digital dissemination of guidebooks and training materials and promotions of kits/programming - develop specifications and budget for production to national scale of kits - develop criteria for pricing/granting kits - identify potential funding source for national scale distribution	- number of visits to SciStarter library subsite - funding interest for state/ national scale implementation

ASU's University Office of Evaluation and Educational Effectiveness (UOEEE) will work closely with the project team to clarify project goals and provide both formative and summative evaluation services during the three phases of the project. UOEEE evaluators will collaborate with the project PI(s) and key stakeholders to develop a journey map and project logic model as well as the subsequent evaluation plan; use formative evaluation methods to ensure the feedback of the key stakeholders is integrated into the project design; collaborate with PIs and key stakeholders to establish roles and responsibilities, methods for data collection and sharing among the project team, stakeholders, and evaluators. Evaluators will identify/design instruments and deploy data collection strategies. Finally, UOEEE evaluators will assist project personnel in establishing best practices from the experiences of the key stakeholders. Evaluation reports will be provided at the conclusion of each phase of the project and will include a description of the evaluation data collection/analysis activities either in process or completed during the time period, a summary of key evaluation findings and accompanying data, and key recommendations. The third and final report will focus on the summative evaluation, providing an overview of the evaluation's activities, critical findings with supporting evidence, and forward-looking recommendations and will be delivered after the close of the project. UOEEE will also provide ongoing, informal feedback throughout the funding period.

UOEEE will facilitate community forums and the journey mapping activities, in addition to conducting ongoing monitoring and evaluation activities to document the progress toward meeting project goals, objectives, timelines, activities, deliverables, and outcomes. Goals and objectives are included below in Table 1 with forecasted data collection strategies. UOEEE will observe select activities; conduct interviews and/or surveys with a subset of key personnel and stakeholders; collect experiential and perceptual data from participants; and monitor and provide critical feedback on the development and deployment of key project deliverables.

Phase 1: November 2017-August 2018. Work collaboratively to iteratively develop, evaluate, and improve a citizen science toolkit accessible through the Arizona public library system, together with a supporting SciStarter website. The toolkit will include reliable instruments and supporting instructions for several research projects to be determined by the interests and concerns of local communities via a series of informal forums at participating libraries. A custom SciStarter page will feature an online version of the kit and additional resources for librarians (to be determined during the journey mapping phase), under the guidance of PI Darlene Cavalier, founder of SciStarter, and co-PI Rae Ostman, director of NISE Net. The projects, instruments, and supporting materials will be chosen and designed so they can be used by individual volunteers, as well as in the context of library programming. Formative evaluation will focus on usability and utility of these resources from the perspective of all stakeholders, as well as participant engagement and learning.

Phase 2: September 2018 - June 2019. During the second phase of the project, ten copies of the toolkits will be produced, and entered into circulation at two public libraries in Arizona for a 12-week testing period (five kits at each library during each cycle): First: Maricopa County Public Library's Southeast Regional Library and White Tank branch. After the 12-week testing and evaluation, the kits will then rotate to Mesa Public Library and Apache Junction library 40 miles outside of the metropolitan area, both of which have partnered with the project team on previous projects. And finally the kits will rotate to two Scottsdale Public Libraries, which have implemented IMLS supported Maker programs for senior citizens. Summative evaluation will focus on public participants' engagement in citizen science and perception of libraries as hubs for citizen science.

Phase 3: July- October 2019. During the third and final phase of the project, the project team will convene stakeholders to create a plan to scale up the program to more libraries in Arizona (as guided by co-PI Dan Stanton, ASU Librarian and former President of the AZ State Library Association and Chris Guerra at Arizona State Library, to other states (as guided by advisors Holly Menninger, director of public science from NC State University; Lila Higgins from LA Museum of Natural History who is testing citizen science nature kits in LA public libraries; and Sarah Seiter from the Museum of CA, Oakland, who co-created mini citizen science kits for vending machines in her museum); and nationally through library networks (under the leadership of advisors Cynthia Randall from Cornerstones of Science and Paul Dusenbury from STAR_Net) and museum networks (under the leadership of Rae Ostman from NISE Net). We expect to have a much better understanding of what needs to be in the future kits, and be able to specify and cost out kits that could be produced to national scale. We will document and share outcomes and recommendations among library, citizen science, and informal science education networks. Summative evaluation, providing an overview of the evaluation's activities, critical findings with supporting evidence, and forward-looking recommendations.

PROJECT RESOURCES:

Personnel: The project will be directed by Darlene Cavalier, MA, professor of practice at ASU and founder of SciStarter, a citizen science subject matter expert (0.75 month / year) who will serve as the project director, oversee the successful completion of this project, with a concentration on the digital infrastructure , dissemination of findings, develop final report and manage communications with IMLS. Co-PI Rae Ostman, PhD, associate research professor at ASU and director of the NISE Network of museums and universities, has extensive experience developing physical toolkits for informal STEM learning (0.5 month/year) will guide the methodology for the design, delivery and prototyping of the toolkits. The project coordinator, Jeannie Colton, program coordinator at Arizona State University, who has worked on multiple collaborations among science museums, libraries, and ASU (1 month/year) will coordinate the project schedule, team, logistics, community forums, solicitations to and input from advisors at scheduled intervals, in-person and virtual meetings at Phase 1, 2, and 3, and weekly calls with key staff and advisors as needed; Risa Robinson, former Supervisory Librarian, Adult Services at Apache Junction Library now at ASU Library/Maker Services (1 month/year) will coordinate the kit roll outs and rotations, site visits to libraries during prototyping, and support partner librarians. Chris Guerra, Project Specialist at Arizona State Library will advise on scaling this state-wide as will Dan Stanton, MA, associate librarian at ASU and past president of Arizona Library Association (.25 month/year); Nico Franz, PhD, director of ASU's Natural History Collections will guide us on the selection and use of kit instruments and participate in related public programs at libraries; advisors Cynthia Randall,

Executive Director, Cornerstones of Science and Paul Dusenbury, Project Director, STAR_Net, will help us shape our vision to scale this approach in libraries, nationally; Holly Menninger, director of public science for the College of Sciences at NCSU, Lila Higgins, Manager, Citizen Science at Natural History Museum of Los Angeles County and Sarah Seiter, Curator at Oakland Museum of California, each of whom has unique experience with citizen science kits and lending libraries through museums, will advise us on their experiences and help us scale this to NC and CA; all will collaboratively determine the design and features of the prototype toolkit and recommended a path forward; additional staff.

Evaluation of the project will be the responsibility of ASU's independent evaluation unit, the University Office of Evaluation and Educational Effectiveness (UOEEE). Shelly Potts, Ph.D. (Senior Director), Alison Cook-Davis, Ph.D. (Assistant Director), and their staff will design and implement a strategy to assess the objectives of the project. Qualitative and quantitative data collection and analysis methods will be used to formulate feedback that is relevant, actionable, and useful at various stages in the project's development and implementation. Written evaluation reports will be provided by UOEEE as part of the ongoing feedback loop and will be included along with annual project progress reports.

PROJECT TIMELINE

November –December 2017: In-person and virtual kick off meeting and journey mapping with librarians, PIs, Advisors, product designer, project managers, organized by project coordinators.

January-February 2018: Organize informal community meet-ups at libraries to learn about citizen scientists' interests in topics/types of projects, current sources of projects/tools, preference of engagement (do projects at home? alone? in a group? possibly at the library?).

March 2018: Identify representative sample of projects and related tools and work with kit designer to sketch beta version of a kit to include resources for librarians and citizen scientists.

April- May 2018: Select tools and projects for kits based on criteria discovered during research and customer discovery (Nov-Feb). Collaborate on instructional and supporting materials (print and online) and templates for promotional and supporting materials and informal community-building events. Iterations, testing, development of kit and SciStarter Library page.

June 2018: Prototype the kits and wireframes. Solicit feedback from librarians, community members and local citizen scientists identified through SciStarter and librarians.

July-August 2018: Modify toolkit and website designs. Final review and test with professionals, visitors, and subject matter experts. Produce Kits.

Sept-June 2019: Test toolkits in 12-week testing period (five kits at each library): We will seek to understand risks: "cost of goods," scalability conditions, understand if/how communities use the kits to do citizen science at the library vs checking them out to use at home; test minimal level of required training; what is learned to help scale this among professionals in libraries, who will provide kits/instruments when this scales?); solicit insights from librarians and advisors; understand what changes need to be made to the kits, website, and supporting promotional materials. Evaluate t program's impact on participants' engagement in citizen science and perceptions of the library as a community hub for citizen science.

July- October 2019: Evaluation: stakeholder meetings, data collection, analysis, and final reports and dissemination of lessons learned and best practices based on the kits.

Budget: The project budget is $249,994 which includes $64,085 for salaries and wages, $20,979 for fringe benefits, $10,000 for materials, $20,160 for participant expenses, $49,000 for contracts and consulting services, $4,696 for travel and other costs, and $ 81,074 for indirect costs. A more detailed view of the budget and budget justification are attached to this proposal. ASU is committed to the completion of these deliverables and believes that the budget is both necessary and sufficient to complete the planning tasks as described.

Communications Plan: By tapping each of our distinct networks, we can share project results, best practices, and the kits' resources widely. Presentations: The project team will present the toolkits and outcomes at the Citizen Science Association conference in 2019, at state library conferences, and at the annual Citizen Science Maker Summit at ASU. Online: ASU, SciStarter and the project partners will document and share outcomes and best practices through SciStarter's blog network (SciStarter, DiscoverMagazine.com, National Science Teachers

Assoc., Public Library of Science), the Citizen Science Assoc. listserv; SciStarter's community of citizen science project owners (1600+) and citizen scientists (75,000+); ASU social media, NISE Net social media, ASU Library's website and social media and our collaborators' and advisors' networks. Journals: We will submit a paper to the Citizen Science Journal and seek guidance from advisors for journals to consider.

NATIONAL IMPACT: This project will develop a field-tested, replicable toolkit of citizen science resources for public libraries. The project team of librarians, informal STEM educators, practitioners, and scientists, will: 1) develop and evaluate citizen science toolkits that will be available for and through the public library partners; 2) create associated resources to train, support, and communicate with librarians and citizen scientists; and 3) work with stakeholders to create a plan to scale the model among interested libraries, statewide then nationwide. The toolkit will be scalable so that libraries, regardless of their financial resources, can offer patrons an effective engagement with authentic science through participation in citizen science. This project positions the libraries as community anchors, empowering them to promote civic engagement, cultural opportunities and economic vitality by encouraging their patrons to take an active role in finding solutions, alongside scientists, around the science-based community issues. Citizen science enables people of all ages, cultures, and skill sets to engage in real scientific research by collecting or analyzing data that is shared with professional scientists, and it has also been shown to increase public understanding of science. In so doing, the project is meeting the IMLS agency-level goal of placing the learner at the center and supporting their ability to contribute to the collection of data and issues that are relevant and meaningful to them.

Phase 1 Goal: Develop content to create toolkits that can be readily accessible through libraries as citizen science hubs in order to increase participation in citizen science through libraries as community anchors for lifelong learning. Phase 2 Goal: Provide the kits to the libraries and to test: 1) how they are used to build or support a community of citizen scientists or groups at the libraries; 2) if and how the kits are used; 3) identify components (tools, projects, instructions/resources) that are/are not working. Phase 3 Goal: Develop open, best practices for public libraries to consider adopting and informing to help scale *Libraries as Community Hubs for Citizen Science* nationally.

Table 1: Evaluation Methods

Phase 1 Goal: Develop content to create toolkits that can be readily accessible through libraries as citizen science hubs in order to increase participation in citizen science through libraries as community anchors for lifelong learning.			
Project Objective	*Data Sources*	*Data Collection Methods*	*Outcomes*
Conduct environmental scan to identify key citizen science projects and elements for participation; compare/contrast other citsci kits (*Science Action Club for Kids*, etc)	Librarians, project staff, advisors, local citizen scientists from SciStarter, library patrons	Journey map (key stakeholder workshop)	Community issues/interests and patron interests are identified; key community challenges are identified, kit elements and instruments are identified, content is outlined for tool kits
Map how librarians will catalogue, loan/replace,	Librarians, project staff, advisors, local	Journey map (key stakeholder	Key challenges are identified and addressed, key elements and projects/topics/instruments are identified, content is outlined for tool kits

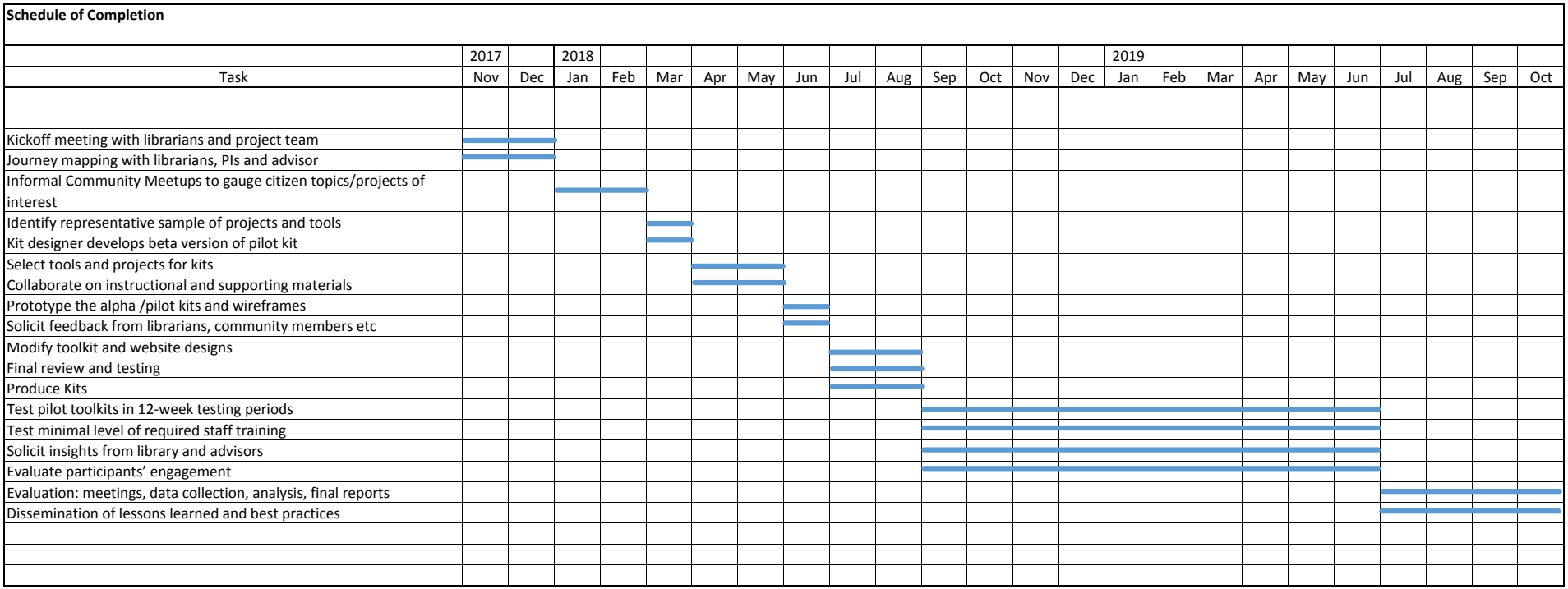
facilitate the use of the kits; how librarians use toolkit resources	citizen scientists from SciStarter, library patrons	workshop)	
Identify key elements of the kits to promote usability among citizen scientists and librarians	Librarians, citizen scientists, project staff; advisors, local citizen scientists from SciStarter, library patrons, project owners.	Interviews, checklists	Kits have necessary materials and instructions to be used by non-STEM experts (training and orientation materials, planning and promotional materials, etc); librarians report being comfortable with facilitating the use of the kits.
Create a promotional strategy to advertise the availability of the kits to existing and potential citizen scientists.	PIs; Advisors, Citizen scientists, librarians, SciStarter	Document review; interview(s)	List of lending locations available on SciStarter website and ISL partner sites. Users can provide sources from which they learned about the kits.

Phase 2 Goal: Provide the kits to the libraries and to test 1) how they are used to build or support citizen scientists at the libraries; 2) if and how the kits are used; 3) identify components (tools, projects, instructions/resources) that are/are not working.			
Project Objective	*Data Sources*	*Data Collection Methods*	*Outcomes*
Provide libraries with materials to promote/facilitate CS.	library partners	Library partner interviews	-Partners indicate kits have necessary documentation to easily facilitate in libraries -CS promotion compliments existing programming
Promote library events to draw CS participants and promote kits.	CS participants; library facilitators	Observation ; program records; survey and/or interviews	-# of CS attending events -Quality of experiences -Participant engagement in programming -Intentions of CS for ongoing participation -CS perception of library as hub for CS
Provide access to quality tools and projects that allow citizens to contribute to science.	Lending library; Citizen scientists; citizen science project owners	Library records; survey and/or interviews	-Increased accessibility (e.g., perceptions, # of users). -Consistency of data obtained from use of the kits. -Ease of use and sturdiness of kits. -Types and number of projects conducted by kits. -Duration of participation.

Increase participation in citizen science.	Lending libraries; Citizen scientists; Project owners; SciStarter platform	Library records; survey/interviews; SciStarter analytics and "SciStarter 2.0 Dashboard"	-Number of times kits were checked out. -Number of times kits lent to same patron. -Demographics of citizen scientists using kits. -Usability of the tools based on instructions and microsite provided. -Number of data contributions provided to projects. -Quality of data provided to projects. -Number/types of additional projects participants join beyond those featured in the kit
Phase 3 Goal: Develop open, best practices for public libraries to consider adopting and informing to help scale *Libraries as Community Hubs for Citizen Science* nationally.			
Project Objective	*Data Sources*	*Data Collection Methods*	*Outcomes*
Determine the characteristics that make an ideal toolkit.	ISL stakeholders, Citizen scientists	Focus groups or interviews; document review	-Based on key stakeholder experiences, what are the key pieces that should be included? -How can these kits be utilized in broader ISL contexts (e.g., science museums)? -How can these kits be utilized in other counties, states, regions? -Checklist or guide is developed based on lessons learned from the project.
Develop lessons learned and best practices guide for scaling toolkits at more libraries and ISEs including ways to network citizen science kit libraries.	PIs and Advisors; library partners	Document review; website review; partner library reports	-Libraries report local experiences and implementation efforts. -Lessons learned and "best practices" are available on SciStarter website or similar location for citizen scientist or ISEs. -Guides are provided for individuals/entities interested in developing and circulating citizen science kits

Sustainability: At the completion of the project, project resources and best practices, digital versions of the toolkits, case studies, the evaluation report and recordings of trainings and webinars will be published on SciStarter.org/research, where they will continue to be available to all for free. Content will be under a Creative Commons non-commercial, share alike attribution license. Participating library staff, volunteers, community members, informal STEM educators and host sites, citizen science practitioners, and any other stakeholders who may be interested, will have continued access to these resources. NISE Net will share links to the SciStarter Library site through social media. Additionally, the knowledge and skills acquired through this project will be used to map a nationally scalable path forward. ASU and SciStarter will continue to support the libraries with training, promotions, and other services. Our partners and advisors will continue to build on this knowledge base and adapt relevant components. We intend to join forces on future proposals to scale up testing and evaluation, develop a robust community of practice, provide public libraries with road maps and tools to integrate citizen science and see their role as major citizen science catalysts in their communities.

Schedule of Completion



DIGITAL PRODUCT FORM

Introduction
The Institute of Museum and Library Services (IMLS) is committed to expanding public access to federally funded digital products (i.e., digital content, resources, assets, software, and datasets). The products you create with IMLS funding require careful stewardship to protect and enhance their value, and they should be freely and readily available for use and re-use by libraries, archives, museums, and the public. However, applying these principles to the development and management of digital products can be challenging. Because technology is dynamic and because we do not want to inhibit innovation, we do not want to prescribe set standards and practices that could become quickly outdated. Instead, we ask that you answer questions that address specific aspects of creating and managing digital products. Like all components of your IMLS application, your answers will be used by IMLS staff and by expert peer reviewers to evaluate your application, and they will be important in determining whether your project will be funded.

Instructions
You must provide answers to the questions in Part I. In addition, you must also complete at least one of the subsequent sections. If you intend to create or collect digital content, resources, or assets, complete Part II. If you intend to develop software, complete Part III. If you intend to create a dataset, complete Part IV.

PART I: Intellectual Property Rights and Permissions

A.1 What will be the intellectual property status of the digital products (content, resources, assets, software, or datasets) you intend to create? Who will hold the copyright(s)? How will you explain property rights and permissions to potential users (for example, by assigning a non-restrictive license such as BSD, GNU, MIT, or Creative Commons to the product)? Explain and justify your licensing selections.

We will create digital content for this project and all content will be assigned Creative Commons licensing to allow for sharing and attributions.

A.2 What ownership rights will your organization assert over the new digital products and what conditions will you impose on access and use? Explain and justify any terms of access and conditions of use and detail how you will notify potential users about relevant terms or conditions.

All content created for this project will be assigned Creative Commons licensing to allow for sharing and attributions.

A.3 If you will create any products that may involve privacy concerns, require obtaining permissions or rights, or raise any cultural sensitivities, describe the issues and how you plan to address them.

Program participants and PIs will generate content including, but not limited to, project plans and designs, digital toolkits, best practices documents, a microsite on SciStarter, and other works related to their participation. ASU and SciStarter will own copyrights on the materials but will assign Creative Commons licensing to assure sharing and attribution.

Part II: Projects Creating or Collecting Digital Content, Resources, or Assets

A. Creating or Collecting New Digital Content, Resources, or Assets

A.1 Describe the digital content, resources, or assets you will create or collect, the quantities of each type, and format you will use.

We will create at least two digital versions of Citizen Science Toolkits for Libraries including training videos, PDF of supporting materials, instructions, promotional materials and press releases; a microsite with HTML pages of text and CC licensed videos and images of projects, instructions and instruments, data entry forms, project information, links NSF-funded SciStarter dashboards; recordings of webinars made publicly available for streaming or download; additional documents in Word, PPT, PDF, Excel. Outcomes and links will be posted on SciStarter.org/Research

A.2 List the equipment, software, and supplies that you will use to create the content, resources, or assets, or the name of the service provider that will perform the work.

Content will be produced by ASU, SciStarter, staff, advisors and partners. We will use WebEx for webinars and google hangouts and skype for trainings and team meetings.Content will be published and shared on SciStarter.org/research, on the SciStarter microsite and related blogs posts and websites.Content will also be created using Word, Excel, PPT, PDF and other content creation tools.

A.3 List all the digital file formats (e.g., XML, TIFF, MPEG) you plan to use, along with the relevant information about the appropriate quality standards (e.g., resolution, sampling rate, or pixel dimensions).

We will use DOC, DOCX, PPT, PPTX, XLS, XLSX, PDF, JPG, GIF, MP4. We will use the highest quality settings appropriate for displays.

B. Workflow and Asset Maintenance/Preservation

B.1 Describe your quality control plan (i.e., how you will monitor and evaluate your workflow and products).

All digital content will be reviewed and approved by the PIs and a content development specialist with experience in science writing and instructional design. Web designers and developers will manage quality assurance testing and debugging.

B.2 Describe your plan for preserving and maintaining digital assets during and after the award period of performance. Your plan may address storage systems, shared repositories, technical documentation, migration planning, and commitment of organizational funding for these purposes. Please note: You may charge the federal award before closeout for the costs of publication or sharing of research results if the costs are not incurred during the period of performance of the federal award (see 2 C.F.R. § 200.461).

All content will be archived on SciStarter.org/research using SciStarter's django framework and Amazon Web Services. Codes will be documented and shared on GitHub.

C. Metadata

C.1 Describe how you will produce any and all technical, descriptive, administrative, or preservation metadata. Specify which standards you will use for the metadata structure (e.g., MARC, Dublin Core, Encoded Archival Description, PBCore, PREMIS) and metadata content (e.g., thesauri).

N/A

C.2 Explain your strategy for preserving and maintaining metadata created or collected during and after the award period of performance.

N/A

C.3 Explain what metadata sharing and/or other strategies you will use to facilitate widespread discovery and use of the digital content, resources, or assets created during your project (e.g., an API [Application Programming Interface], contributions to a digital platform, or other ways you might enable batch queries and retrieval of metadata).

N/A

D. Access and Use

D.1 Describe how you will make the digital content, resources, or assets available to the public. Include details such as the delivery strategy (e.g., openly available online, available to specified audiences) and underlying hardware/software platforms and infrastructure (e.g., specific digital repository software or leased services, accessibility via standard web browsers, requirements for special software tools in order to use the content).

All content will be openly available online at SciStarter.org/research and made accessible via standard web browsers.

D.2 Provide the name(s) and URL(s) (Uniform Resource Locator) for any examples of previous digital content, resources, or assets your organization has created.

https://www.scistarter.org https://www.globescistarter.org https://www.scistarter.org/research

Part III. Projects Developing Software

A. General Information

A.1 Describe the software you intend to create, including a summary of the major functions it will perform and the intended primary audience(s) it will serve.

A.2 List other existing software that wholly or partially performs the same functions, and explain how the software you intend to create is different, and justify why those differences are significant and necessary.

B. Technical Information

B.1 List the programming languages, platforms, software, or other applications you will use to create your software and explain why you chose them.

B.2 Describe how the software you intend to create will extend or interoperate with relevant existing software.

B.3 Describe any underlying additional software or system dependencies necessary to run the software you intend to create.

B.4 Describe the processes you will use for development, documentation, and for maintaining and updating documentation for users of the software.

B.5 Provide the name(s) and URL(s) for examples of any previous software your organization has created.

C. Access and Use

C.1 We expect applicants seeking federal funds for software to develop and release these products under open-source licenses to maximize access and promote reuse. What ownership rights will your organization assert over the software you intend to create, and what conditions will you impose on its access and use? Identify and explain the license under which you will release source code for the software you develop (e.g., BSD, GNU, or MIT software licenses). Explain and justify any prohibitive terms or conditions of use or access and detail how you will notify potential users about relevant terms and conditions.

C.2 Describe how you will make the software and source code available to the public and/or its intended users.

C.3 Identify where you will deposit the source code for the software you intend to develop:

Name of publicly accessible source code repository:

URL:

Part IV: Projects Creating Datasets

A.1 Identify the type of data you plan to collect or generate, and the purpose or intended use to which you expect it to be put. Describe the method(s) you will use and the approximate dates or intervals at which you will collect or generate it.

A.2 Does the proposed data collection or research activity require approval by any internal review panel or institutional review board (IRB)? If so, has the proposed research activity been approved? If not, what is your plan for securing approval?

A.3 Will you collect any personally identifiable information (PII), confidential information (e.g., trade secrets), or proprietary information? If so, detail the specific steps you will take to protect such information while you prepare the data files for public release (e.g., data anonymization, data suppression PII, or synthetic data).

A.4 If you will collect additional documentation, such as consent agreements, along with the data, describe plans for preserving the documentation and ensuring that its relationship to the collected data is maintained.

A.5 What methods will you use to collect or generate the data? Provide details about any technical requirements or dependencies that would be necessary for understanding, retrieving, displaying, or processing the dataset(s).

A.6 What documentation (e.g., data documentation, codebooks) will you capture or create along with the dataset(s)? Where will the documentation be stored and in what format(s)? How will you permanently associate and manage the documentation with the dataset(s) it describes?

A.7 What is your plan for archiving, managing, and disseminating data after the completion of the award-funded project?

A.8 Identify where you will deposit the dataset(s):

Name of repository:

URL:

A.9 When and how frequently will you review this data management plan? How will the implementation be monitored?