



## National Leadership Grants for Museums

Sample Application MG-245862-OMS-20  
Project Category: Diversity and Inclusion

### spectrUM Discovery Area, University of Montana

Amount awarded by IMLS:	\$670,969
Amount of cost share:	\$670,969

The project description can be viewed in the IMLS Awarded Grants Search:  
<https://www.imls.gov/grants/awarded/mg-245862-oms-20>

Attached are the following components excerpted from the original application.

- Narrative
- Schedule of Completion

Please note that the instructions for preparing applications for the FY2021 National Leadership Grants - Museums grant program differ from those that guided the preparation of FY2020 applications. Be sure to use the instructions in the Notice of Funding Opportunity for the grant program and project category to which you are applying.

## Project Justification

*What field-wide need, problem, or challenge will your project address, and how was it identified?*

“**Making Across Montana: Developing a Model for Museums to Support a Sustainable Maker Culture in Rural and Tribal Communities**” addresses the need for a replicable, sustainable model for science museums to engage K-12 students and teachers in rural and tribal communities with making and tinkering. In particular, the project addresses a **key challenge** in developing such a model for museums serving large, predominantly rural states: how can they both respond to rural and tribal communities’ unique needs and interests and also effectively serve a large and diverse array of communities?

This project takes a **two-pronged approach** to addressing this challenge by: 1) collaborating with rural and tribal partners to develop a mobile making and tinkering exhibition and education program designed to travel to K-12 schools statewide to directly engage students and 2) implementing a K-12 teacher professional development program that uses a cognitive apprenticeship approach to build schools’ long-term capacity for making and tinkering.

The exhibition will engage learners in the design thinking process through iterative activities—for example multiple prototypes of braided cordage, for example—as well as exhibit pieces that are progressively engaging as the learner interacts, such as a large Lite Brite installation where learners can create images or geometric shapes by working together. Design and implementation of the exhibition will draw on spectrUM’s experience developing mobile exhibitions—including “Hands on Health,” “Motion,” and “Water”—that travel to rural and tribal schools with our “Science on Wheels” program. The exhibition will additionally incorporate the Kʷul ’Iʔtkin Maker Truck, a mobile, cultural makerspace that spectrUM co-developed and co-operates with the Confederated Salish and Kootenai Tribes.

The **K-12 teacher professional development sequence** will use a cognitive apprenticeship approach to build schools’ long-term capacity for making and tinkering. Cognitive apprenticeship, which involves phases of modeling, coaching and fading within relevant, situated contexts, has been shown to support individuals who begin as novices in a complex skill in developing mastery over time (Collins, Brown, & Holum, 1991). spectrUM uses this approach in its teacher professional development model in the rural Bitterroot Valley, where one principal described the format as “I do, we do, you do,” with teachers first observing an expert facilitator from spectrUM, then co-facilitating, then facilitating autonomously with spectrUM in a supporting role.

In the Bitterroot, spectrUM has a sustained presence and deep, continuous partnerships with teachers; this project, by contrast, will develop a shorter, more compressed PD sequence designed to serve an estimated 30-50 teachers and museum professionals annually while preserving the co-facilitation and mentorship components that have been so vital to the success of spectrUM’s existing model. Participating teachers will: i) complete a workshop in which they learn about the maker mindset and practice facilitating activities that build on themes and activities from the exhibition, ii) observe spectrUM’s making and tinkering program manager Nick Wethington facilitating an activity with students, iii) co-facilitate an different activity alongside Wethington, and iv) continue facilitating activities using a leave-behind curriculum book and supply kit, with access to follow-up activity resources developed through this project on the project’s website and Instructables.

*Are others addressing this need?*

The Discovery Network at Arkansas’s Museum of Discovery is perhaps the most successful existing model within the museum field for building rural capacity for informal STEM education. From its hub in Little Rock, the Discovery Network offers professional development trainings, exhibits, and activity kits to a network of 20 museums, K-12 schools, public libraries, and universities across a heavily rural and relatively low-SES state. Brittney Kugler, assistant director of the Discovery Network, has guest facilitated spectrUM’s Making and Tinkering Institute for teachers in the Bitterroot and has consulted informally on the development of spectrUM’s making and tinkering activities, curriculum, and teacher PD. Although Arkansas’s model has been

The University of Montana spectrUM Discovery Area influential on this project's mission and in the development of spectrUM's existing and proposed professional development activities, Making Across Montana proposes an alternative model designed to succeed in regions where significant, long-term philanthropic capital might not be available and which focuses on helping K-12 schools build sustainable, internal capacity for making and tinkering.

*What other studies or best practices have you used in developing your project?*

This project's approach draws on Shawn Jordan's work on culturally relevant engineering education. Jordan's NSF CAREER project, "Engineering Design Across Navajo Culture, Community, and Society" (NSF#1351728) engaged K-12 students on the Navajo Nation in designing Rube Goldberg machines that incorporate cultural story-telling. This approach to inclusive STEM engagement influenced spectrUM and the Confederated Salish and Kootenai Tribes' K<sup>w</sup>ul 'I'tkin Maker Truck, which engages K-12 students on the Flathead Reservation with cultural making activities and informs this project's foundational assumption that rural and tribal students and teachers have unique needs and interests that require culturally relevant, place-based approaches.

In envisioning a model to disseminate to other urban museums, this project draws from IMLS and the Children's Museum of Pittsburgh's *Making + Tinkering in Museums and Libraries: A Practitioner's Guide and Framework*, a toolkit and case studies in creating physical hubs for making and tinkering. Drawing inspiration and lessons learned from that study, this project conversely aims to build a framework for bringing makerspace engagement and the maker mindset out from urban hubs and into rural and tribal communities that traditionally have not benefited from the same level of access to makerspaces programming. NSF's 2016 *Envisioning the Future of the Maker Movement Summit Report* offers a number of broad recommendations that Making Across Montana seeks to fulfill, including increasing maker-related professional development and networks and connecting making with the community. Unaddressed in the report, however, are the needs of rural and tribal communities, which this project identifies as an area of significantly unmet need within the maker movement.

The project also draws significantly on experiences and lessons learned from spectrUM's making and tinkering engagement in the Bitterroot, currently supported by two family foundations. Program evaluation conducted by spectrUM's Dr. Beth Covitt and external evaluator Becky Carroll of Redwing Research has found that spectrUM's Bitterroot model—which includes an annual, 2-day PD workshop, in-class activities co-facilitated by spectrUM's Nick Wethington and teachers, and supplementary resources including a curriculum booklet and online Instructables—is building lasting capacity in participating K-12 schools. In evaluation interviews with Carroll (2019), teachers describe this capacity in multiple ways: one teacher describes how the professional development and co-facilitation sequence has built collaborations among teachers: "We share how we integrate things into our classrooms"; as a result of this project, a group of teachers have formed a multi-district Peer Learning Community around making and tinkering. Another teacher reports that the school librarian now maintains making and tinkering supplies for checkout in the library, so that "everyone has access"; another describes how making and tinkering has transformed the school library into "a gathering space, a thinking space." This project draws from the long-term, sustained model in the Bitterroot to develop a replicable approach for engaging more broadly on a shorter-term basis with rural and tribal communities.

*How will the museum field benefit from your project?*

"Making across Montana" will create a print and online toolkit for use by science museums to design effective making and tinkering programming in rural and tribal communities while building K-12 school capacity. Additional dissemination to support museums, libraries, and other informal science organizations in implementing and iterating on the resources in the toolkit will include: a presentation at the Association of Science and Technology Centers conference, two workshops for Montana science museums interested in deepening their rural and tribal engagement (see letters of support), and PD workshops in years 2 and 3 for teachers at the Montana Educator Conference and the Montana Indian Education Association conference.

*How will collaborators be involved and contribute to the success of the project?*

spectrUM takes a community-based, collaborative approach to informal STEM, including in rural and tribal communities in our region. As described further under “Project Work Plan,” the project team will engage spectrUM’s **advisory groups and K-12 education partners** in the Bitterroot and on the Flathead Reservation to co-design the exhibition. The co-design process will build on spectrUM’s deep history of partnering with both communities to develop making and tinkering and other informal STEM programming, curriculum guides, and K-12 teacher professional development trainings that are locally relevant and culturally responsive.

The project team will pilot the exhibition and activities at spectrUM Discovery Area (our hub at Missoula Public Library), EmPower Place (spectrUM’s IMLS-funded, collaboratively operated family learning center at Missoula Food Bank & Community Center), at existing mobile sites and communities events in the Bitterroot (including spectrUM’s “Summer of Science” programming at rural libraries and community organizations, the annual Bitterroot Maker Fair, and in-school K-12 engagement), and spectrUM’s programming sites on the Flathead Reservation (including spectrUM’s Science Learning Tent at summer powwows, “Science Bytes” programming at summer free meal sites, and at the Boys and Girls Club of Lake County and the Flathead Reservation, which hosts pop-up spectrUM exhibits). The project team evaluator Dr. Beth Covitt will incorporate feedback from **partner organizations** at these sites in refining the exhibition. During the implementation of the exhibition and teacher PD in rural and tribal communities, **K-12 teachers and librarians** will be instrumental to the success of the project by collaborating to build capacity for making and tinkering in their schools and by participating in project evaluation to refine the PD programming.

*How will your project address the goals of the NLG for Museums program and align with the project category you have chosen?*

This project addresses the goals of the NLG for Museums program by responding to critical need within the museum field to develop and disseminate models for engaging rural and tribal audiences, particularly in geographically large states. Within the agency-level goal of promoting lifelong learning, the project specifically aims to advance urban museums’ practice in supporting rural and tribal schools and communities in building sustainable capacity for making and tinkering and informal science education.

Within the Diversity and Inclusion category, the project seeks to develop a model to help urban museums deepen their engagement with rural and tribal audiences, who traditionally have experienced geographic, socioeconomic, and cultural barriers to accessing museum experiences. In large, predominantly rural states like Montana, geographic distance compounds socioeconomic access barriers: for example, the Blackfeet Reservation community of Browning, which this project will serve, is located a two hours’ drive from the nearest children’s museum and four hours from spectrUM. To put our state’s geography and demographics in perspective, Montana stretches the equivalent of the distance from Chicago to Washington, D.C. but has just over one million residents, roughly the same population as Delaware. Even in communities closer to urban centers, distance limits museum participation: for example, in evaluation conducted on spectrUM’s STEM programming in the rural Bitterroot Valley, adult family members reported that they were unlikely to drive to programming in a neighboring community 20-30 minutes away, let alone an hour to 90 minutes away in Missoula. While spectrUM has long addressed transportation barriers by bringing mobile exhibits and programming to rural and tribal communities, this project’s model adds sustainability and community capacity-building to the mobile programming model, adding depth to breadth by supporting K-12 teachers in embedding making and tinkering and informal science practices in their teaching.

The communities served by this project reflect Montana’s socioeconomic and ethnic diversity. Browning (population 1,016, 93% Native American) is the most geographically isolated community served by this project; the largest community on the Blackfeet Reservation, an area roughly the size of neighboring Glacier National Park with just 11,000 residents, Browning has a median household income of \$21,786 (compared to the statewide median of \$53,386), with 35% of residents living below the poverty line (US

The University of Montana spectrUM Discovery Area Census). Frenchtown, a rural commuter town near Missoula, is more prosperous, with a median household income above the statewide average, yet 41% of Frenchtown middle-school students qualify for free/reduced lunch. In Missoula, an estimated 500 Missoula County Public Schools students were homeless or in unstable housing last school year (Missoula Housing Report, 2019), and one in three Missoula children access Missoula Food Bank & Community Center at least once a year for food security (Missoula Food Bank & Community Center, 2018). Economic inequality is acute in our region: Missoula County is the 100th most unequal of 3,064 counties nationwide (Sommeiller, Price & Wazeter, 2016). The project will additionally serve K-12 students and teachers in the Bitterroot and on the Flathead Reservation, as well as three additional rural and/or tribal communities in year 3.

### **Project Work Plan**

*What specific activities, including evaluation, will you carry out?*

The 3-year “Making across Montana” project will progress as follows:

In year 1, spectrUM will collaborate with our advisory groups and K-12 education partners in the rural Bitterroot Valley and on the Flathead Indian Reservation to co-design a making and tinkering exhibition. The co-design process will build on spectrUM’s deep history of partnering with both communities to develop making and tinkering and other informal STEM programming, curriculum guides, and K-12 teacher professional development trainings that are locally relevant and culturally responsive.

This project’s new exhibition will build on these existing resources while generating new making and tinkering exhibit activities and related role-model signage that spectrUM and our partners will pilot in K-12 schools and at informal science events on the Flathead Reservation and in the Bitterroot. Although the exact content of the exhibition will emerge through the community-based design process, possible exhibits and activities include a Rig-a-ma-jig building set for students to create their own contraptions, a light play studio for visitors to create their own stories, and a robotics exploration station. Exhibition signage will feature STEM, engineering, and design role models living and working in rural and tribal Montana communities, including those served by this project. Concurrently, the project team will develop the curriculum booklet and activity supply trunks that teachers will receive through the PD workshops offered in years 2 and 3.

Through spectrUM’s partnership with the Confederated Salish and Kootenai Tribes’ Natural Resources Department, the exhibition will weave in the K<sup>w</sup>ul ’I’tkin Maker Truck and its resources and equipment. The maker truck, named for the Salish and Kootenai words for “to make,” is a mobile, cultural makerspace developed through a prior NSF grant to spectrUM and the Tribes. Equipped with a 3D printer, laser cutter, and other high- and low-tech tools, the truck brings a makerspace to rural schools, allowing students and teachers to use and learn about making technologies without the schools having to invest in or necessarily become expert in specialized equipment. Through the NSF project, spectrUM and the Tribes co-developed three cultural making activities—beading, drum-making, and basket-weaving—that this project’s exhibition will incorporate and expand upon, for instance by utilizing commercially available materials to illustrate the traditional Salish and Kootenai processes of braiding cordage and designing and creating fish traps.

The exhibition and teacher PD program, including curriculum materials and supply trunks, will roll out to K-12 schools in the Bitterroot and on the Flathead Reservation during spring of year 1. spectrUM has strong partnerships in place in both communities that will support this piloting phase: for example, for over three years, spectrUM’s making and tinkering program manager Nick Wethington has previously embedded in Bitterroot middle schools to co-facilitate activities with teachers. On the Flathead Reservation, spectrUM has built a strong teacher network through the U.S. Department of Education-funded BRAIDS project that developed a tech challenge on the Flathead Reservation with accompanying teacher PD.

In year two, the exhibition and accompanying K-12 teacher and student engagement will continue in the Bitterroot and on the Flathead Reservation while expanding to three rural and/or tribal Montana communities

The University of Montana spectrUM Discovery Area that spectrUM has served in the past but where we do not offer consistent, sustained programming. These communities including **Browning**, located on the Blackfoot Indian Reservation, and the rural communities of **Frenchtown** and **Anaconda**. The making and tinkering exhibition will pop up in school gymnasiums, where spectrUM educators will lead in-school field trips that engage middle-school students in hands-on design challenges that promote creativity, teamwork, and resilience. Each community visit will progress as follows:

Day 1: spectrUM's making and tinkering program manager Nick Wethington will lead a 3-hour PD workshop for K-12 teachers and school librarians, who will receive stipends for their participation. When feasible, the workshop will take place during after-school hours on the first day of a 3-day visit to each community, but depending on schools' needs, the workshop could also be scheduled separately on a designated teacher professional development day. Drawing from the 2-day Making and Tinkering Institute that spectrUM currently offers teachers in the Bitterroot, the workshop will introduce participants to the maker mindset and train them to facilitate two activities that build on the content of the exhibition. Possibilities include bouncy rockets (small rockets made from paper straws propelled by a bouncy ball), propeller-powered ziplines, and light play, an activity that blends art, science and storytelling. 10 teachers and school librarians in each community will receive the project's leave-behind supply trunks and will participate in the full co-facilitation sequence, but the workshop will be open to additional teachers and informal educators based on interest.

Day 2: During the school day, Wethington will visit the equivalent of one full grade of students, facilitating a making and tinkering activity in each teacher's classes and/or during a structured time with students in the school library. The activities will be scalable for students in any middle-school grade. Concurrently, spectrUM educators will lead guided, in-school field trips through the exhibition for every class in the school, including those participating in the in-class facilitated activities. As part of the exhibition, students and their families will tour the K<sup>w</sup>ul 'I'tkin Maker Truck to learn about design and engineering technologies, careers that build on skills students are learning through the project's in-class activities, and cultural making practices of the Confederated Salish and Kootenai Tribes.

Day 3: In-class facilitation and in-school field trips will continue. In addition, each community visit will culminate with a Family Science Night, where parents and family members will be invited to try out the exhibition's activities and see their students' creations.

Beyond spectrUM's community visit, the project team will also connect with teachers in a follow up Zoom meeting to provide additional support. Teachers will also have access to additional activity resources developed by the project team and posted on Instructables, a user-friendly, online maker community where, using the Teacher Notes function, teachers will have the option to provide feedback, ask questions, and share how they implement the activities. As an example of how spectrUM currently uses Instructables to share activity resources with teachers, visit our [Bitterroot Making and Tinkering page](#) on the site.

To **disseminate** the project's model to the broader museum and informal science fields, the project team will create a print and online toolkit designed to equip science centers to design effective rural and tribal making and tinkering programming while building capacity in K-12 schools through the cognitive apprenticeship approach. The project team will present on the project's model, including the online toolkit, at the Association of Science and Technology Centers' 2022 conference. Regionally, the project will offer a workshop in year 3 to disseminate the model to Montana science centers, children's museums, libraries, and other informal learning organizations that strive to serve rural and tribal audiences. Each museum will additionally receive a curriculum activity trunk to implement with their audiences.

The toolkit will build on similar resources that spectrUM has created through prior community partnerships, including a [Making and Tinkering Cookbook](#) developed with Bitterroot partners, the [K<sup>w</sup>ul 'I'tkin Maker Truck](#) curriculum booklet developed with Flathead Reservation partners through an NSF project to develop a mobile, cultural makerspace, and the [EmPower Place booklet](#) developed with Missoula Food Bank &

The University of Montana spectrUM Discovery Area Community Center and Missoula Public Library as part of spectrUM's NLG for Museums that created EmPower Place. In addition to developing a print and pdf booklet like these existing resources, this project will develop a more interactive web version to be housed on spectrUM's website.

In year three, schools from **3 additional rural and/or tribal communities** will be eligible to apply to bring the making and tinkering exhibition to their community and to participate in the project's teacher professional development. In addition, spectrUM will offer the PD workshop at Montana Educators Conference and the Montana Indian Education Association conference (2022), where the project team will promote the opportunity to apply to host the exhibition and professional development sequence.

Throughout years 2 and 3, spectrUM will continue engaging K-12 students and the public with the project's exhibition and activities at spectrUM's Missoula locations and at mobile programming sites in the Bitterroot and on the Flathead Reservation. In addition to multiplying the project's impact by reaching local audiences, rotating the project's exhibition to these sites eliminates the need to lease storage space for dormant exhibits, a significant practical and financial challenge in sustaining a mobile museum program.

To **sustain** the project's impact beyond the grant period, spectrUM will offer the making and tinkering exhibition and PD workshop to schools as a fee-based option within spectrUM's Science on Wheels program. While charging a fee can pose a barrier for lower-income communities, many rural and tribal Montana communities have historically secured funding for Science on Wheels programming through the U.S. Department of Education's GEAR UP and Talent Search programs, as well as through local foundations and corporate sponsors. In addition, spectrUM offers full and partial fee waivers through its Science for All Fund, supported by local donors.

Concurrently with the project activities above, Dr. Beth Covitt will implement the following **formative and summative evaluation plan**. While questions guiding formative and summative evaluation will be similar, formative evaluation will be conducted throughout the project to provide timely feedback for informing refinements to implementation. Summative evaluation will support reporting of comprehensive evidence to facilitate documenting project outcomes and sharing of lessons learned.

The formative evaluation will document each of the key project activities to provide timely feedback so that activities can be compared with the rationale and plan, and so that the plan and activities may be refined over time. These evaluation activities will include:

- In year one, Covitt will interview project leaders, advisory group members, and K-12 education partners after collaboration activities to understand (1) how collaborators perceive the strengths and weakness of the plan, the activities, and the collaboration itself; and (2) what suggestions they have for improvements.
- In years two and three, Covitt will conduct evaluation activities in conjunction with the traveling exhibition. Evaluation information will be collected with K-12 educators and administrators, adult participants at family science nights, and the rural and tribal Montana role models featured in signage. Methods will include short surveys and interviews to obtain breadth and depth of feedback. Questions will focus on to what extent and how participants perceive program activities in their communities (1) reflect responsiveness to communities' interest and needs, (2) fulfill community need for high quality, local informal learning experiences, and (3) integrate science and culture in appropriate and engaging ways. Participants will also be queried about importance of local role models and suggestions for improving future experiences.
- In years 2 and 3, Covitt will conduct evaluation of the teacher professional development. Evaluation will address teachers' (1) perceptions of quality, value, and usefulness of the professional development to their teaching; (2) perceptions of culturally responsive making and tinkering; (3) perceptions of spectrUM as a culturally responsive science education resource; and (4) suggestions for improving future professional development opportunities.

After each set of activities, Covitt will provide a formative feedback report to project leaders detailing evaluation evidence and strengths and weaknesses of the activities.

The summative evaluation will answer the following questions:

- How do project partners including leaders, advisory group members, and K-12 education partners characterize (1) the nature and quality of the collaboration, (2) the extent to which the project accomplished identified goals, (3) approaches to and methods for collaboration that are necessary for success, and (4) suggestions for future collaborations?
- What is the nature and quality of audiences' experiences with the project's activities? In what ways do these experiences impact visitors' perceptions of spectrUM as a provider of culturally and locally responsive engagement activities?
- What is the contribution of the project to teachers who participate in professional development, and in what ways and to what extent does the professional development impact their classroom practice, their perceptions of efficacy and resource availability for school-based making and tinkering (i.e. capacity), their perceptions of culturally responsive science education, and their perceptions of spectrUM as a resource for culturally responsive science education?
- What lessons learned could be useful for the broader museum and library fields?

For the summative evaluation, Covitt will draw on all of the formative data collected, as well as final interviews with project leaders and staff, advisory group members, a subset of community role models, and representatives from K-12 school partners. A final report will summarize the contributions of the project, as well as the broader lessons learned for the field of museums and libraries.

*What is your project's maturity level (i.e. exploratory, piloting, scaling, or mainstreaming)?*

This is a scaling project that builds on spectrUM and our partners' pilot work in the Bitterroot and on the Flathead Reservation to build and disseminate a model that could ultimately be mainstreamed to museums and others serving rural and tribal communities nationwide.

*What are the risks to the project? Have you identified ways to monitor or mitigate risk in the work plan?*

**The risk that teachers will not have the capacity to remain engaged in the project:** K-12 teachers have many competing demands on their time and attention. To help ensure that participating teachers remain engaged, we will: i) compensate them, ii) develop recruiting materials and a written participation agreement that clearly identify the project's intended benefits and expectations of participants and emphasize the exhibition and activities' alignment with NGSS standards, iii) hold the PD workshop either on designated school PD days or during after-school hours so that teachers do not need to arrange for subs, and iv) encourage school librarians, who often have greater flexibility in their curriculum and schedules, to consider participating. By following these practices in our teacher professional development and co-facilitation in other communities, spectrUM has successfully recruited and retained active, engaged cohorts of K-12 teachers.

**The risk that the project's professional development model will not be robust enough to build lasting capacity in the schools:** In designing this project, spectrUM draws from lessons learned through exploratory work in the Bitterroot and on the Flathead Reservation. In both of these communities, however, we have a year-round presence and strong ties to our community advisory groups and K-12 school partners. This project distills approaches developed in these communities in an effort to develop a model for fostering a sustainable maker culture in schools that we will visit for only 3 days annually. To mitigate the risk that this compressed PD approach will be too light to make lasting impact, the project team will: i) roll out the exhibition and PD sequence first to rural and tribal schools where spectrUM has existing relationships, helping ensure strong interest and engagement in the project ii) provide a follow up Zoom meeting with teachers as a follow up to our visit and iii) dedicate significant personnel time on the project to designing, piloting, and refining the project's curriculum guide, leave-behind supply kits, and digital peer community, helping ensure that teachers are set up to succeed in implementing making and tinkering activities beyond spectrUM's visit. Project evaluation will help identify opportunities to improve the PD sequence to further help ensure real sustainability before bringing the project in year 3 to communities that spectrUM does not regularly serve.



*Who will plan, implement, and manage your project?*

Project personnel and partners will include:

Jessie Herbert-Meny (PD), spectrUM's director, will lead the project, focusing particularly on i) overseeing spectrUM's K-12 and community partnerships in the Bitterroot, on the Flathead Reservation, and in rural and tribal communities served by the project, ii) overseeing the design and implementation of the project's exhibition and PD resources, iii) disseminating the project's model, including by leading the design of the project's online toolkit for museums and accompanying workshops and presentations, and iv) ensuring that evaluation iteratively informs project engagement throughout the grant period. Herbert-Meny, who has led spectrUM's education programs since 2008 and received her master's in education last summer, was co-PI on spectrUM's recent NSF project that developed the K<sup>w</sup>ul 'I'tkin Maker Truck and currently leads spectrUM's partnership on a U.S. Department of Education grant that seeded an annual STEM and tech challenge on the Flathead Reservation. She recently accepted an "Edgie" Award from the Association of Science and Technology Centers in recognition of spectrUM's innovative visitors experience at EmPower Place.

Nick Wethington, spectrUM's making and tinkering program manager, will directly implement the project's K-12 student and teacher engagement, including supervising support educators. Wethington leads spectrUM's making and tinkering programming, including K-12 teacher PD, in the Bitterroot, where he has collaborated with middle-school teacher cohorts for over three years to co-facilitate making and tinkering activities in their classes and school libraries. He, Covitt, and others recently co-authored a forthcoming article in *Connected Science Learning* disseminating lessons learned from this project. He also authored spectrUM's *Making and Tinkering Cookbook* and collaborated with Herbert-Meny and Flathead Reservation partners on the K<sup>w</sup>ul 'I'tkin Maker Truck curriculum booklet.

Dr. Beth Covitt, spectrUM's head of STEM education research and evaluation, will serve as the project's evaluator. She received her PhD in Environmental Education and Conservation Psychology from the University of Michigan in 2004. Dr. Covitt has over twenty years' experience in science education research and program evaluation and serves as education program evaluator for multiple projects at UM, including for previous spectrUM projects that involve building and sustaining partnerships with rural communities. She also served as program development manager for the NSF MSP Big Sky Science Partnership (NSF-0634587), for which she collaborated with Montana tribal educators to design and implement culturally responsive science education teacher professional development.

Caitlin Ervin, spectrUM's museum manager, will serve as a making and tinkering educator during the exhibition's visits to rural and tribal communities, oversee spectrUM educators in integrating the project's activities into spectrUM's Missoula locations, and, beyond the project period, manage the integration of the exhibition into spectrUM's Science on Wheels program.

Dr. Amanda Duley, spectrUM's staff scientist, will collaborate with the project team to develop role model signage and will manage the project's digital engagement, including building teacher professional development resources and the online toolkit for museums on spectrUM's website. Duley will also help Wethington lead professional development trainings for teachers and, as spectrUM's liaison with Missoula Food Bank & Community Center, Duley and will schedule and lead project programming at EmPower Place.

Dr. Nathalie Wolfram, director of the Broader Impacts Group, spectrUM's parent program at UM, facilitates spectrUM and BIG's Bitterroot STEAM advisory group and will serve as their liaison with the project.

spectrUM Educators, including UM undergraduates and an AmeriCorps team leader, will implement the project's making and tinkering activities at spectrUM Discovery Area and EmPower Place, as well as at mobile programming events on the Flathead Reservation and in the Bitterroot. Educators will also travel with the mobile exhibition to facilitate in-school field trips in rural and tribal communities.

The University of Montana spectrUM Discovery Area spectrUM's Bitterroot STEAM Advisory Group and SciNation advisory group on the Flathead Reservation will collaborate to design the project's exhibition, activities, and signage. Additionally, spectrUM will collaborate with Tribal Natural Resources on the Flathead Reservation to design the integration of the Maker Truck into this project's exhibition and programming, as well as with K-12 teachers on the Flathead Reservation and in the Bitterroot to pilot and co-facilitate the project's activities in their classes.

SciNation members include: Stephanie Gillin (Confederated Salish & Kootenai Tribes (CSKT Information and Education Office), Dr. LeeAnna Muzquiz (CSKT Health), Whisper Camel-Means (CSKT Wildlife Biology), Dr. Jonathon Richter (Tech4Good), Aric Cooksley and Amy Vaughan (Boys & Girls Club of Lake County and the Flathead Reservation), Wren Walker Robbins (Salish Kootenai College), Kend Mullison (North Lake County Public Library), and Cindi Laukes (UM Neural Injury Center).

Bitterroot advisory group members include: Kristina Berger, Jenell Semple, and Rich Durgin (Corvallis School District), Wendy Campbell (Bitterroot Public Library), Hannah Gimpel (UM Bitterroot College), Marlin Lewis, Kristi Rodriguez, Matt Watts, Chad DeLong, and Dan Kimzey (Hamilton School District), Tamar Stanley (Ravalli County Museum), Sarah Anzick and Beth Fischer (NIH Rocky Mountain Labs), and Jennifer Bush (Marcus Daly Memorial Hospital).

*How will you initiate or strengthen collaborative efforts to ensure broad participation and diverse perspectives?*

By design, this project is intended to broaden participation in museum experiences and informal STEM by developing a model for urban museums to more deeply engage K-12 students and teachers in rural and tribal communities. By engaging rural and tribal partners in the planning and the design of all K-12 students and teacher engagement—specifically spectrUM's SciNation and Bitterroot advisory groups and K-12 and community partners—the project will draw from diverse perspectives.

*How and when will you engage end-users in the work plan? How will you integrate their input?*

End-users will play an active role in planning, implementation, and evaluation in several ways: i) spectrUM's SciNation and Bitterroot advisory groups both include members from K-12 education, including teachers and informal educators who will implement the project's activities with their students; ii) through formative evaluation, as described above, that draws input from K-12 teachers, role models, advisory group members, project staff, and community partners.

*When and in what sequence will your activities occur?*

Please see Project Work Plan, question 1, above, as well as the Schedule of Completion.

*What time, financial, personnel, and other resources will you need to carry out the activities?*

Please see the description of personnel above, as well as the Budget and Budget Justification.

*How will you track your progress toward achieving your intended results?*

Dr. Covitt's formative evaluation will continually track the project's progress and inform subsequent work. Additionally, spectrUM continually receives and incorporates feedback from its advisory groups and K-12 and community partners.

*How and with whom will you share your project's results?*

Project dissemination will occur, as described above, to two distinct audiences: i) to Montana K-12 teachers, museum and informal science professionals, and other community partners who will receive the project's curriculum booklet and supply trunks. spectrUM will additionally publish the curriculum booklet and accompanying digital resources on its website and will share it with the Montana Office of Public Instruction to make available to teachers statewide; ii) to the broader museum field, which will have access to the project's online toolkit designed to help urban museums more deeply engage rural and tribal audiences in their state or region. Workshops and presentations described above will support museums in implementing the toolkit.

## **Project Results**

*What are your project's intended results and how will they address the need, problem, or challenge you have identified?*

Key intended results from Making Across Montana include: (1) increased access to and participation in locally and culturally responsive informal making and tinkering experiences in rural and rural, tribal Montana communities, (2) increased internal and sustained capacity for rural and rural, tribal K-12 teachers in Montana to implement locally, culturally responsive, standards-aligned making and tinkering experiences with their students, and (3) creation and dissemination of a replicable model for science museums to more deeply engage rural and tribal audiences. These results address the need for science museums to more effectively serve rural and rural tribal communities that do not have local access to brick-and-mortar science museums.

*How will the knowledge, skills, behaviors, and/or attitudes of the intended audience change as a result of your project?*

The project seeks to develop knowledge and skills among two intended audiences: i) K-12 teachers and librarians, primarily in rural and tribal communities, who will develop knowledge of the maker mindset and experience facilitating making and tinkering activities in their schools, with the long-term goal of building school capacity for making and tinkering and informal science, and ii) professionals in the museum, library, and informal science fields, who stand to benefit from a new model for engaging rural and tribal communities.

*What barriers might there be that pose challenges for broad adoption by others or wider dissemination to the field?*

This project's model will likely be most applicable for museums and other organizations located in proximity to rural areas, although museums in more heavily urban areas may still benefit from the project's approach to serving new audiences beyond their walls. Museums without existing relationships with K-12 schools and communities in rural and tribal communities may progress more slowly in implementing this model, but the toolkit developed through this project will explicitly address relationship-building as a key foundational step.

*What data will you collect and report to measure your project's success?*

Data collection by the program evaluator will include interviews and surveys that address the evaluation questions and provide evidence of project success as described above in the program evaluation plan.

*What tangible products will result from your project?*

As described above, tangible products will include: i) a mobile making and tinkering exhibition, ii) a complementary curriculum booklet and activity trunks for K-12 teachers and informal educators, iii) an online toolkit to disseminate the project's model to museums, libraries, and other informal education organizations, iv) a K-12 teacher professional development and co-facilitation sequence that will both serve Montana teachers and be documented as a replicable approach in the online toolkit for museums, v) additional PD workshops offered to Montana teachers at statewide educator conferences, and vi) workshops and conference presentations to support museum professionals, librarians, and informal educators in implementing the project's online toolkit.

*How will you sustain the benefit(s) of your project?*

Within Montana, spectrUM will sustain the benefits of the exhibition and teacher PD program by incorporating it into our revenue-generating Science on Wheels program and continuing to fundraise locally to provide financial assistance for schools with financial need. Making and tinkering activity trunks will be available for checkout from Missoula Public Library, enabling schools, museums, and libraries across Montana to access them for free through inter-library loan. When the exhibition is not traveling, it will continue to engage visitors to spectrUM's engagement sites in Missoula and the Bitterroot and on the Flathead Reservation. The project's curriculum resources and toolkit for museums will remain online as a free resource.



