INSTITUTE of Museum and Library SERVICES

Museums for America

Sample Application MA-251826-OMS-22
Project Category: Lifelong Learning

Hitchcock Center for the Environment

Amount awarded by IMLS:	$222,076
Amount of cost share:	$222,448

The Hitchcock Center for the Environment will partner with Massachusetts Public Schools to develop a new program that focuses on using an engineering design challenge approach to build STEM capacity in a large, underserved urban school district. Project activities will include developing and implementing experiential learning in classrooms through school-based design challenges and creating professional training and mentoring support for each teacher participating in the program. The museum will schedule field trips for participating classrooms to its "living building," a net zero energy facility that harvests and recycles its own water, uses composting toilets, and was constructed with responsibly sourced, nontoxic materials. The project will enhance materials and curriculum for participating schools and encourage students and teachers to explore the intersections of engineering, technology and design and their role in addressing environmental challenges that confront society.

Attached are the following components excerpted from the original application.

- Narrative
- Schedule of Completion

When preparing an application for the next deadline, be sure to follow the instructions in the current Notice of Funding Opportunity for the grant program and project category to which you are applying.

SEEDS Initiative - Schools Exploring Engineering Design and Sustainability

This program will support Goal 1, Lifelong Learning, Objective 1.3: Supporting in-school programs.

The SEEDS initiative will focus on using an engineering design challenge approach to build STEM capacity in a large, underserved urban school district. We will partner with the Springfield, Massachusetts public schools (SPS) to facilitate experiential learning in the classroom, field trips to the Hitchcock Center for the Environment's "Living Building", and professional development for teachers. Students and teachers will explore the intersections of engineering, technology and design and their critical role in meeting many of the environmental challenges that confront society today, such as generating renewable energy, maintaining healthy supplies of freshwater, and mitigating climate change. Goals for the students will be to understand the idea of biomimicry in sustainable engineering, to enhance and strengthen their own STEM identities, to identify new career pathways, and to get excited and inspired about science, nature, and hopeful about climate change solutions. Goals for the school staff will be to acquire the skills and knowledge necessary to independently deliver this type of programming in the future.

This project will allow the Hitchcock Center to advance on two key aspects of our strategic plan:

1) Build greater internal capacity to deliver high-quality climate change, sustainability, and environmental justice education in school and community settings.

2) Leverage the Center's building and grounds as a resource for learning in and from nature.

Grant funds will enable the Hitchcock Center for the Environment to offer a pilot program to students and teachers. The SEEDS Initiative (Schools Exploring Engineering, Design, and Sustainability) will engage students and educators in free experiential STEM (Science, Technology, Engineering, Math) infused environmental education.

This program will comprise four key pieces that directly advance our strategic plan:

- Building our internal capacity to carry out a series of hands-on STEM programs taught by educators from the Hitchcock Center at all elementary schools within the Springfield Public School District over the span of three years.
- Ongoing field trips to the Hitchcock Center's Living Building that supports curriculum through a thematic framework that centers on key ecological principles: nature runs on sunlight; uses only the energy it needs; recycles everything; fits form to function; taps the powers of limits; demands local expertise; and banks on biodiversity. Through transparent building systems and integrated, innovative exhibit design, our new building is a living lab that fosters a greater ability for students to comprehend how the world works as a physical system. This award winning building is a powerful destination providing new ways of teaching and learning about environmental sustainability, science, and technology.
- We will provide in- classroom mentoring, professional development, materials and support to every participating teacher to enable them to continue using the materials and curriculum to sustain the long-term enhancement of the district's science curriculum and maintain our ongoing partnership with the district.
- We will create the design for a program and partnership model that can be carried forward into new communities in the future beyond the period of performance of this specific grant.

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

"*By the end of grade 12, all students must have an appreciation for the wonder of science, possess sufficient knowledge of science and engineering to engage in public discussions on related issues, and be careful consumers of scientific and technological information and products in their everyday lives.*"

(MA Department of Elementary and Secondary Education, Science and Technology/Engineering Curriculum Framework, January 2016)

General scientific and technical literacy is critical for students. Most major challenges of the 21st century require, in part, a STEM inspired solution. The unique challenges that define our era—addressing global climate change, protecting biodiversity, restoring the health of our rivers and oceans, developing sustainable food systems, accelerating the shift toward clean, renewable energy—require fundamentally new ways of thinking and acting (Capra, 2007; Rockström, 2009;AAAS, 2001; Barstow & Geary, 2002; Larson, 2011; NRC, 2012; NOAA, 2005 and 2009). Unfortunately, science instructional time is scarce in many elementary schools, especially in schools with fewer resources.

There is a clear need for increased instructional time for STEM in the elementary classroom. This project is designed to make integration of STEM accessible for classrooms. However, just adding more time for STEM in the classroom only addresses part of the issue. Teachers need access to high quality professional development, and mentors who can help them address barriers, overcome challenges and apply their skills in the classroom. Schools lack an adequate pipeline of teachers skilled in STEM, hence students' opportunities for STEM engagement are limited. This project expands teachers' knowledge, experience, and comfort with STEM curriculum and engineering design in the classroom.

Many schools do not have adequate funds to support the ongoing training needed to keep teachers updated on the most effective pedagogical approaches in science education. Though schools across our region recognize the need for strengthened science education, fiscal barriers limit their ability to participate in field trips and professional development opportunities thus hindering their ability to make change. This is especially true for Title I schools that have large numbers or high percentages of children from low-income families. By offering this program at no cost, we remove the fiscal barriers that can prevent teachers from gaining the skills and knowledge to use STEM and by partnering closely with the school district we can increase the likelihood that impacts will be sustained beyond the 3-year grant period.

In order to address some of the hardest problems that our society has to solve, students need to develop an interdisciplinary perspective on STEM. To be effective, they must understand what is technically possible, the basic constraints of the physical solutions, and more importantly, the questions that need to be asked. By creating and testing lessons that are closely integrated with elementary science topics, the **SEEDS Initiative** will strengthen the science program while introducing key engineering concepts and fostering positive attitudes towards engineers in ways that include all students from a wide variety of ethnic and cultural backgrounds. It also seeks to expand children's images of engineering, and broaden their interests, expectations and hope for the future. This directly meets a need expressed by the Springfield school's "Portrait of a Graduate" rubric that students can "Identify and pursue career pathways that empower and sustain them". (See Supportingdoc2)

The SEEDS program shifts our focus from learning about nature to **learning from nature** as a means to strengthen education for sustainability. Educating for sustainability functions as a powerful rationale for teaching and learning in the 21st Century (Sterling, 2001; Wheeler and Byrne, 2004; Cloud, 2010). It is a "whole system of inquiry" that combines current best practices of teaching and learning with the content, core competencies, and habits of mind required for students to actively participate in creating a sustainable future (Bergstrom, 2009; Cloud, 2010; ESA, 2012). It can be defined as a transformative learning process that equips students, teachers, schools, and informal educators with the knowledge and ways of thinking that society needs to achieve economic prosperity and responsible citizenship while restoring the health of the living systems upon which our lives depend (Cloud, 2004 and 2010; Kwauk and Casey, 2021).

The Intersection of Education, Climate, Social, Economic and Health Risk Factors

These needs are particularly acute within underserved communities such as the region served by the Springfield Public Schools. In many cities across the United States, climate change is leading to increased frequency of intense precipitation events, which is taxing aging infrastructure for managing stormwater, overwhelming sewage treatment systems, and reducing water quality in natural water bodies. These challenges are exacerbated in communities that have additional vulnerabilities due to social, economic, and health risk factors.

These conditions are exemplified in the Pioneer Valley of Western Massachusetts, home to a population of nearly 700,000. US Census Bureau data indicates that more than 25% of Pioneer Valley residents have three or more social, economic and health risk factors (e.g., low income, single or zero caregiver household, crowding, linguistic isolation, lack of education, unemployment, and chronic health conditions). The addition of these chronic stressors make these residents particularly vulnerable in the face of climate-related challenges. Nearly all reside in one of four midsize "Gateway Cities" -- Westfield, Holyoke, Chicopee and Springfield -- and as in many communities there is a strong overlap of these risk factors with BIPOC and immigrant populations.

This situation is particularly acute in the city of Springfield, New England's fourth largest city with a population of more than 150,000. Historically Springfield was a manufacturing leader, but has experienced economic decline over the last several decades exacerbated by white flight, foreclosures, and abandonment. Widespread and deep poverty (32% overall poverty rate) negatively impacts the tax base, making it difficult for the City to contend with aging infrastructure and vulnerable residents. While the city is the employment and economic center for the region, most high-paid workers live outside Springfield, while city residents are likely to be in low paying positions or unemployed. The state has designated Springfield as an Environmental Justice Community.

•Who is the target group for your project and how have they been involved in the planning?
The Springfield Public School system will be our primary partner during the creation and implementation of the SEEDS program. During our planning discussions with the district they have identified their greatest need for this project to be with their grade 3 students. Springfield Public Schools (SPS) have a current enrollment of about 24,000 students. With our focus on grade 3 over the course of three years we will have the opportunity to work with approximately 100 first grade teachers and with almost 1,800 grade 3 students directly. Each of these students would participate in five distinct programs with the Hitchcock Center during their grade 3 school year.

Over the course of three years the project will reach approximately 3,600 individual grade 3 students as the Springfield schools classroom teachers transition into the role of the direct content instructors of the programming we have modeled and provided for them.

Who are the ultimate beneficiaries for this project?
Students, teachers and schools are all direct beneficiaries of the SEEDS program by receiving engaging school activities, free professional development, and the enhancement of the schools' existing materials and curriculum.
However, to accurately include the "ultimate" beneficiaries we need to include individuals and institutions outside of those receiving direct services.

- **Future Partners** - Could benefit from this project being implemented in other school districts in the future. Springfield is typical of many mid-size, post-industrial gateway cities (with high immigrant populations) across the region and the country. What is learned in this project could be implemented in other school districts in the future in our region and beyond.

- **Community** - A better informed community of citizens with an enhanced STEM identity and better critical thinking skills to better prepare them not only for potential STEM careers, but to be more effective problem solvers in their everyday life.

- **Local Industry** - Preparing a next generation of students who are well equipped to join the workforce, bringing inspiration and increased STEM skills to help address challenges within their professions.

Project Work Plan

What specific activities will you carry out and in what sequence? -
Based on the proposal of serving all of Grade 3 at all Springfield Elementary Schools, we are proposing a three year program introducing and delivering these programs to roughly one third of the district elementary schools each year.

Each year the project will rotate through a cycle of planning, direct instruction by Hitchcock Center educators onsite at the Springfield Elementary schools, a student field trip to the Hitchcock Center, then summer professional development to **help support the teachers taking over the direct instruction in following years.** The details of this schedule are included within the "Schedule of Completion" document.

More details about the specific activities include:

THE ENGINEERING CHALLENGES

Energy Investigations: Solar Energy Challenge
Students will investigate where our energy comes from in Massachusetts and how it is generated. Students will explore both renewable and non-renewable energy sources and generate electricity using solar collectors. Students will create and test a prototype to test the efficiency of solar energy use. There will be an emphasis on sustainable technologies and carbon emissions, and making the connection between human activities and climate change.

Wind Energy: The Turbine Design Challenge
Students will investigate how wind can generate electricity using fans and small motors. They will view photos of various wind turbine designs to inspire them in creating their own prototype. Students build and test their models by measuring electricity generated. After their initial test, students will evaluate design features and plan for re-design.

Rainwater Capture Challenge
In this activity, students will be presented with a real-world problem – a shortage of water. They are challenged to create a model of a roof top capture to store rainwater and snowmelt. They must meet certain criteria and work within the constraints of materials and time. Students will test, compare solutions, and discuss possible improvements to their models.

Water Filtration Challenge
Clean water is essential for human life. Students will be presented with a situation where human activities have polluted drinking water. They will choose appropriate materials to design and build a water filtration system. Students will compare different systems and discuss possible improvements to their designs.

These programs will be designed to directly support the science and engineering NGSS and Massachusetts Curriculum Framework standards requested by the Springfield schools administration. (See Supportingdoc1)

Massachusetts Curriculum Framework - Grade 3: Technology/Engineering: ETS1. Engineering Design
3.3-5-ETS1-1. Define a simple design problem that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost that a potential solution must meet.

3.3-5-ETS1-2. Generate several possible solutions to a given design problem. Compare each solution based on how well each is likely to meet the criteria and constraints of the design problem.

3.3-5-ETS1-4(MA). Gather information using various informational resources on possible solutions to a design problem. Present different representations of a design solution. Examples of representations can include graphic organizers, sketches, models, and ***prototypes***

FIELD TRIP OPPORTUNITY

In addition to onsite school programs, every classroom will participate in a field trip to the Hitchcock Center's new living building, a new net-zero energy, water and waste facility, built to the highest standard of green building in the world – The Living Building Challenge™. Through its transparent building systems and integrated, innovative exhibit design, the Center's new living building has been designed and built to serve as an innovative new teaching tool to foster a greater ability to comprehend how the world works as a physical system and provide fertile ground for new ways of thinking and teaching about sustainability. Students will explore the world of biomimicry, ecological design, and sustainable technology through the building's rainwater collection, storage and treatment system, rooftop solar array and energy efficient building strategies, and composting toilets and waste reduction strategies.

Students attending the field trip will be introduced to important ecological principles demonstrated throughout the building. An interactive digital dashboard display in the building reinforces learning about these principles by showing real time and historic performance data of specific building energy production and use, and water collection and use. The dashboard is also available online for teachers to actively use in the classroom to demonstrate ecological design principles in action. (See Supportingdoc7) Field trips will be provided for all classrooms participating in the curriculum each of the three years.

PROFESSIONAL DEVELOPMENT

Each teacher participating in the program will have four outreach programs delivered to their classroom students by a Hitchcock Center educator. During these classroom programs teachers will become familiar with the materials used, the engineering design process, and strategies that can be used to successfully carry out the engineering challenges in future years. After the programs, the Hitchcock Center will carry out a day of direct professional development and training focused on resolving any unanswered questions, assembling teacher classroom kits, and becoming familiar with how they can continue to use the Hitchcock Center as an ongoing partner for support and collaboration into the future.

At the end of their year of partnership with the Hitchcock Center, teachers will have tools and resources to strengthen their confidence, content knowledge and teaching methods in the engineering design process. They will have developed the skills they need to continue implementing the lesson plans and design challenges independently. Shifting their practice and instruction to provide active engagement in learning about science, technology, and engineering will promote a growth mindset. This growth mindset will prepare their students to think deeply and to problem solve so that they have the chance to become innovators, educators, researchers, and leaders who can help to solve the most pressing challenges facing our world, both today and tomorrow.

The most significant risk to a project of this scope will be maintaining the continued cooperation with our program partner. We have mitigated this risk by not moving forward with this proposal until we had secured a solid partnership with a school district familiar with our organization and invested in the idea of utilizing our organizational strengths to meet a direct need of the school district. Within that partnership, another risk to the project will be the impact of any teacher turnover within the participating schools. Three strategies that will help to minimize the impact of any turnover will be that we are training ALL of the grade level teachers within a school; we are creating tools and relationships that will foster collaboration among the teachers; and the kits will contain instructions and guidance about how they should be utilized.

Scheduling a large and increasing number of programs every year will also be a challenge. We will work closely with the district director of science to optimize our ability to create mutually agreeable schedules. This process has already started by allowing the district to decide that this programming could best be arranged around their grade 3 schedules and curriculum needs.

The necessary costs of materials and transportation for this program could increase if inflation continues to rise during the performance period of the grant. It is our expectation that this increase will not be beyond our ability to leverage support for the program and potentially increase our cost share to meet this challenge.

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

Billy Spitzer- Hitchcock Center Executive Director - Will provide overall direction for the project and alignment with the Hitchcock Center's strategic program plan.

Ronald P. St.Amand - Director of Science, Springfield Public Schools - Our key partner with the Springfield Public Schools, he will oversee the integration of our programming into the elementary school curriculum and facilitate the participation of Springfield teachers to attend our professional development.

Dan Butterworth- Hitchcock Center Education Manager - Project Director of IMLS SEEDS Initiative Proposal - Will manage the details of the grant and facilitate the ongoing program implementation and assessment.

Colleen Kelley- Hitchcock Center Education Director - Will develop curriculum and coordinate kit production.

Aemelia Thompson- Hitchcock Center Educator - Will assist in curriculum development, teach school programs, field trips and professional development.

Gillian Andrews - Educational Consultant - Will assist with improving teacher practices, address systematic issues and ultimately improve student outcomes. She will design and oversee our program rubrics and assessment measures.

What time, financial, personnel, and other resources will you need to carry out the activities?
In order to carry out these activities we will need both administrative and direct instructional time from the Hitchcock Center staff for: curriculum and kit development, program planning, oversight and evaluation, plus direct instruction and hosting of professional development, we will utilize the Hitchcock Center itself for field trips that will require bus funding to transport students the roughly 20 miles from Springfield. We will need to purchase materials both for our education staff to utilize, as well as the kits that will be permanently given to the school district. We will also utilize the time of a program evaluation expert to assess the ongoing success of the project. The final IMLS funding required will total $222,076 with a cost share of $222,448.

Progress towards achieving our intended results will be tracked on several different levels:
Individual students will complete a pre and post survey to assess their own STEM engineering identity. This survey will be based on the research included with Supportingdoc5. Over the course of the year we will assess if the activities are improving student interest, confidence and views of science and engineering. We will carry out similar assessments with teachers to measure their increasing confidence and skills from before and after the program.

We will be working with an outside educational evaluation expert, Gillian Andrews (Supportingdoc4), who will focus on direct instruction and program delivery, evaluation and assessment. She will be involved with the creation of appropriate analytical rubrics designed to use for ongoing program effectiveness assessments. Teachers will have the opportunity to provide direct feedback after each program they observe. During the professional development phase of the program the teacher's comfort level with their skill and ability to lead future programs will be assessed and supported as necessary.

What are your project's intended results and how will they address the need, problem, or challenge you have identified?
Our goal is to provide in-depth training and support to a cohort of teachers, giving them the tools, confidence, and commitment they need to be effective sustainability educators inside the classroom.

Teachers will assess student-learning outcomes acquired through the ***SEEDS*** program against the practices of effective Science and Engineering Practices (SEPs) (Supportingdoc8)

- Asking questions - What is the problem? What are the limitations?
- Imagine - Brainstorm solutions.
- Plan - Sketch the idea. Identify materials and steps.
- Create - Build a prototype. Bring the idea to life. Test it and make notes.
- Improve - Make it better. Repeat the process.

In order to sustain the enhanced programming in future years we will need to ensure participating teachers feel prepared and comfortable with the skills necessary to effectively carry out the engineering design challenges. Active engagement in the online classroom collaboration will help to improve and refine the ***SEEDS*** curriculum and provide ongoing teacher support.

How will the knowledge, skills, behaviors, and/or attitudes of the target group change as a result of your project?
FOR SCHOOLS: School administrators will be invited to actively observe the program with the goal of supporting whole school adoption and continuation of the ***SEEDS*** curriculum in all grade 3 classrooms after completion of the project.

FOR TEACHERS: Teachers will receive professional development in engineering and design practices, intentional learning, phenomena learning, STEM curriculum design and participate in a teacher support online classroom for support to implement the SEEDS engineering challenges. Teachers will understand that they are part of a larger learning community and will share their successes and failures to inform a growing network of Springfield teachers with the best practices of educating for sustainability using established engineering design processes.

FOR STUDENTS: Goals for the students will be to understand the idea of biomimicry in sustainable engineering, to enhance and strengthen their own STEM identities, to identify new career pathways, and to get excited and inspired about science, nature, and hopeful about climate change solutions. They will be able to apply the tools and concepts of systems thinking in their present lives, and to inform the choices that will affect our future.

What products will result from your project?
During the course of this project we will create:

1) A comprehensive program designed to integrate STEM into a school district's curriculum where the district identified that they have an inherent need and weakness.
2) A professional development plan designed not only to mentor participating teachers but also supply them with necessary materials and ongoing support.
3) Kits will be created and provided to approximately 100 participating teachers
4) The grade 3 curriculum in Springfield will be altered to include the enhanced STEM engineering program
5) Programs and field trip will be directly provided for 3600 students from the city of Springfield

How will the project's benefits be sustained?
Based on the product outcomes outline above, at the completion of the period of performance we can expect the following long term outcomes to have ongoing benefits:

1) It is the intention of the Hitchcock Center to see this program expand beyond just Springfield Public Schools. In our immediate area we have three other large urban communities with similar demographics and also identified by the U.S. Census Bureau as having similar community resilience risk factors. See Supportingdoc3. This plan can also serve as a model outside of our region to other partnering organizations about the steps necessary to successfully create an integration and partnership similar to SEEDS.
2) The professional development will have a long lasting impact on the pedagogy of engineering design and STEM identities within Springfield classrooms.
3) Materials will be utilized by the district for many years to come
4) Not only will the content of the curriculum shift, but the pedagogical skills to teach this type of content in the district will be vastly improved, and the teamwork and collaboration within the district will be enhanced for many years to come.
5) The direct long term impact on 3600 students cannot be underestimated. These students will move forward in their education having an enhanced STEM identity at an earlier age than before. This will improve their engagement and outcomes in future science learning, as well as their views of themselves and their future.

YEAR 1 ----------Hitchcock Center for the Environment - SEEDS Initiative----------

September - December 2022:

- Preliminary planning and scheduling with Springfield Public Schools begins
- Curriculum and content design finalized
- Program testing in a small number of classrooms
- Potential curriculum and program modifications based on pilot program feedback

January - April 2023

- Student and Teacher pre-assessment surveys
- Year one of program implementation begins for cohort one classroom teachers
- STEM Engineering programs carried out by Hitchcock education staff at Springfield Schools

April 2023 - June 2023

- Field trips to the Hitchcock Center for all cohort one classrooms
- Student post-assessment survey

Summer 2023

- Professional Development for all participating year one teachers
- Kit distribution to cohort one teachers
- Teacher post-assessment survey
- Integration of the online classroom for ongoing support of cohort one teachers

YEAR 2 ----------

October 2023 - April 2024

- Cohort one teachers engaged in ongoing support and collaboration using online classroom
- Cohort one teachers carry out direct classroom instruction of STEM Engineering programs
- Student and Teacher pre-assessment surveys
- Program implementation begins for cohort two classroom teachers
- STEM Engineering programs carried out by Hitchcock education staff at SPS for cohort two

March 2024 - June 2024

- Field trips to the Hitchcock Center for all cohort one and two classrooms
- Student post-assessment survey

Summer 2024

- Professional Development for all cohort two teachers
- Kit distribution to cohort two teachers
- Teacher post-assessment survey
- Cohort two teachers join cohort one teachers in the online classroom collaboration

YEAR 3 ----------

October 2024 - April 2025

- Cohort one and two teachers engaged in ongoing support and collaboration using online classroom
- Cohort one and two teachers carry out direct classroom instruction of STEM Engineering programs
- Student and Teacher pre-assessment surveys
- Program implementation begins for cohort three classroom teachers
- STEM Engineering programs carried out by Hitchcock education staff at SPS for cohort three

March 2024 - June 2025

- Field trips to the Hitchcock Center for ALL grade three classrooms
- Student post-assessment survey

Summer 2025

- Professional Development for all cohort three teachers
- Kit distribution to cohort three teachers
- Teacher post-assessment survey
- Cohort three teachers join cohort one and two teachers in the online classroom collaboration

Hitchcock Center for the Environment - SEEDS Initiative

	2022 - 2023	2023 - 2024	2024 - 2025	2022 - 2025 Totals
Springfield Teacher Cohort 1 (approx. 34 teachers 600 students)	Receiving direct instruction from Hitchcock Center educator	Springfield teachers carrying out direct instruction	Springfield teachers carrying out direct instruction	
Springfield Teacher Cohort 2. (approx. 34 teachers 600 students)		Receiving direct instruction from Hitchcock Center educator	Springfield teachers carrying out direct instruction	
Springfield Teacher Cohort 3 (approx. 34 teachers 600 students)			Receiving direct instruction from Hitchcock Center educator	
Field Trips	Cohort 1 Field Trips (approx. 34 teachers 600 students)	Cohorts 1 and 2 Field Trips (approx. 68 teachers 1200 students)	Cohorts 1, 2 and 3 Field Trips. (approx. 100 teachers 1800 students)	
Teachers participating in professional development and online classroom collaboration	34	68	102	102 Teachers
Total unique students involved with program each year	600	1200	1800	3600 Students