Stealthy STEM:
Unexpected and Alternative On-ramps toward STEM Careers

Facilitator:

Ruth Kermish-Allen – Maine Math and Science Alliance

Panelists:

Cat Stylinski – University of Maryland Center for Environmental Science

Lauren Birney – Pace University

Stacey Forsyth – University of Colorado Boulder Science Discovery


STEM???


STEM?


STEM?
Talong
Bush Sitao

How might stealthy STEM projects and strategies change our definition of STEM, is that positive or potentially hurtful?

When incorporating stealthy STEM strategies what new opportunities might present themselves?

When incorporating stealthy STEM strategies what are the potential pitfalls or dangers projects should consider?

What should the ITEST community be focusing on to incorporate new on-ramps to STEM careers?

Which new audiences could stealthy STEM approaches be most influential for and why?

Stealth Science to Open Doors to Science Encounters

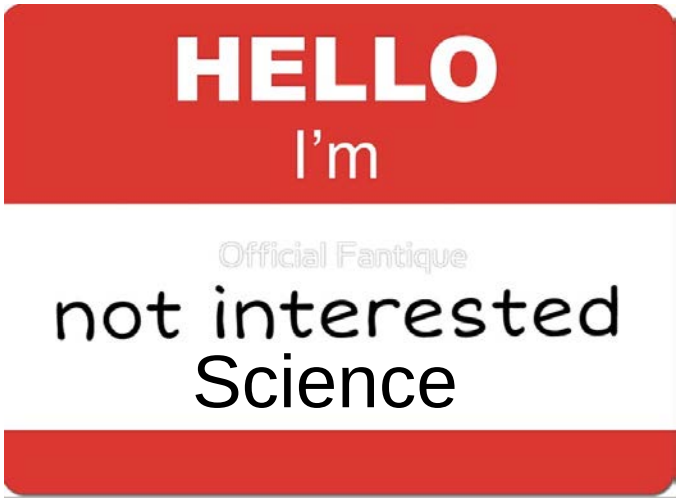
University of Maryland
Center for Environmental Science

VE RI TAS
HARVARD

maine

Oregon State University

MMSA
Maine Mathematics and Science Alliance


HELLO
I'm
Official Fantique
not interested
Science

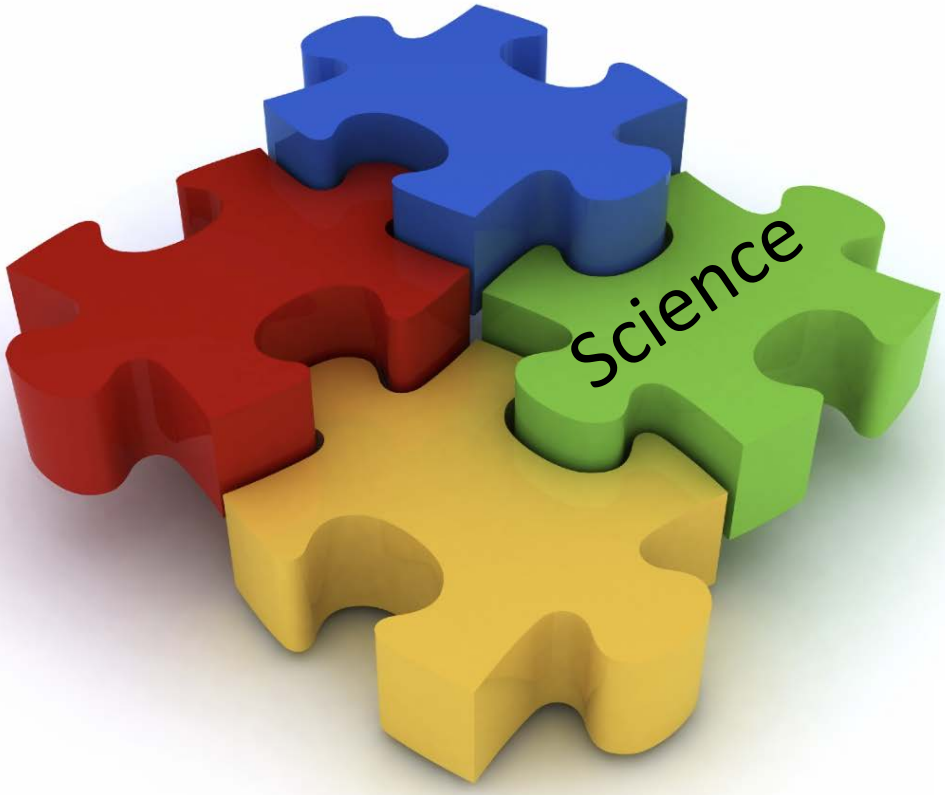
Girls need opportunities to explore their interest and identity in science


Stealth
Science

Meet audiences where they are

Figment NYC festival


AR
Girls

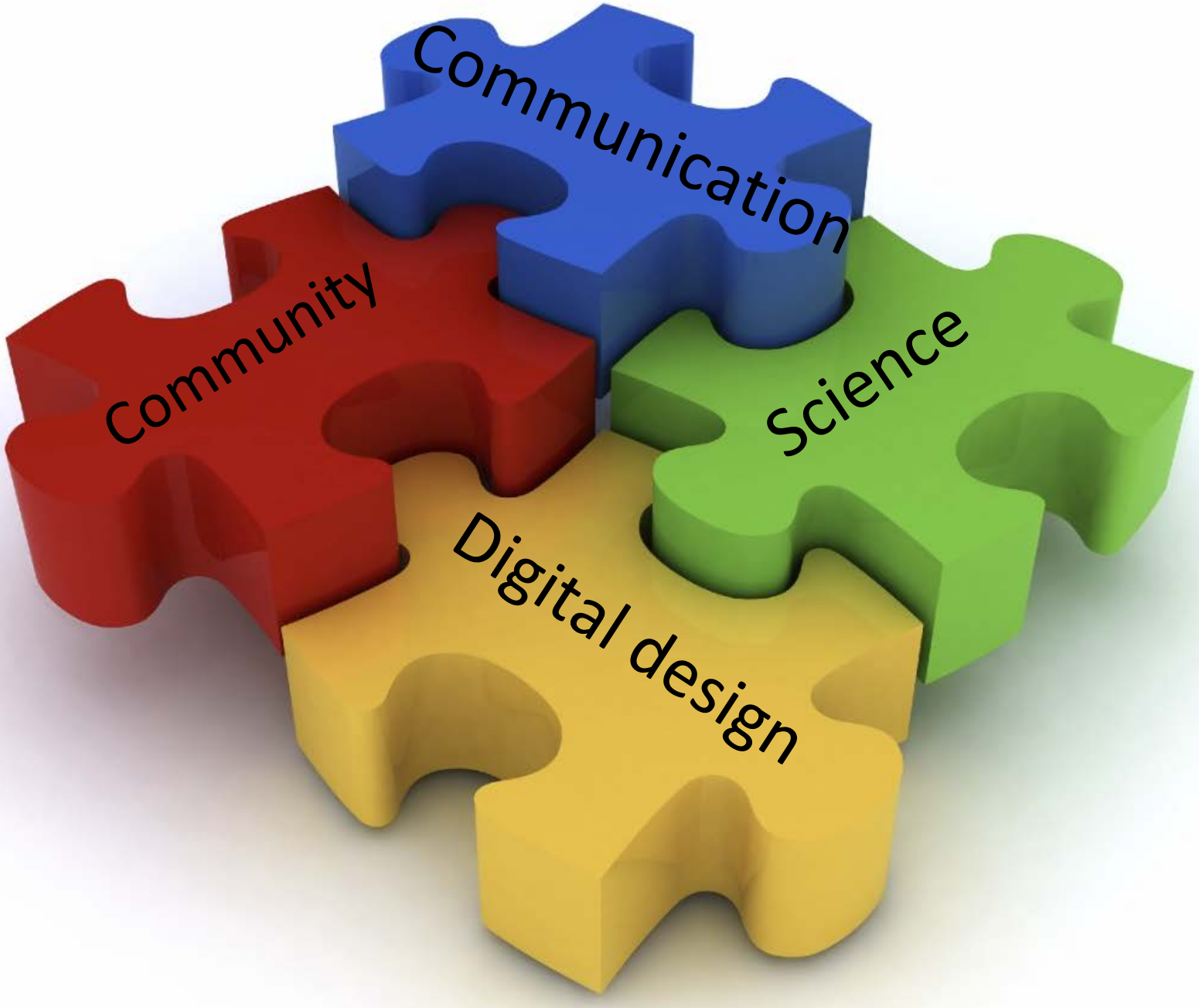

Science

Art-oriented teenage girls


WATERFALL ARTS
256


Hang Out – Make Media Art – Design Digital Stories
The summer intensive launches a brand new Augmented Reality (AR) digital storytelling club for girls that will continue from September – December.
Work with other girls and community members to create your own interactive digital stories about your community.
Plan a Showcase to present your AR Experience, and explore more ways to connect with other creators.
apply at www.mmsa.org/AR-Girls


AR
Girls

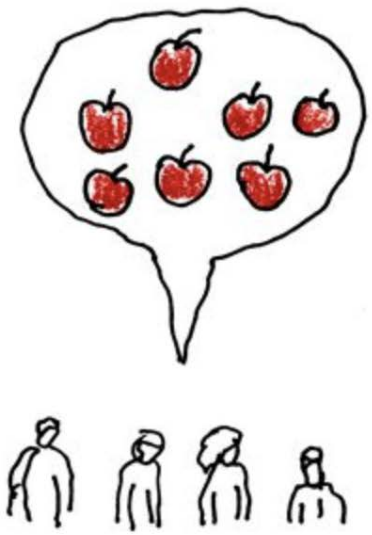

Communication
Community
Science
Digital design

ARIS | *Create location-based games and stories*

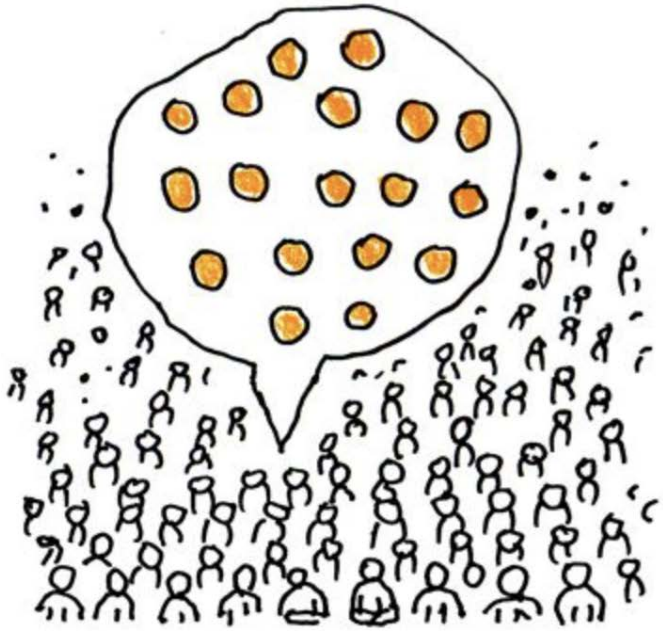

TERENCE BLACKER
SAMSUNG


Mrs
Murphy

Science communication



scientists



the public


Where in the World?
Everest

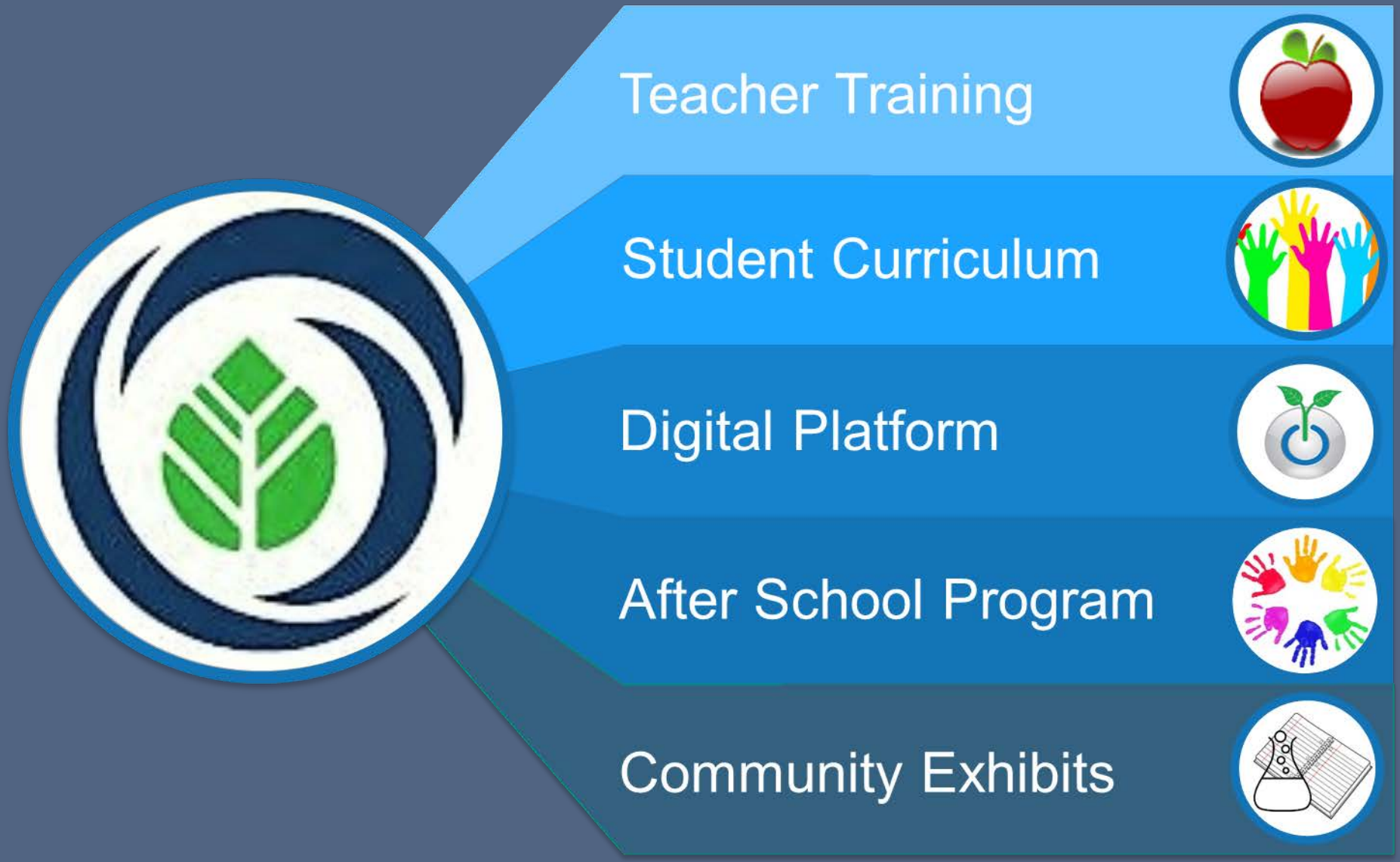
Cat Stylinski
cstylinski@umces.edu

Dr. Lauren B. Birney | Assistant Professor
Pace University | School of Education
CCERS Principal Investigator
NSF DRL 1440869
NSF DRL 1643016

CCERS

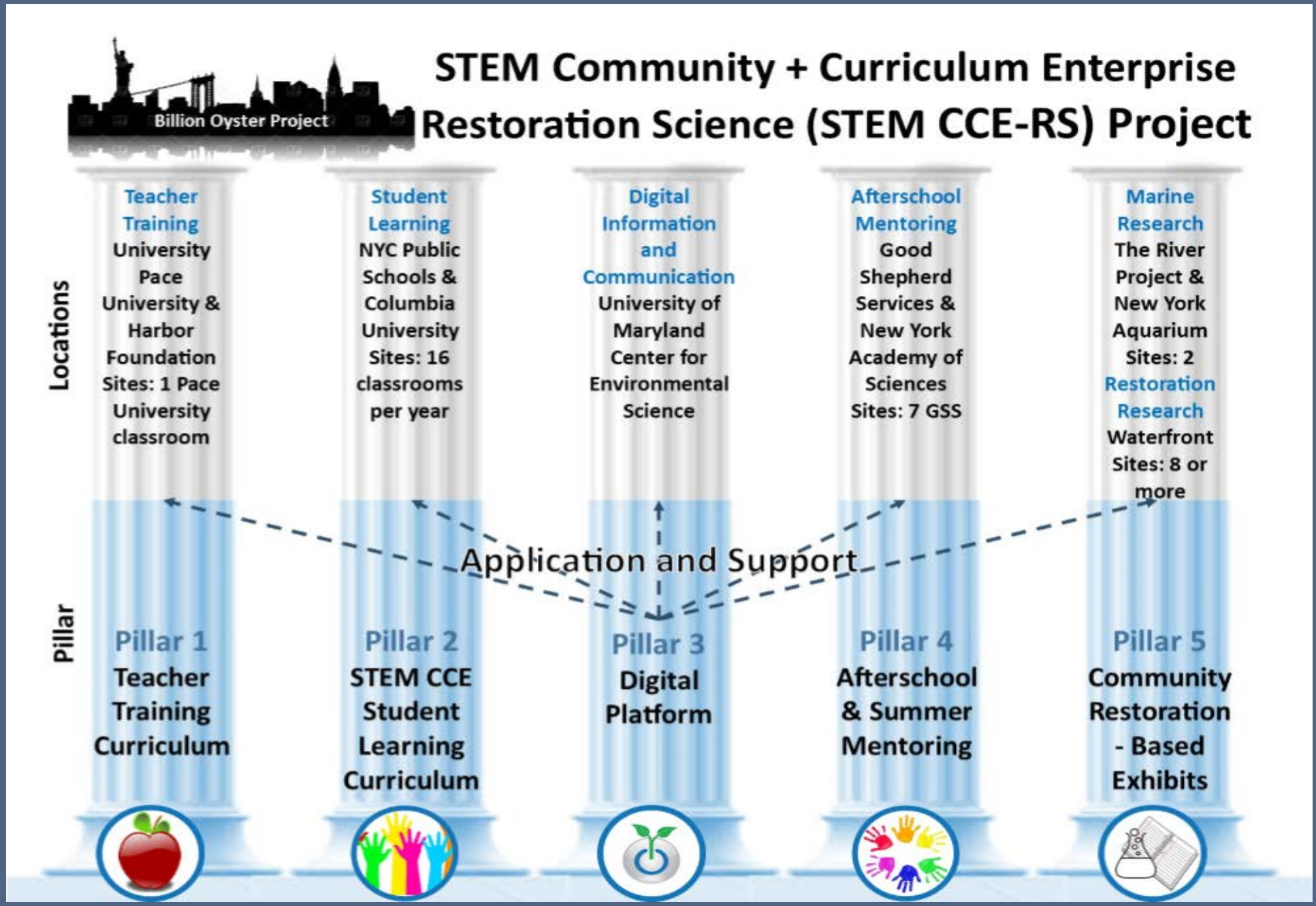
Curriculum and Community Enterprise for Restoration Science in New York Harbor

Manhattan, New York – New York Harbor 2018



Design Educational Models incorporating CITIZEN SCIENCE Design Multifaceted Integrated Citizen Science through Environmental Restoration with Student Field Research and Inquiry Learning

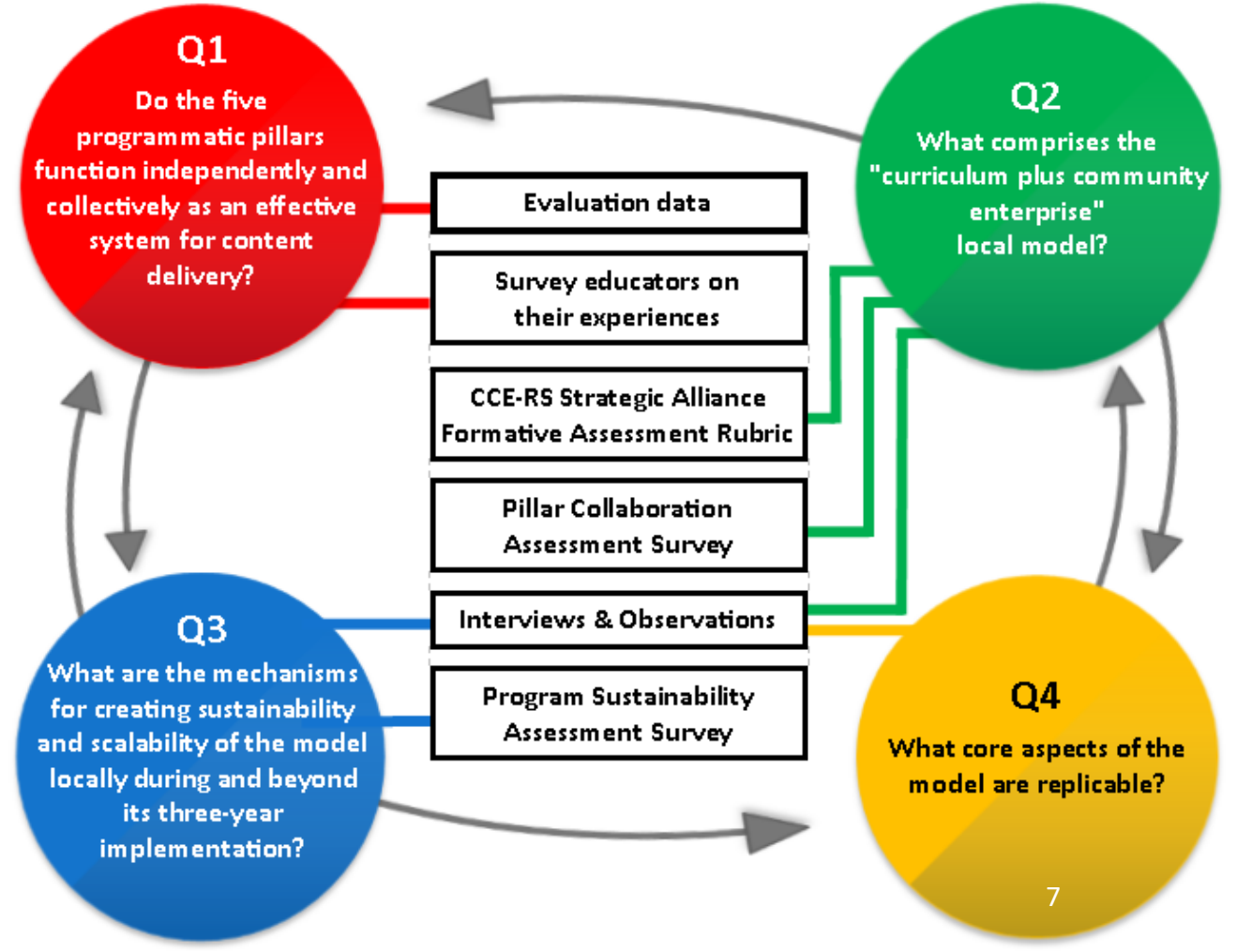
New York Harbor Eco Dock – Governor's Island, New York


Billion Oyster Project
STEM Community + Curriculum Enterprise
Restoration Science (STEM CCE-RS) Project
Locations
Pillar
Teacher Training
University Pace University & Harbor Foundation Sites: 1 Pace University classroom
Student Learning
NYC Public Schools & Columbia University Sites: 16 classrooms per year
Digital Information and Communication
University of Maryland Center for Environmental Science
Afterschool Mentoring
Good Shepherd Services & New York Academy of Sciences Sites: 7 GSS
Marine Research
The River Project & New York Aquarium Sites: 2
Restoration Research
Waterfront Sites: 8 or more
Application and Support
Pillar 1
Teacher Training Curriculum
Pillar 2
STEM CCE Student Learning Curriculum
Pillar 3
Digital Platform
Pillar 4
Afterschool & Summer Mentoring
Pillar 5
Community Restoration - Based Exhibits

New York City Department of Education Middle School Students

Curriculum and Community Enterprise for Restoration Science
Evaluation & Research

Mission:
Meaningfully connect teaching and learning to restoration of New York Harbor. Enhance life outcomes for students historically underrepresented in STEM-C fields.



ESTABLISH REPLICABLE EDUCATIONAL MODEL

Designing an Effective and Efficient Environmental Restoration Model

CCERS Research Plan

What comprises the "curriculum plus community enterprise" local model?

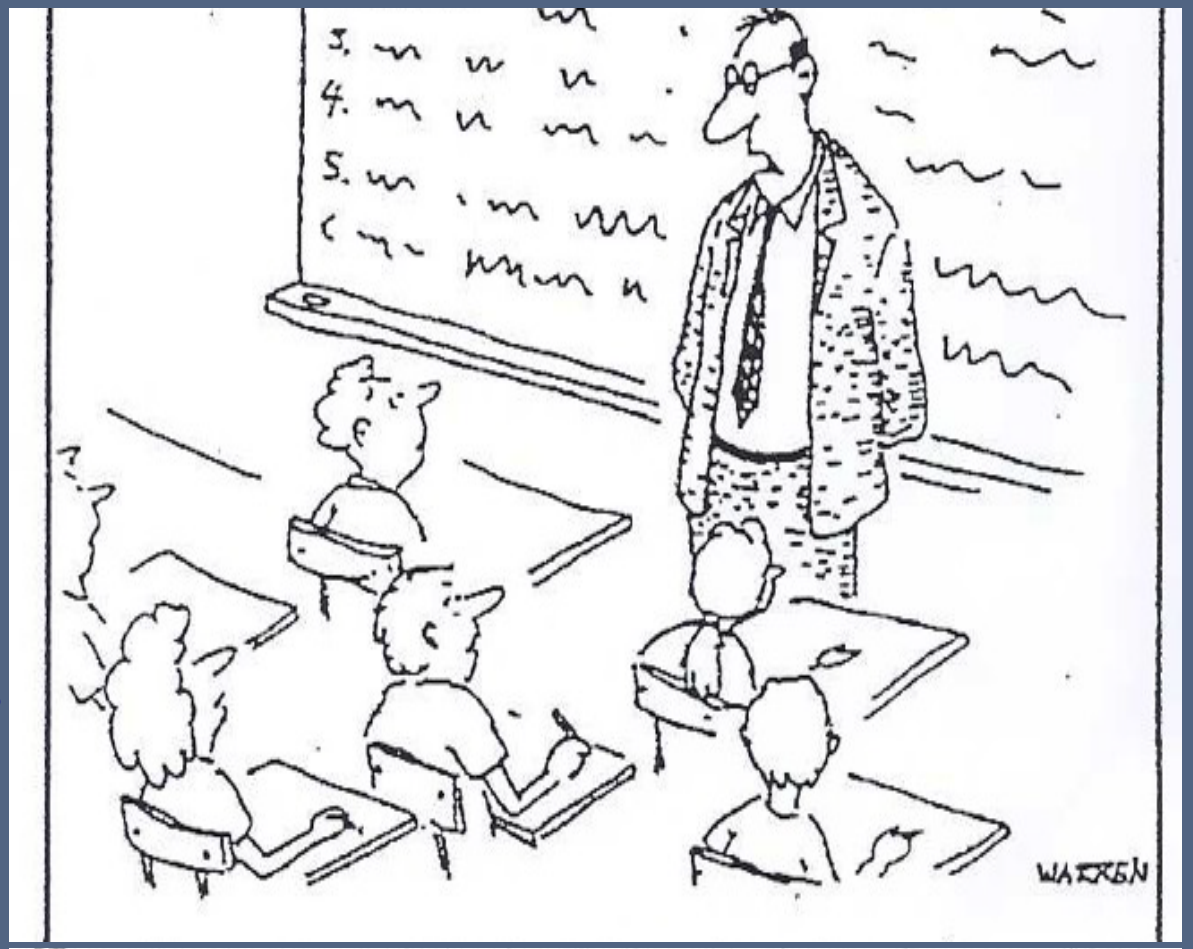
Operationalized Collaboration	Identify & Map Communities of Practice	Monitor Stage(s) of Development	Assess Levels of Integration	Assess Cycles of Inquiry
Improve Understanding	Plan Strategically	Enhance Collaboration	Inform Decision Making	Strengthen Inter-organizational capacity
Reflect on Literature	Map connections: between partners, organizations, and pillars.	Conduct Interviews: determine stage and potential growth areas.	Identify current and ideal integration: Organizational Integration Rubric Conduct Interviews identify how to achieve optimal level of integration.	Conduct Collaborative Assessment Rubric: identify strengths and areas of growth.

Citizen Science through Environmental Restoration New York Harbor, New York

Project Footprint – Project Deliverables and Outcomes

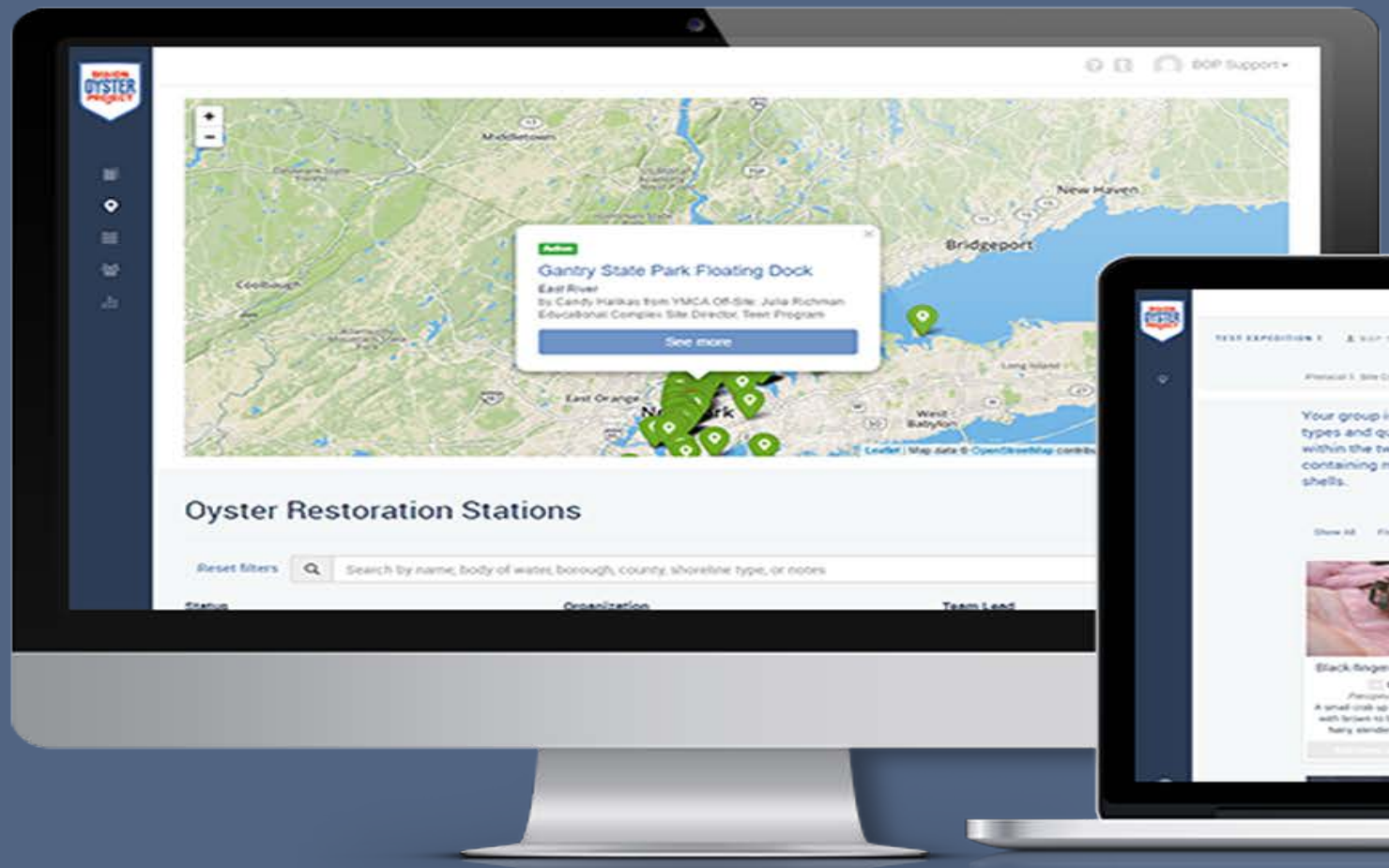
Plan the Project's Footprint

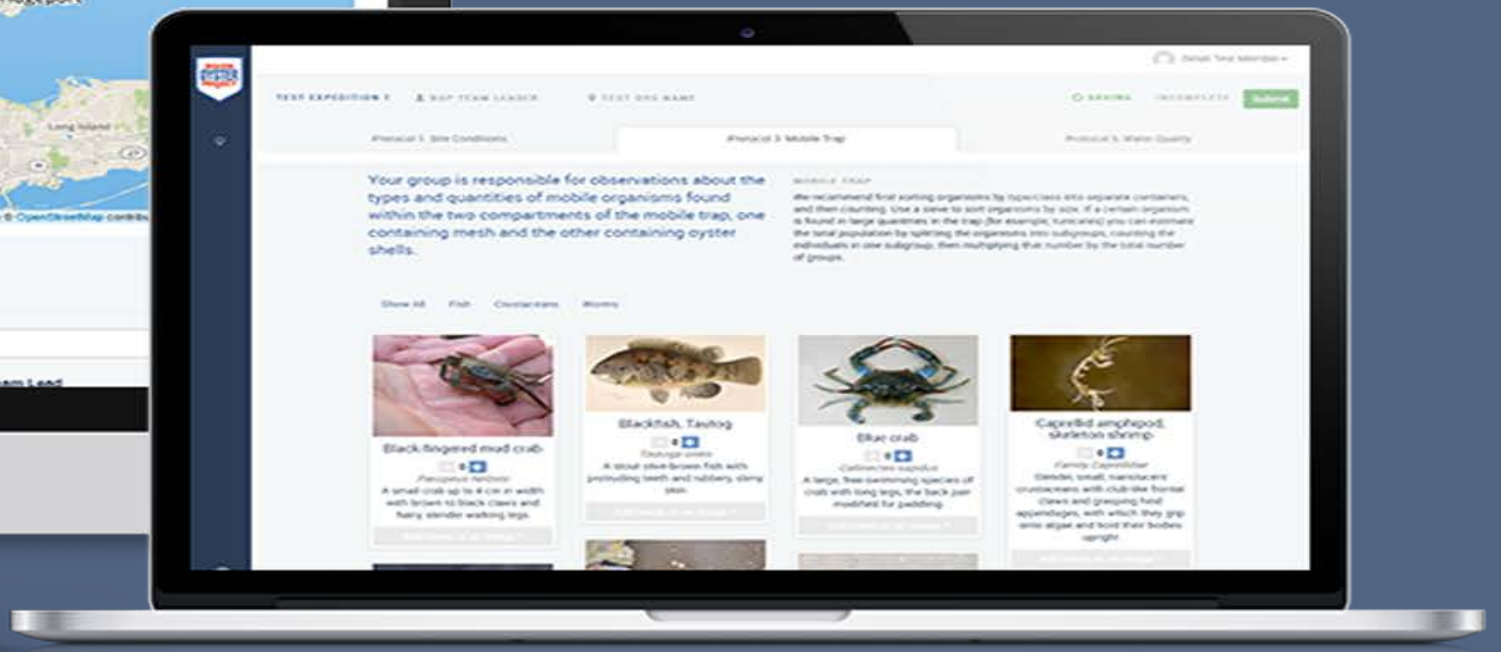
- **Curriculum for Middle School Teachers**
- Field Science Manual for New York Harbor
- White Paper
- Journal Publications and Articles
- Presentations, Symposia and Colloquia
- Videos and Film
- **Digital Monitoring Platform**
- Permanent Displays and Exhibits at Institutions
- STEM Teacher Training Model
- STEM Mentoring Model
- Restoration Based Community Science Model
- Mobile Applications

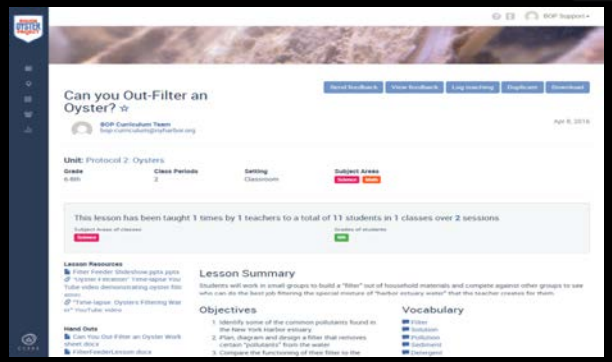


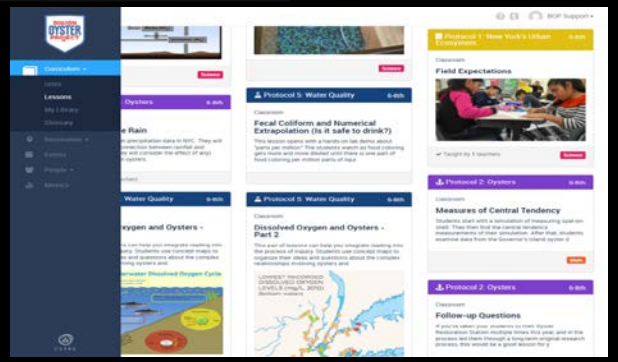
'I expect you all to be independent, innovative, critical thinkers who will do exactly as I say'

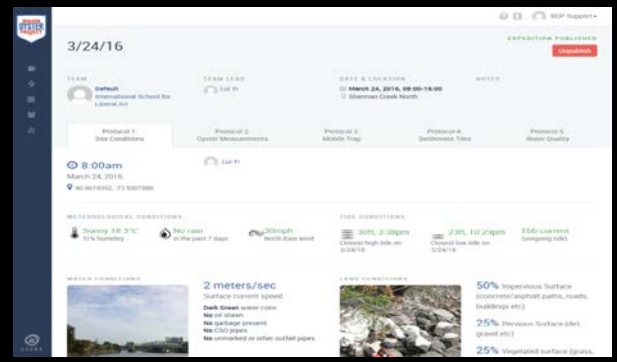
fearless


Gantry State Park Floating Dock
East River
See more
Oyster Restoration Stations
Reset filters
Search by name, body of water, borough, county, shoreline type, or more


Your group is responsible for observations about the types and quantities of mobile organisms found within the two compartments of the mobile trap, one containing mesh and the other containing oyster shells.
Blackfish, Tautog
Blue crab


Can you Out-Filter an Oyster?
Lesson Summary
Objectives
Vocabulary


Field Expectations
Fecal Coliform and Numerical Extrapolation (Is it safe to drink?)
Dissolved Oxygen and Oysters - Part 2
Measures of Central Tendency
Follow-up Questions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Metrics
Timeline
Lessons per Unit
Grade
Periods
Setting
Subject Areas

Quantitative Poster CCERS

Pillar 1: Teacher Development

Professional development course trains middle school teachers in New York City public schools to develop and implement new CCERS curriculum to promote active learning of STEM-C with Project Based Learning (PBL) & Bybee's 5E Model.

In accordance with research on effective pedagogical practices, project lessons connect learning activities to day-to-day life in the local community, so students see the effects their efforts have beyond school (Koullion & Gomez, 2021). Project teachers interact directly with scientists to master techniques and principles, and develop strategies to implement lessons. This enables teachers to scaffold students' discovery process, empowering students to think critically, employ problem-solving strategies, and develop scientific research skills. (Baumgartner & Zabih, 2008; Bybee et al, 2008; Krajcik, Blumenfeld, Marx, & Soloway, 1994).

- Teachers agreed their participation in the project enhanced their knowledge, skills, and confidence in teaching the principles and processes of restoration science (M=5.17).
- Baseline data indicate teachers can improve skills in incorporating all 5E components to implement more effective pedagogical practices.

Pillar 2: Student Learning

Curriculum is aligned to Next Generation Science Standards (NGSS). Lessons incorporate harbor restoration activities with field site monitoring.

Project-based learning activities have been shown to increase students' interest as they apply their knowledge to real-world problems (David, 2008). The guided inquiry and shared discovery approach is consistent with NGSS, which emphasizes investigating to develop deep understanding, rather than memorizing facts (Marx et al, 2004). Students completed pre-surveys to assess their initial content knowledge, scientific interest, and self-efficacy. Post-surveys will be administered at the end of the school year.

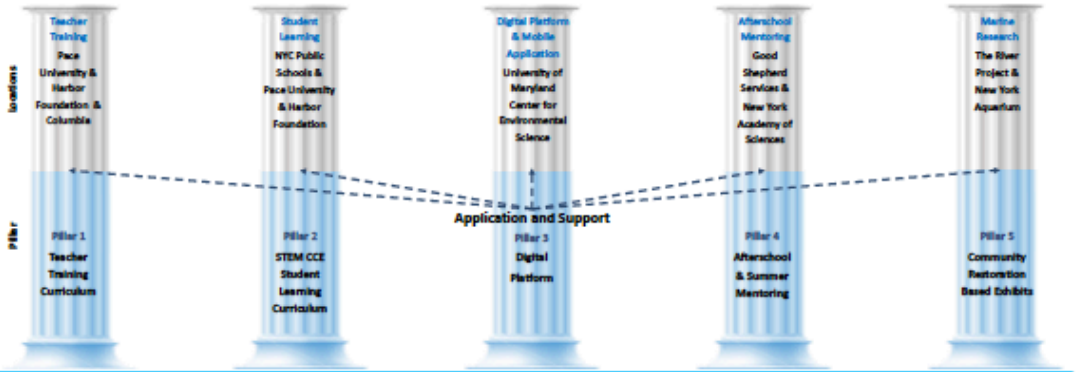
- Baseline data show substantial room for students to improve their knowledge of harbor geography, marine science, and other project content (M=30% correct answers).
- Students' post-survey scores will be compared to baseline, and to a control group who continue to receive traditional science lessons.

Educational Models

Project Based Learning (PBL)

Bybee's 5E Model

Goal 1 - The Educational Model: Increase quality and effectiveness of STEM-C teaching and learning
Goal 2 - Teachers: Increase knowledge and instructional skill
Goal 3 - Students: Increase knowledge of and interest in STEM–C



Pillar 3: Digital Platform

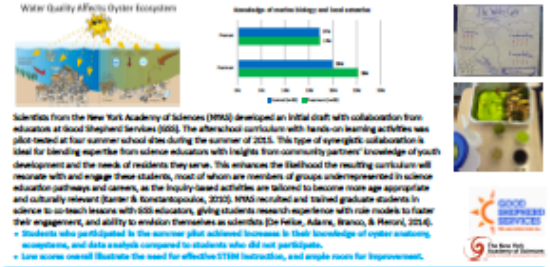
Teachers, scientists, and curriculum specialists try out and contribute to project-developed lesson plans, with learning activities, and optional resources using a standardized template. The database will also store measurements and observations collected by students on field site visits. Software is in development to record these in the field. Ultimately an online dashboard will enable students to analyze their own and others' data, and to create charts and graphs for scientific reports.

Research on learning technologies has demonstrated usage can enhance student learning, engagement, and interest in science (López-Pérez, Pérez-López, Rodríguez-Ariza, & Argente-Linares, 2016) and mathematics (Ryoon & Yaratan, 2014). Engagement in STEM activities and gaining a sense of project ownership "increased participating students' interest in STEM majors and encouraged them to pursue science and engineering related careers" (Sahin, Ayar, & Adiguzel, 2014, p. 316). Student collaborations involving problem identification, analyzing data, and conducting problem-solving activities using computer software contribute to developing data collection and analysis skills (Reid-Griffin & Carter, 2008).

- Members of all pillars contribute content and feedback toward development of digital platform and/or app to collect and record data at oyster restoration field stations. The information technology team beta-tested app to identify ways to maximize performance and increase usability. While the app is currently being redesigned, students in project classes test water quality, monitor site conditions, and collect other measurements and observations on

Pillar 4: Afterschool/Mentoring

Scientists and youth development experts collaborate on a STEM-C curriculum adaptable for afterschool and summer school settings with few provided resources.

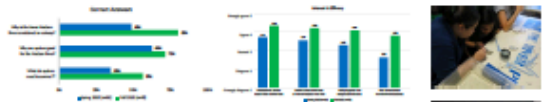


Scientists from the New York Academy of Sciences (NYAS) developed an initial draft with collaboration from educators at Good Shepherd Services (GSS). The afterschool curriculum with hands-on learning activities was pilot-tested at four summer school sites during the summer of 2015. This type of synergistic collaboration is ideal for blending expertise from science educators with insights from community partners' knowledge of youth development and the needs of residents they serve. This enhances the likelihood the resulting curriculum will resonate with and engage these students, most of whom are members of groups underrepresented in science education pathways and careers, as the inquiry-based activities are tailored to become more age appropriate and culturally relevant (Kanter & Konstantopoulos, 2010). NYAS recruited and trained graduate students in science to co-teach lessons with GSS educators, giving students research experience with role models to foster their engagement, and ability to envision themselves as scientists (De Feliz, Adams, Branco, & Menzel, 2014).

- Students who participated in the summer pilot achieved increases in their knowledge of oyster anatomy, ecosystems, and data analysis compared to students who did not participate.
- Low scores overall illustrate the need for effective STEM instruction, and ample room for improvement.

Pillar 5: Community Exhibits

Student field trips incorporate content on biodiversity and local restoration efforts. Collaborative efforts produced interactive exhibits tied to the CCERS project.



Ecological education studies (e.g., Rogers, 1998) indicate experiential learning is effective in fostering positive environmental attitudes, such as stewardship intentions and conservation behaviors. Nadelson & Jordan (2012) suggest field trip experiences are recalled well and that positive attitudes will be maintained. Building connections between the local community and science education increases students' sense that the content is relevant to their lives (De Feliz et al., 2014). Field trips to The River Project were offered to project participants during the spring and fall. These focused on project-related content developed in partnership with scientists and educators from Pillar 1. Students were surveyed after visits in spring (minimal teacher treatment) and fall (greater teacher treatment). Students' interest in ecological stewardship, raising others' awareness, scientific efficacy, and interest in STEM careers were measured on a 5-point Likert type scale. The comparison is a promising indicator that partners' combined efforts may produce effective outcomes.

- Fall field trip student's demonstrated greater knowledge recall than those surveyed in spring.
- Fall students expressed greater interest in their local environment and rated their scientific efficacy and career interest higher as well.

Project Description

Demand for job skills in scientific and technological fields continues to rise; however, the number of students entering higher education STEM-C pathways is low. Thus, employment opportunities in Science, Technology, Engineering, Math, and Computer Sciences (STEM-C) are swiftly outpacing supply of qualified applicants. New models for increasing students' interest, efficacy, and intentions to pursue STEM-C careers are being designed and tested. One multi-faceted approach currently being developed and refined is the Curriculum + Community Enterprise for Restoration Sciences (CCERS), funded by a grant from the National Science Foundation (NSF) for urban middle school students to explore restoration of the oyster population in New York Harbor. The partners are: Pace University, Columbia University Lamont-Doherty Earth Observatory, New York Harbor Foundation, New York Academy of Sciences, University of Maryland Center for Environmental Science, New York City Department of Education, New York Aquarium, The River Project, and Good Shepherd Services. Extensive collaboration efforts are underway to develop this educational model and implement a sustainable project-based learning curriculum. Project-based science (PBS) emphasizes reforming pedagogy to motivate students to learn through long-term projects promoting inquiry and finding solutions to real world problems. Activities designed around Bybee's 5E Model encourage students to act like scientists, building their critical thinking skills to construct meaningful understandings instead of memorizing facts. The goal is to enhance STEM-C education by engaging participants in long-term restoration ecology and environmental monitoring projects. Partners will develop a replicable model for other restoration projects as suited to local environmental conditions. The model has five programmatic pillars: 1) Teacher Training Continuing Education Fellowship in implementing PBS lesson plans and activities; 2) Student participation in PBS curriculum and authentic

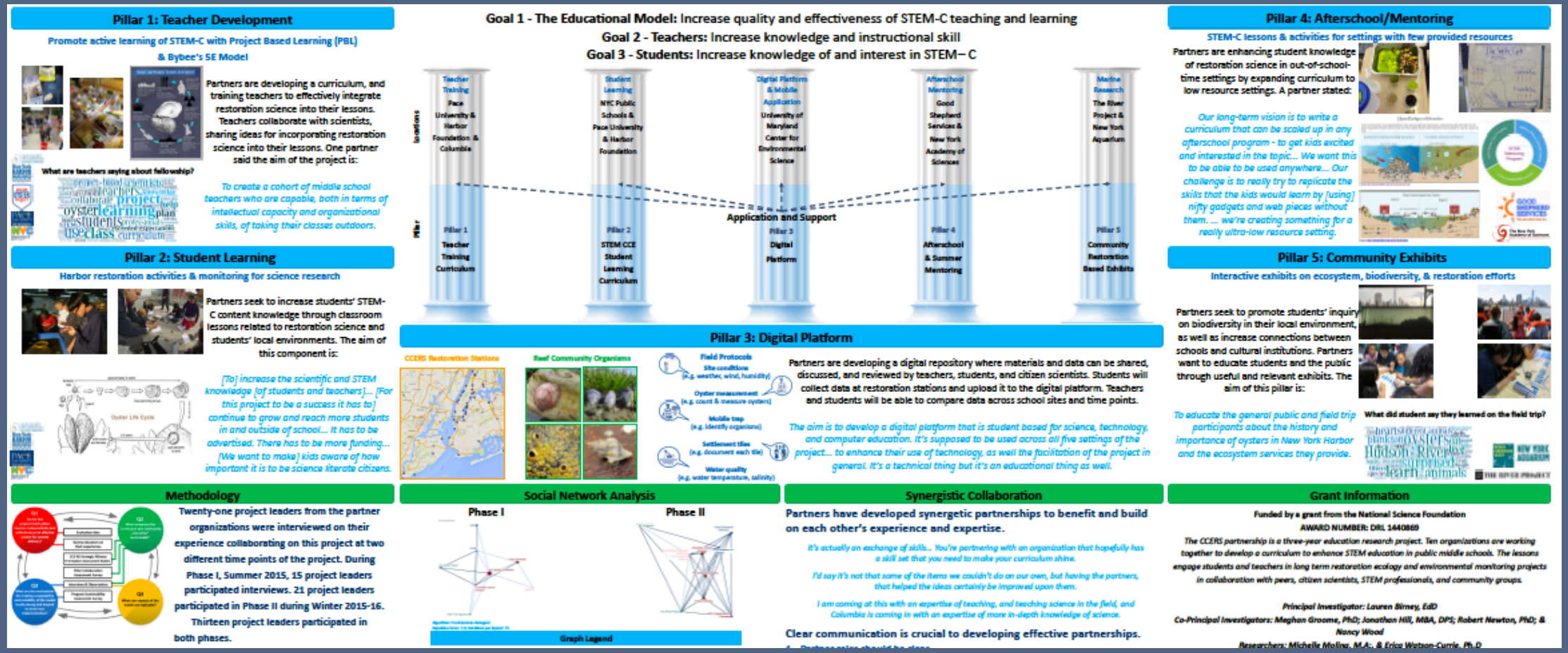
Grant Information

Funded by a grant from the National Science Foundation
AWARD NUMBER: DRL 1440869

The CCERS partnership is a three-year education research project. Ten organizations are working together to develop a curriculum to enhance STEM education in public middle schools. The lessons engage students and teachers in long term restoration ecology and environmental monitoring projects in collaboration with peers, citizen scientists, STEM professionals, and community groups.

Principal Investigator: Lauren Birney, EdD
Co-Principal Investigators: Meghan Groome, PhD; Jonathan Hill, MBA, DPS; Robert Newton, PhD; & Nancy Wood
Researchers: Erica Watson-Currie, Ph.D & Michelle Molina, M.A.
Evaluators: Gaylen Moore & Alexa Nicolas

Qualitative Poster CCERS



Short-term process

- Professional development for teachers, afterschool staff, mentors
- Digital lesson repository
- Mobile application for citizen scientists
- Educational public exhibits
- Demonstrate real world use of STEM-C

Teacher Training

Promote active learning of STEM-C with PBL & 5E Model

Student Curriculum

Harbor restoration activities & monitoring for science research

Digital Platform

Lesson repository, mobile app for data collection & display

Afterschool Mentoring

STEM-C lessons & activities for low resource settings

Community Exhibits

Interactive exhibits on ecosystem, biodiversity, restoration efforts

- Database of STEM-C lessons and activities for various educational settings
- Replicate model in different locations
- Tailor curriculum to wide variety of restoration projects
- Increase STEM-C knowledge
- Promote environmental awareness and stewardship

Long-term vision of model

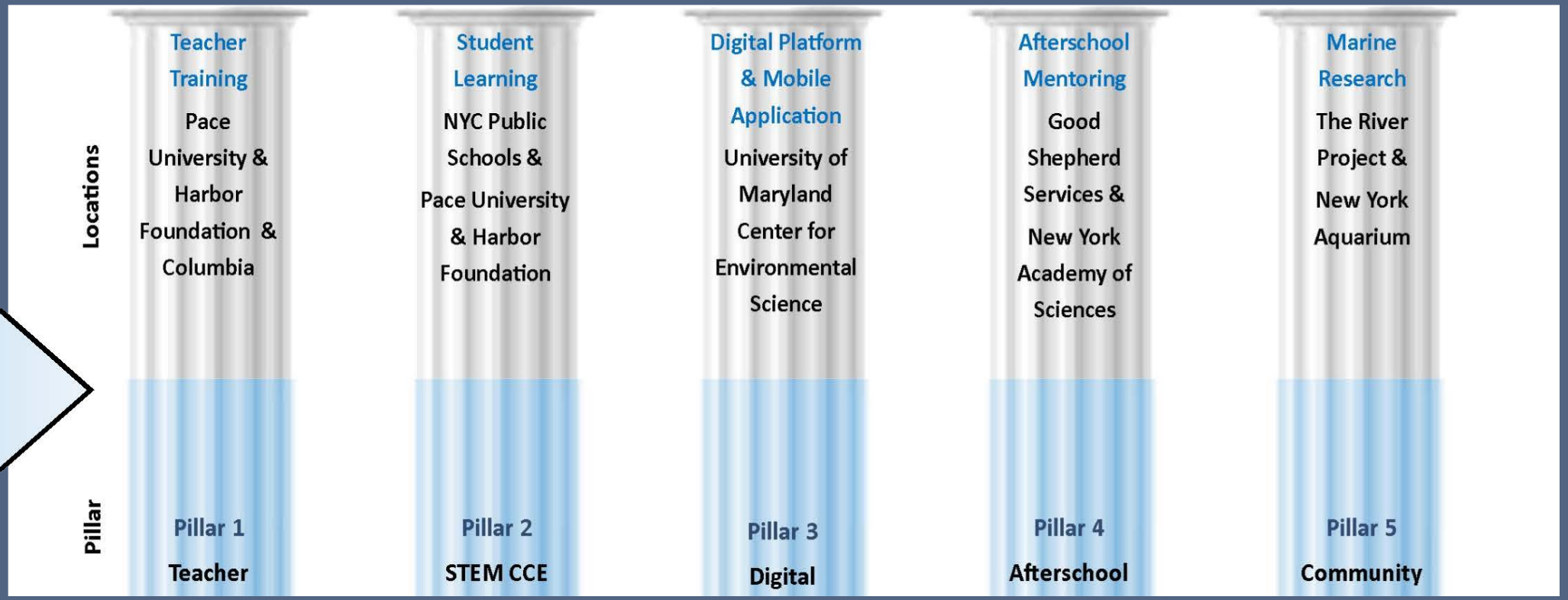
Smart and Connected Communities

Components to be funded by Smart & Connected Communities grant

Connect restoration STEM with environmental policy and law

- **Provide advanced training in environmental sensing-based technology**
- **Expand Digital Platform**
- **Strengthen afterschool STEM mentoring engagement with smart & connected technology**
- **Increase community connections through Summer STEM institutes**

Existing CCERS Project Pillars and Partners (DRL 1440869)



Future Landscape New York Harbor 2019

The Living Breakwaters 2020

Designed by Scape

The New York Harbor Foundation
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CCERS Project Manager

Pete Malinowski
Director of Billion Oyster Project

Denise McNamara
Anne Lederberg
Curriculum Specialists

New York City Department of Education
Chancellor Carmen Farina

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Physical Oceanography

Elisa Bone
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Field Science Procedures (Author)

Matthew Palmer
Research Scientist
Field Science Procedures (Advisor)

The New York Academy of Sciences

Stephanie Wortel London
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Curriculum Developer

The River Project
Cathy Drew
President

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Rebecca Kusa
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Exhibit Development

Good Shepherd Services

Lori Krane
Executive Director
Afterschool Programming

University of Maryland
Center for Environmental Studies

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Environmental Studies

Judy O'Neil
Research Scientist
Environmental Studies

Fearless Solutions
Platform Designer and Developer

Simon Costanzo
Research Scientist and Platform Designer

Gaylen Moore
Evaluation

SmartStart
Research

CCERS

Curriculum and Community Enterprise for the Restoration of New York Harbor in New York City Public Schools

The STEM Collaboratory NYC®

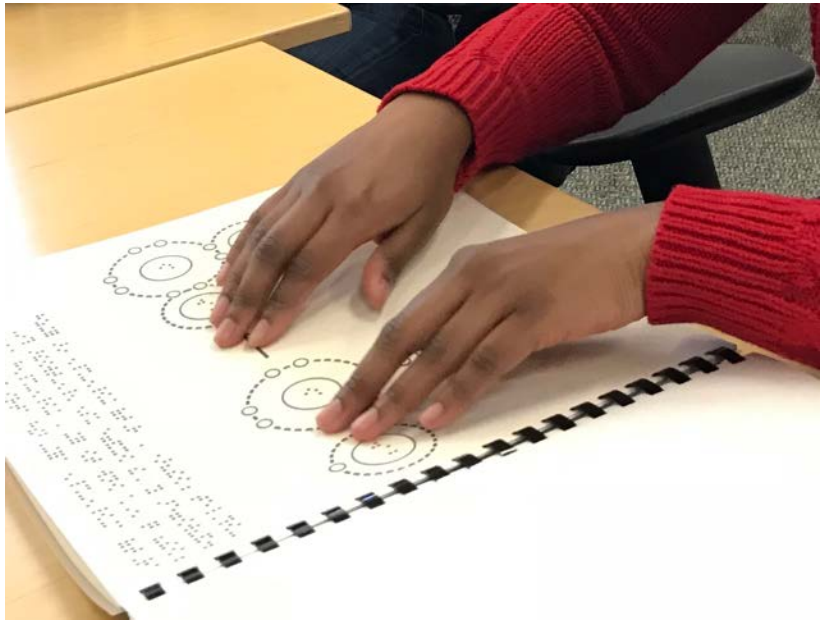
Lauren Birney, Pace University New York lbirney@pace.edu

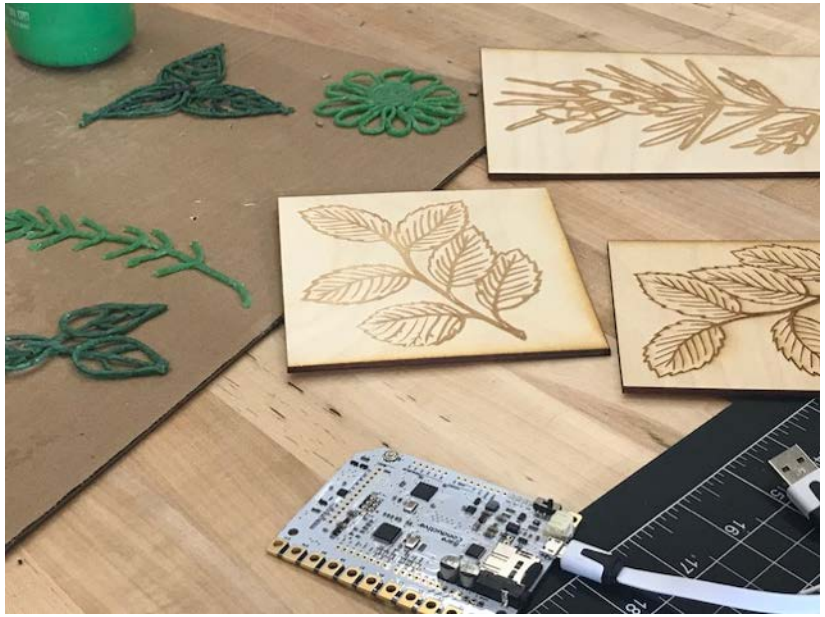
BUILD

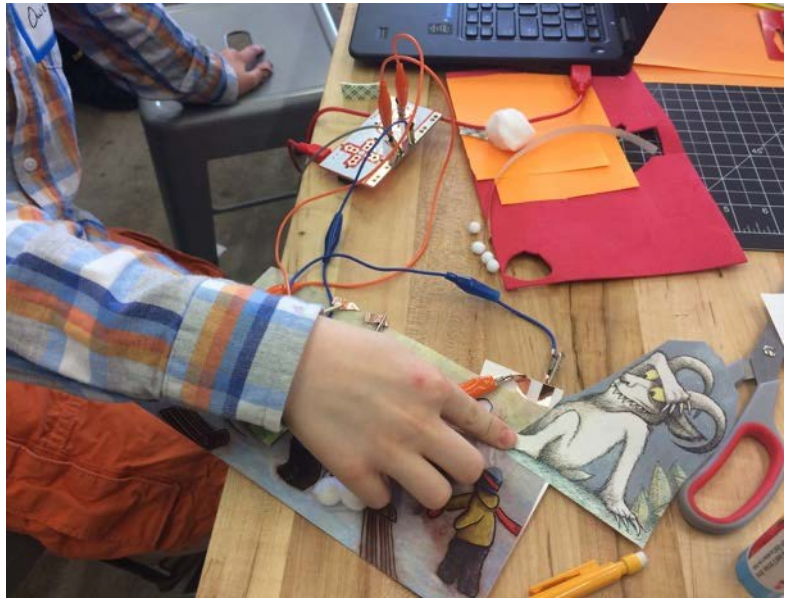
A BETTER BOOK

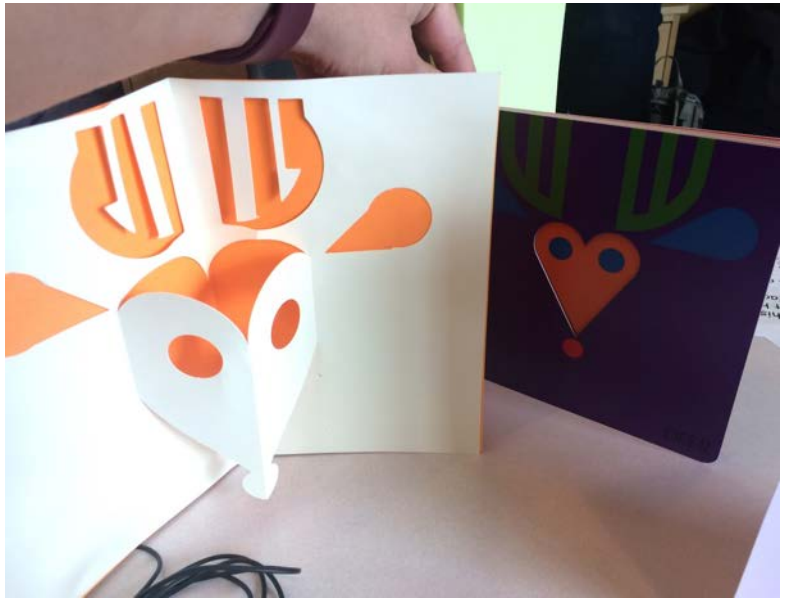
University of Colorado Boulder


BLDG 61
Telescope

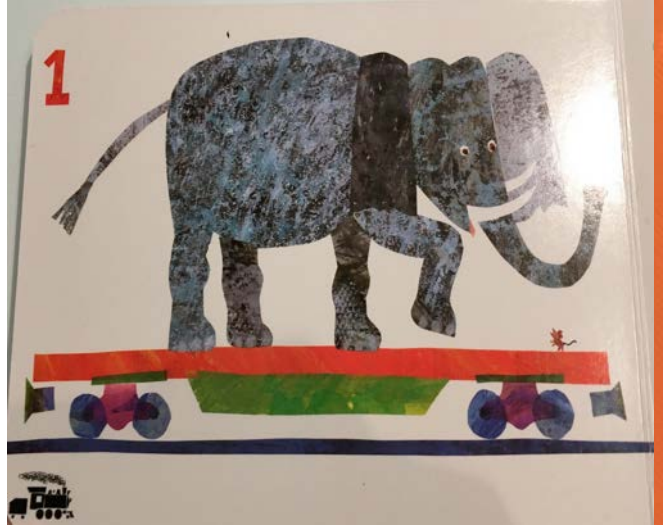









Catch a Crawdad!
¡Atrapa a la Langosta!
By Jeronimo Palacios,
Kaija Van Zante, & Sydney Wanner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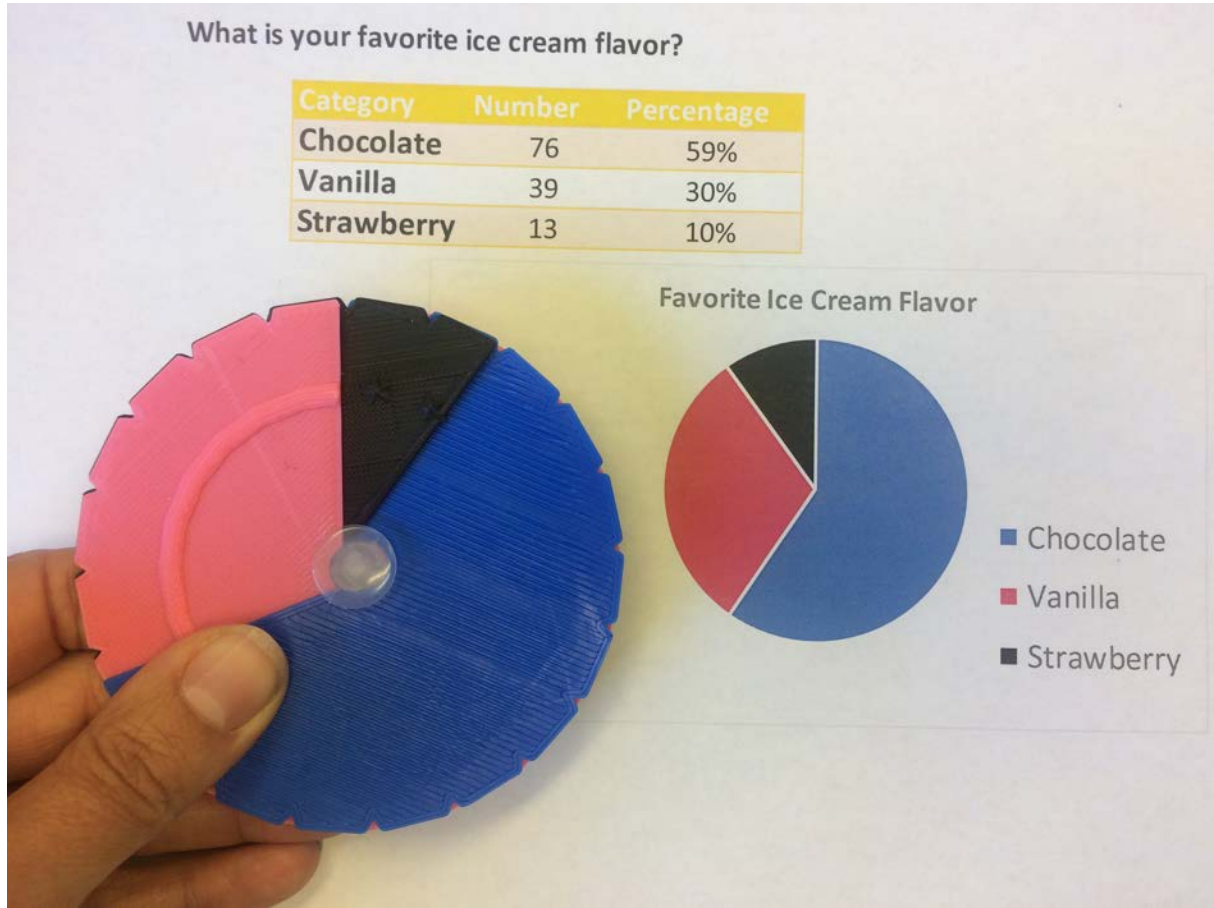
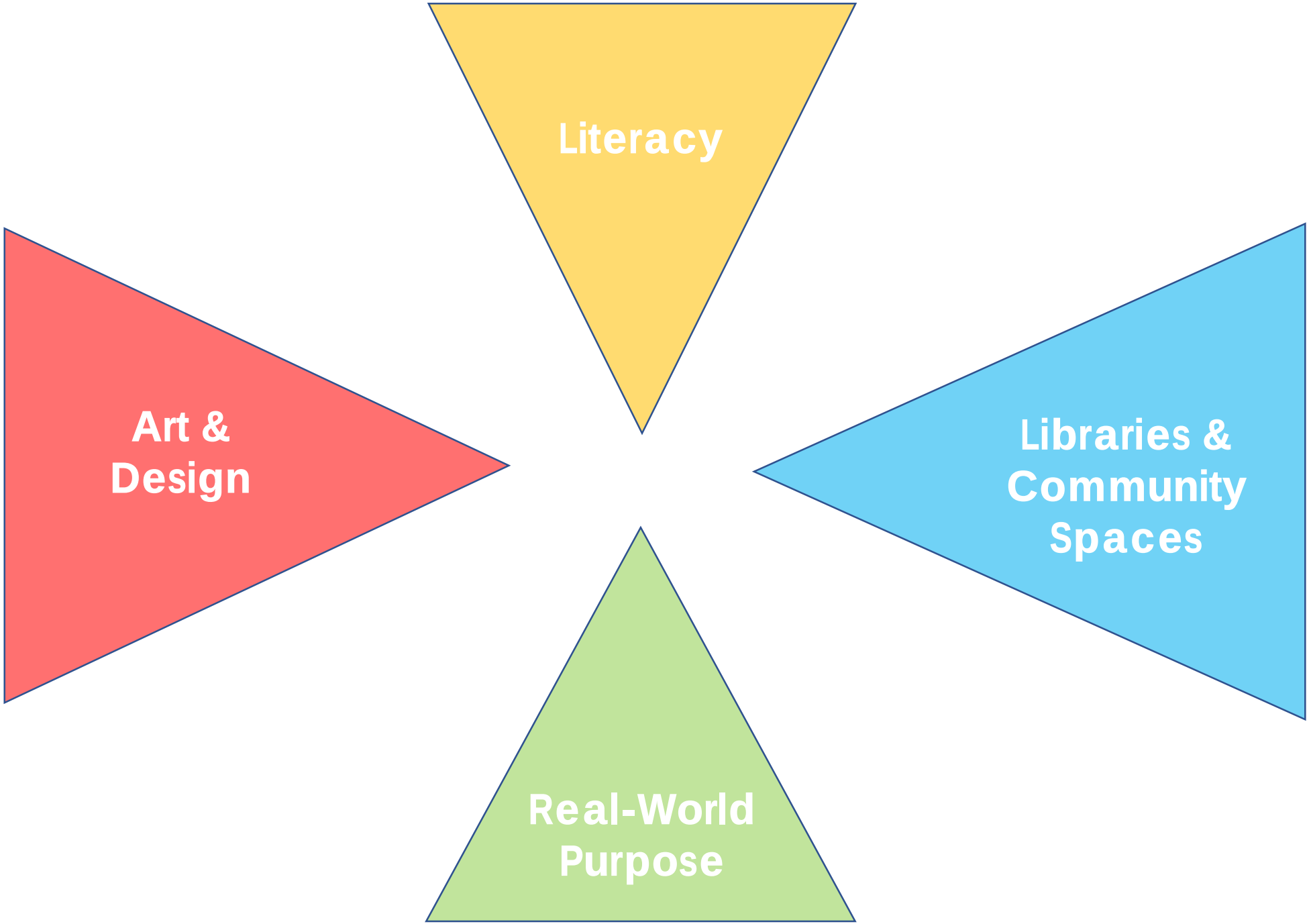
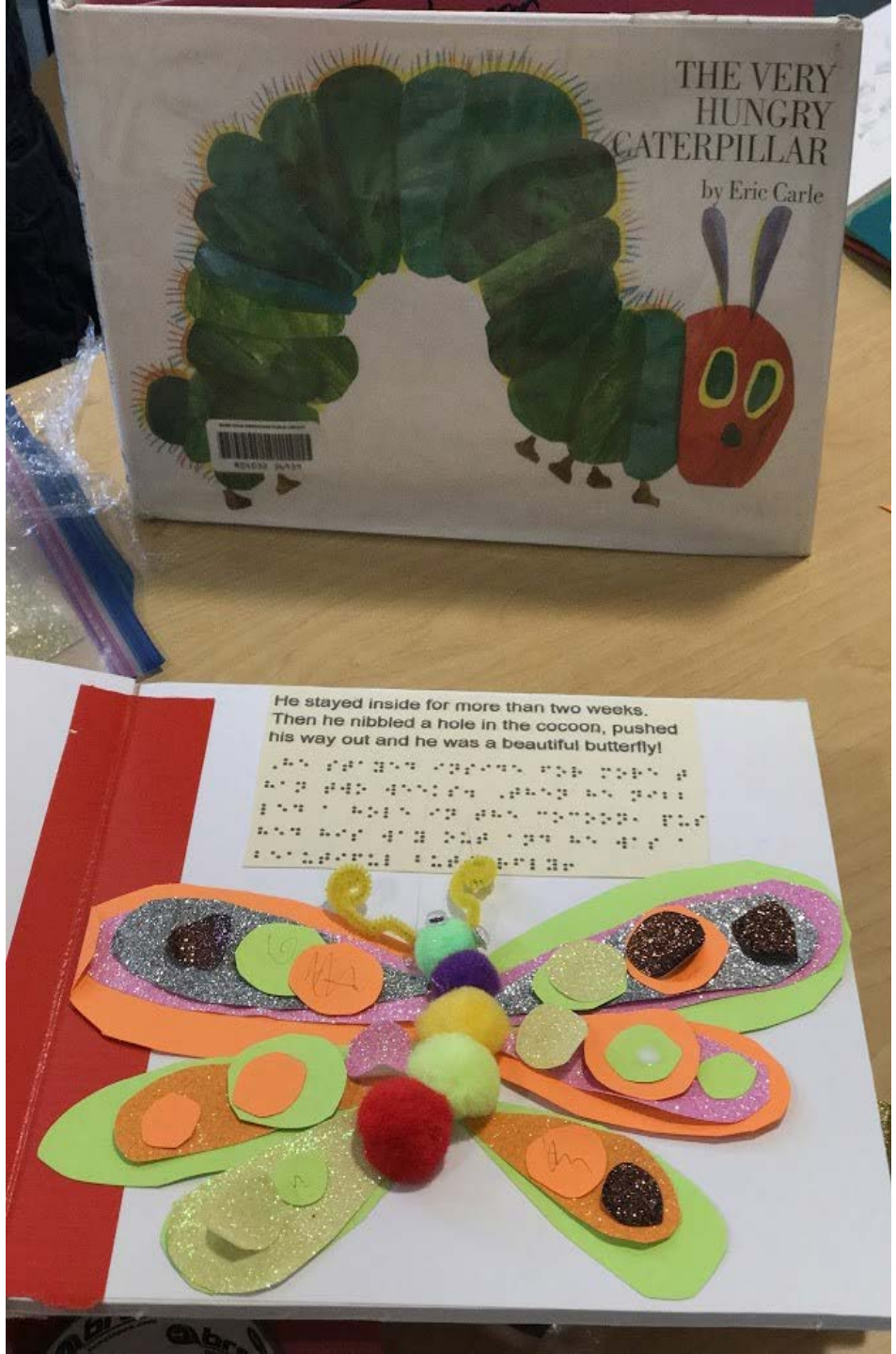

What is your favorite ice cream flavor?
Category Number Percentage
Chocolate 76 59%
Vanilla 39 30%
Strawberry 13 10%
Favorite Ice Cream Flavor
Chocolate
Vanilla
Strawberry


Literacy
Art &
Design
Libraries &
Community
Spaces
Real-World
Purpose

Art & Design


EPILOG LASER
FUSION M2
So when a lemur began to follow me one bright sunny morning in the park...
...I tried my hardest to ignore him.

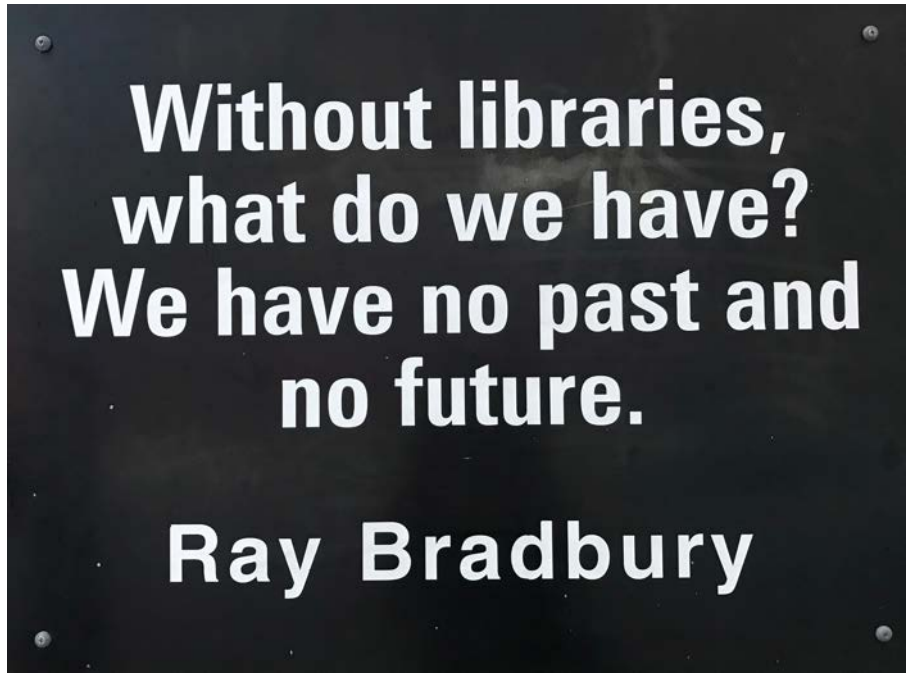

THE VERY HUNGRY CATERPILLAR
by Eric Carle
He stayed inside for more than two weeks. Then he nibbled a hole in the cocoon, pushed his way out and he was a beautiful butterfly!

Storytelling

Purpose

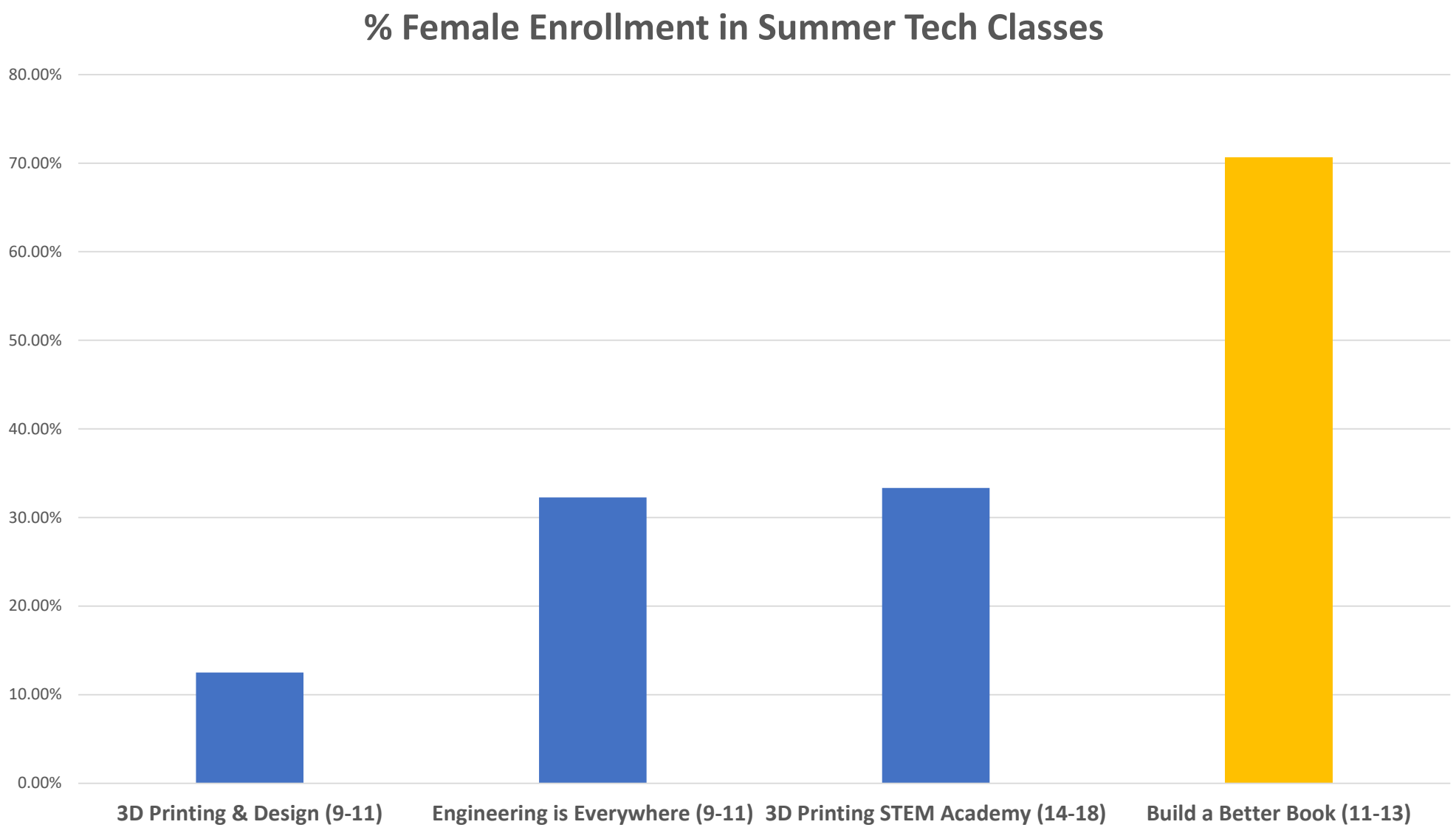

OPEN CALL FOR ENTRIES | APPLY NOW
MAKER MADE
WORKS PRESENTED BY BLDG 61 | DEC 15 - JAN 28
2D & 3D DESIGN, ELECTRONICS, FIBER ART, WOOD, METAL, PLASTIC, ROBOTIC, KINETIC, INTERACTIVE, DECORATIVE, AND INDUSTRIAL WORKS ALL WELCOME.
Show Begins
12.15.2017
Show Ends
01.28.2018
APPLY NOW

Libraries


Without libraries,
what do we have?
We have no past and
no future.
Ray Bradbury


STEM
Science Technolog Engineering Mathematics
LAUNCH

Girls


% Female Enrollment in Summer Tech Classes
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
3D Printing & Design (9-11)
Engineering is Everywhere (9-11)
3D Printing STEM Academy (14-18)
Build a Better Book (11-13)

Mentors

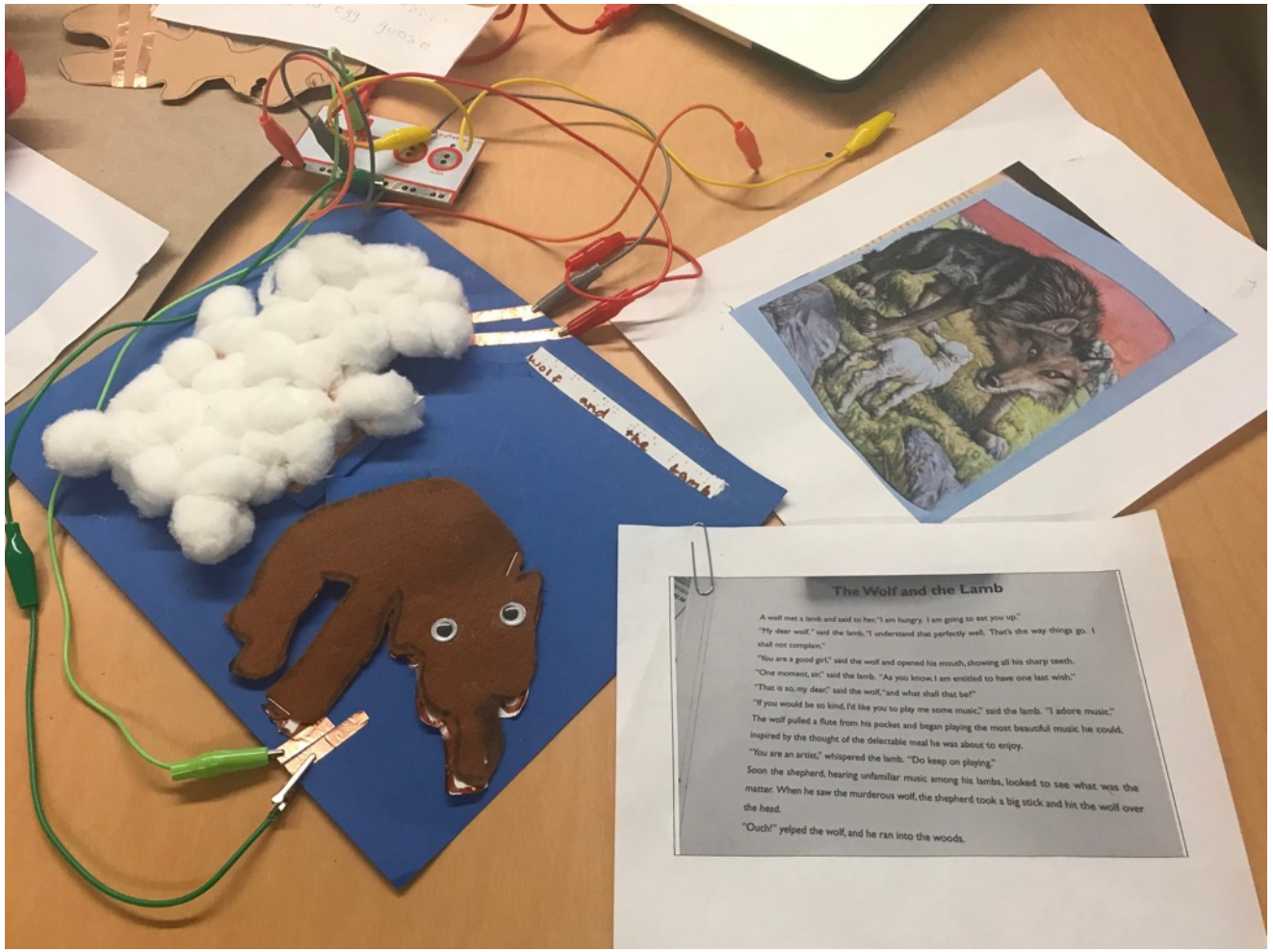

Workshop off
limits at this time

Librarians

“We are excited to have a real-world purpose for our Makerspace… That has a lot of value for us.”

-- Librarian, AnyThink Libraries

ELA Teachers



STEM FOR ALL

BUILD
A BETTER BOOK

BuildaBetterBook.org