Problems with a Purpose: Evoking Empathy to Support STEM Learning

ACM 2022

Mentimeter Link
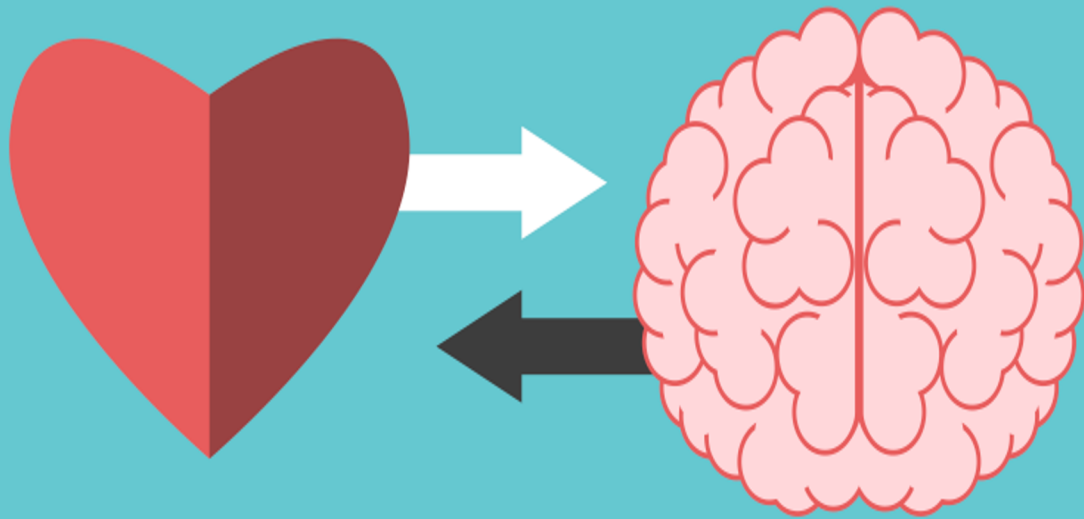
What does "empathy" mean to you?

Empathy is multifaceted

Emotional responses like concern, compassion

Cognitive perspective-taking, imagining another point of view

Prosocial behaviors, taking action to help others

Empathy develops over time

Emotional contagion — Understanding others' emotions

Theory of mind — Imagining others' perspectives

Regulating emotions and social behaviors

Empathy is relevant to many STEM fields

Engineering and design

Biology, ecology, and conservation

Medicine and public health

Computer science and AI

Small Group Discussion

When and how have you noticed children expressing empathy at your museums?

Overview

What will the future look like if we give young children more opportunities to practice being empathic innovators and problem solvers?

BOSTON CHILDREN'S MUSEUM

EDC Education Development Center

Key ideas influencing this project:

- At its core, engineering is one way that humans design things and solve problems.
- Being able to exhibit empathy—to take the perspective of another or put yourself in their shoes—is an important facet of engineering.
- Between the ages of 4 and 6, young children are also beginning to build the foundations for exhibiting empathy.
- They are beginning to understand why another child might want a turn with a toy, or how their actions could make someone happy or sad.

What if we introduce engineering and empathy in parallel, at this very young age?
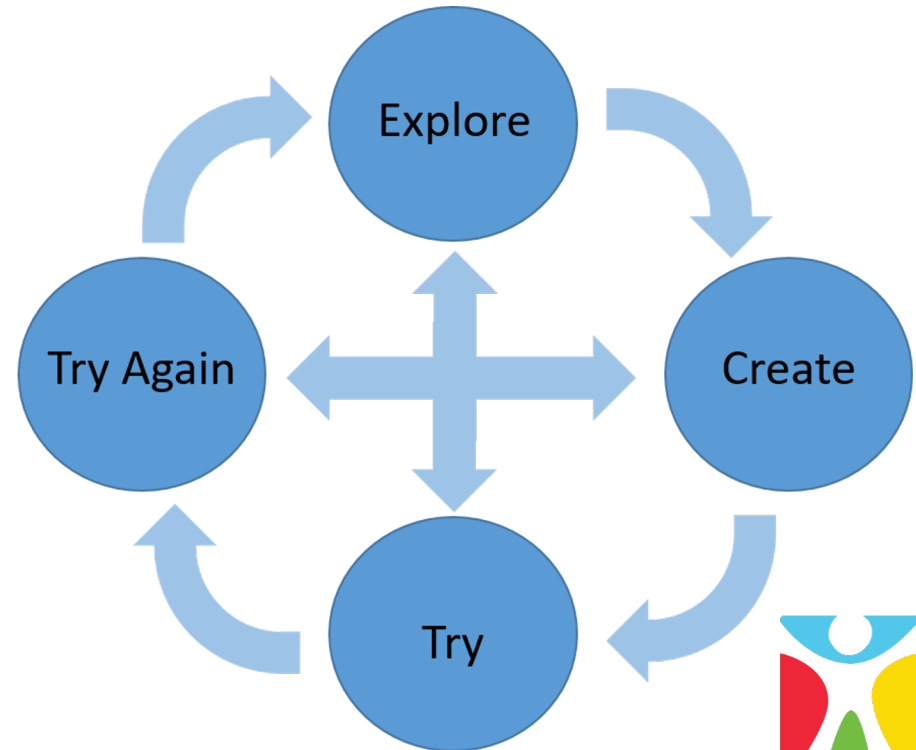
What's engineering?

Engineering and Empathy Ideas to Hold on To

Engineers:

- Are problem solvers
- Are people who use stuff to make stuff that does stuff
- Use science and math knowledge and practices to solve problems

For...

People and communities and animals and others

- the integration of engineering and empathy was new to teachers
- reading the lessons (for the curriculum review) and implementing the lessons (for the formative testing) helped them see the value of pairing the topics
- pre-K formative testing teachers commented that – at first – they did not understand the connection between engineering and empathy and said they were skeptical that the pairing of these topics would support student learning. They noted the PD as instrumental in building their understanding of the link between engineering and empathy
- they felt the activities resulted in children demonstrating and talking about empathy both during and outside the activities

"I like the way this lesson connects the concept of empathy with engineering and the role people and collaboration plays in finding solutions for everyone. I think it is a beautiful way to engage students and connect the science with everyday life issues."
-Pre-K teacher

"I have done many of these same lessons with my students but I like the idea of incorporating the engineering aspect into it."
-Kindergarten teacher

Integrating empathy

What it could've looked like before

- Block centers
- Materials investigations
- Parallel play
- Talking about feelings when a situation comes up

Integrating empathy

What it looks like now
- Narrative or character-based (book, video, verbal stage-setting); including who we are designing for
- Perspective taking
- Designs informed by the needs/wants/feelings of others
- Co-design with teachers

Results so far

Strengths according to teacher participants

- Curricular alignment and cross-curricular application
- Integration of engineering and empathy
- Collaborative nature of activities
- Real-world connections
- Media and sensory components
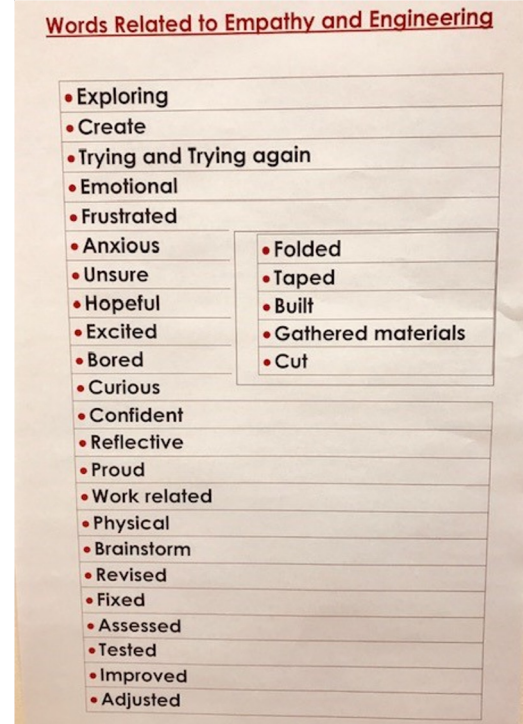- Adaptability of lesson plans
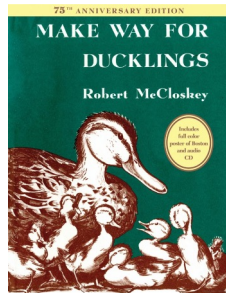
Results so far

Recommendations from teacher participants

- Vocabulary
- Collaboration
- Multi-cultural elements
- Planning components
- Adapting lessons
- Materials

Challenges

- Fine motor skills (perhaps now more than ever)
- Pairings and moving away from parallel play

Words Related to Empathy and Engineering

- Exploring
- Create
- Trying and Trying again
- Emotional
- Frustrated
- Anxious
- Unsure
- Hopeful
- Excited
- Bored
- Curious
- Confident
- Reflective
- Proud
- Work related
- Physical
- Brainstorm
- Revised
- Fixed
- Assessed
- Tested
- Improved
- Adjusted

- Folded
- Taped
- Built
- Gathered materials
- Cut

Keep in touch!

- Melissa Higgins (PI)
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  mcerrone@edc.org
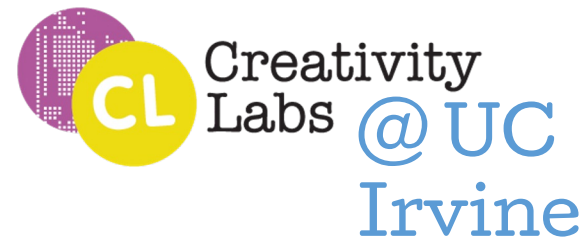- https://bostonchildrensmuseum.org/learning-resources/engineering-and-empathy

Design-based Research: Narratives, Empathy, and Engineering

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Project Partners

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Scott Family AMAZEUM

The Tech Interactive

Creativity Labs @UC Irvine

Our goal: Reframing engineering for gender inclusion

- Engineering education often lacks personal and social relevance

- Emphasizing the things you're designing, not the people you are designing things for, leaves out many learners
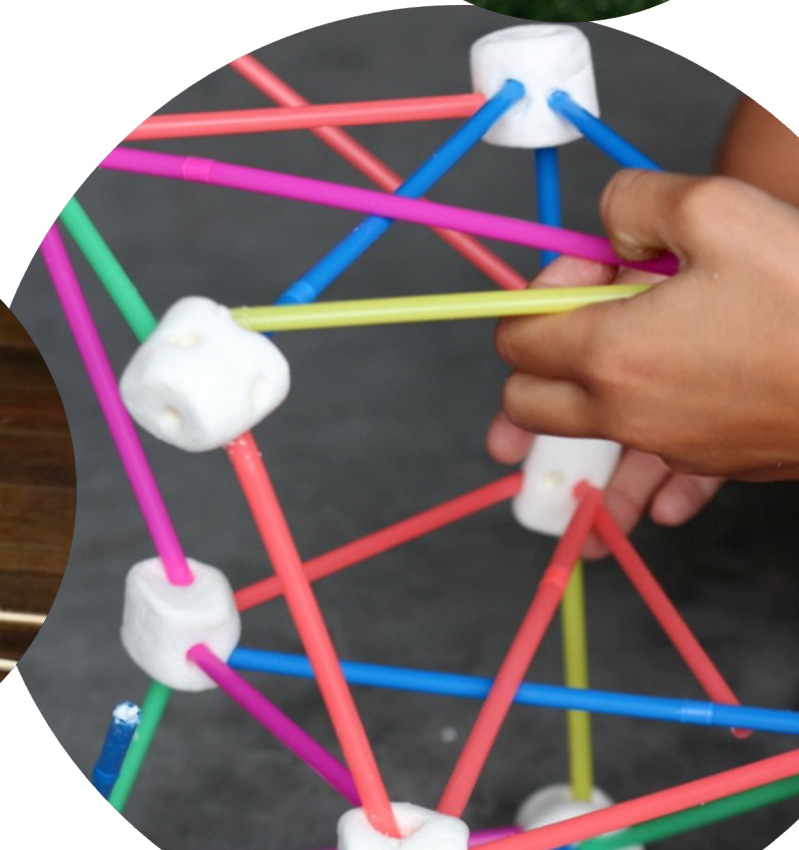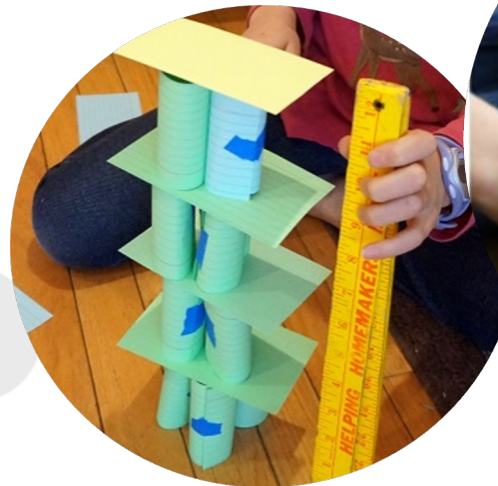
Using narratives to support empathy and engagement

- Providing meaningful contexts for problem-solving

- Encouraging learners to imagine others' thoughts, feelings, and intentions

Supporting empathy as a critical skill in engineering

- Professional engineers use narratives to empathize with stakeholders and imagine how designs will be used.

- Empathy is integral to engineering practice, as engineers work to address complex real-world problems.

Our questions

How can we incorporate narrative elements into engineering design activities?

How can we integrate narratives that evoke multiple facets of empathy?

What impact does this approach have on how 7- to 14-year-old girls engage with engineering?

Our process: Iterative Activity Development

Sympathetic Characters

Evocative Settings

Real-world Problems

Integrating narrative elements into six traditional engineering activities

Activity Examples

Emergency Structures: Build a structure to protect your group from an earthquake.

Help The Pets: Create a chain reaction to take care of a bored, lonely, or hungry pet.

Help Grandma: Design inventions to solve everyday problems for grandparents.

Activity Examples

Air-Powered Vehicles: Design a vehicle to help someone travel around the world.

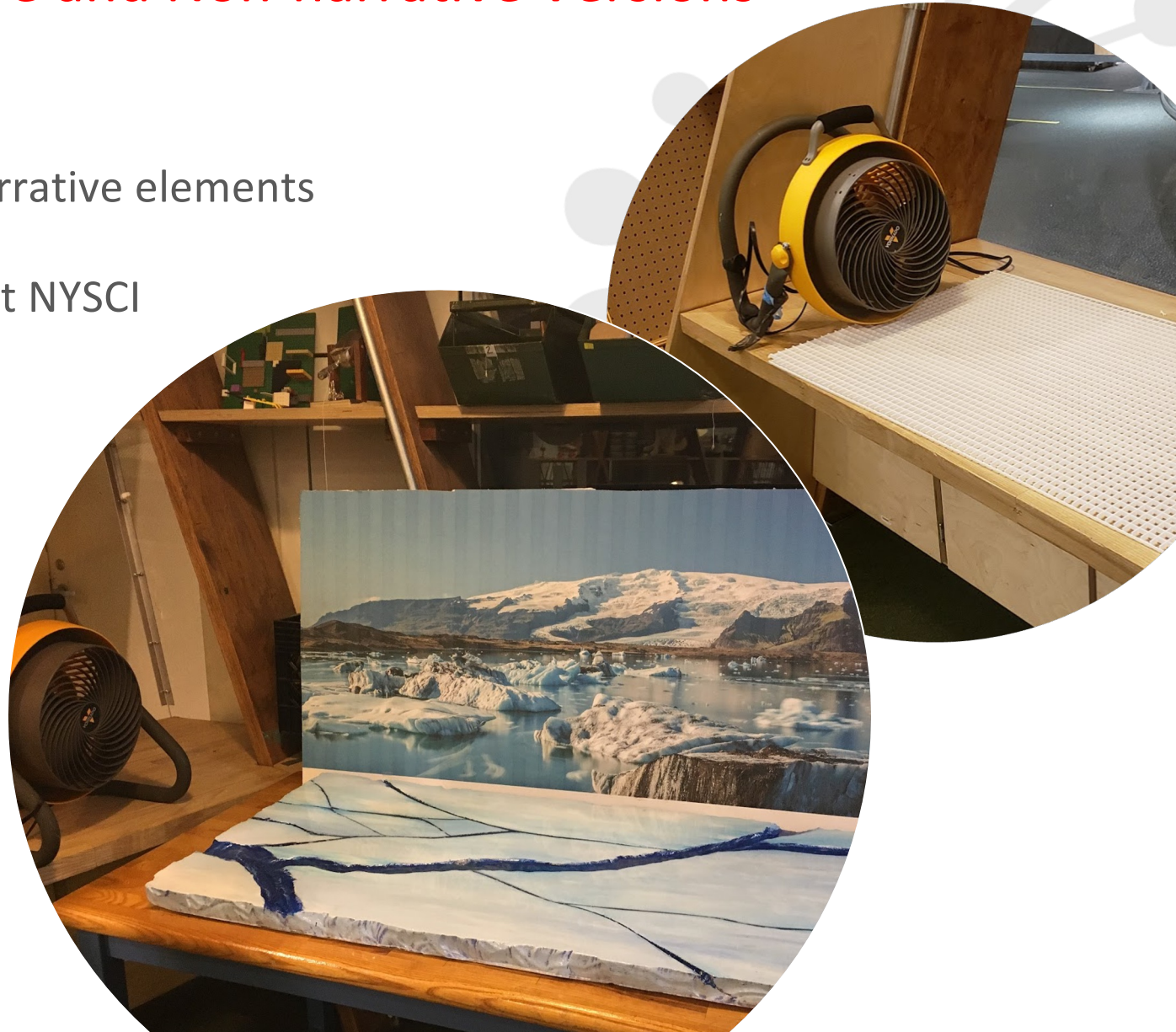**Safe Landing:** Help an astronaut or alien land safely on a planet.

Shadow Stories: Design shadow puppets and scenery to tell a story.

Our process: Comparing Narrative and Non-narrative Versions

- Activities tested with and without narrative elements

- Observed and interviewed 200 girls at NYSCI

- Activities evaluated across 3 sites
  (NYSCI, Amazeum, Tech Interactive)

Research findings

- Girls used more engineering practices in narrative than non-narrative activities.

- When girls expressed empathy, they stayed longer and used a wider range of engineering practices.

- Empathy led to more human-centered decisions while iterating designs.

"I'm trying to make a device that would get the ball to the dog. We thought he would like a ball to play with. … I tried using the roller skate, but the ball worked better. I wanted to the dog to be happy."

- *8-year-old girl participating in a narrative activity*

15

Impact of Narrative-based Activities
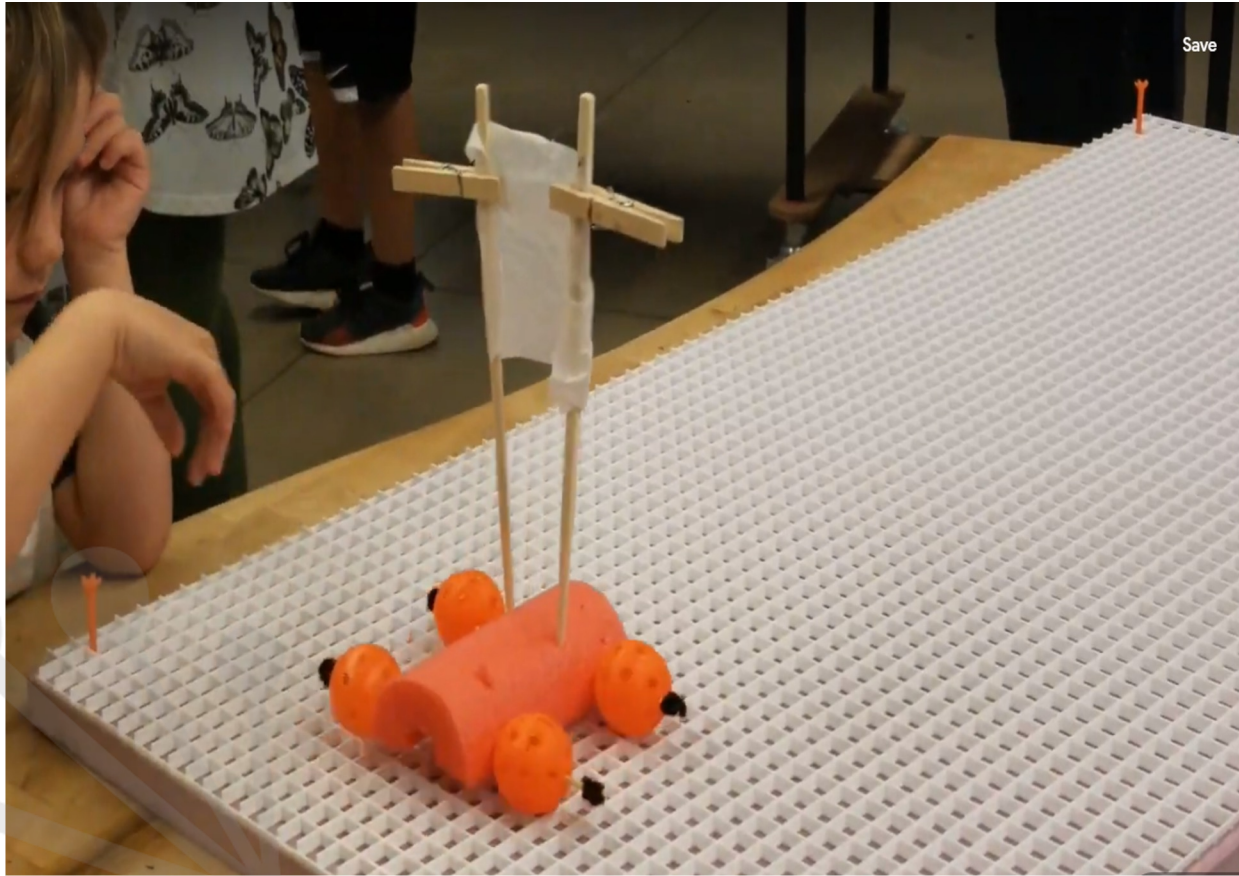
Non-narrative: Design an air-powered vehicle that can move over different surfaces.

Narrative: Design an air-powered vehicle to help someone travel around the world.

Evocative Settings Spark Interest

Settings Encourage Iteration
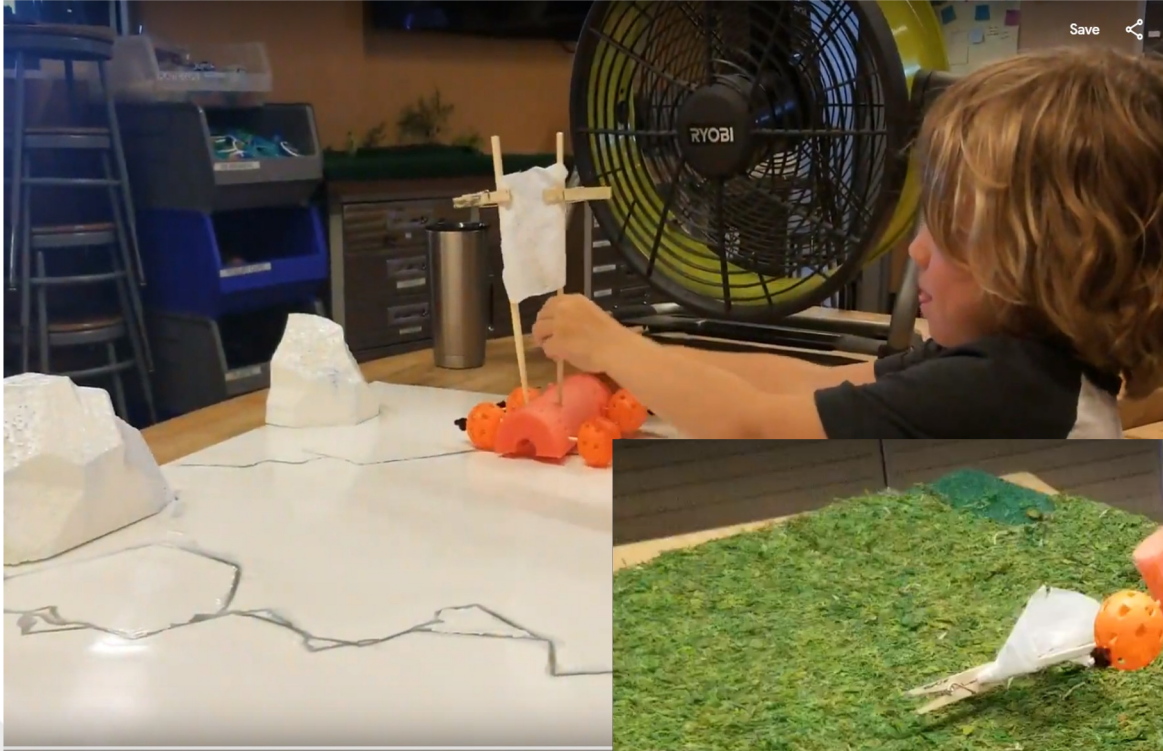
Materials Encourage Iteration

Iterations from Empathy

Lessons learned from Air-Powered Vehicles

Narratives can:

- Draw people in

- Encourage iteration

- Prompt thinking about how others feel or what they need

Key considerations:

- Light challenge framing

- Carefully select materials

Pitfalls

Design Principles

The narrative overshadows or distracts from the engineering goals.

Start with engineering goals.

Reinforce narratives with materials and facilitation.

The narrative overshadows or distracts from the engineering goals.

Use narrative elements to spark learners' own ideas.

Provide choice in defining who to help and how.

Implications for practice

Using Narratives to Support Empathy and Engineering: A Guide for Museum Practitioners
New York Hall of Science

- Design principles for integrating narratives into hands-on activities

- Facilitation tips and options for adapting activities

- Observation tools for noticing and supporting empathy and engineering learning

Link to guide in resource list

Acknowledgments

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Community & Empathy

The Tech Interactive

Empathy and Our Work
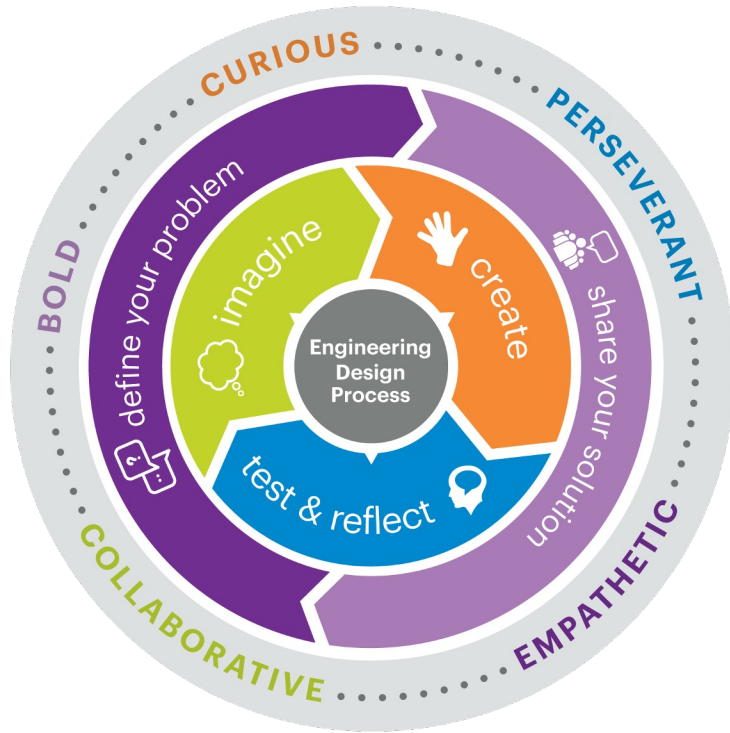
- Carefully consider the needs of self and community

- Be aware of the effects of our work

- Utilize open and honest listening

Getting Started with Community Listening

- What goals/projects do we have that would benefit from community collaboration?

- Do we have the means and capacity to carry out this type of project?

- Is our organization supportive of this project?

Engaging with Empathy

- Interview and/or community conversation
  - direct interviews
  - peer to peer conversations
- Observation
  - watch people interact and struggle with what you made.
  - be open to your own failure
  - be honest with your observations
- Think aloud protocol
  - a marriage of observation and interview
  - have someone talk through their actions and thought process

Cultivating Participation

STANCE TOWARDS COMMUNITY	**IGNORE**	**INFORM**	**CONSULT**	**INVOLVE**	**COLLABORATE**	**DEFER TO**
	0	1	2	3	4	5
IMPACT	**Marginalization**	**Placation**	**Tokenization**	**Voice**	**Delegated Power**	**Community Ownership**
COMMUNITY ENGAGEMENT GOALS	Deny access to decision-making processes	Provide the community with relevant information	Gather input from the community	Ensure community needs and assets are integrated into process & inform planning	Ensure community capacity to play a leadership role in implementation of decisions	Foster democratic participation and equity through community-driven decision-making; Bridge divide between community & governance
MESSAGE TO COMMUNITY	*Your voice, needs & interests do not matter*	*We will keep you informed*	*We care what you think*	*You are making us think, (and therefore act) differently about the issue*	*Your leadership and expertise are critical to how we address the issue*	*It's time to unlock collective power and capacity for transformative solutions*

Co-Designing with Community

The Tech Student Board
- workshop
- peer to peer listening

Learnings for the future:
- Recruitment was slow because relationships with youth partners were not fully established.
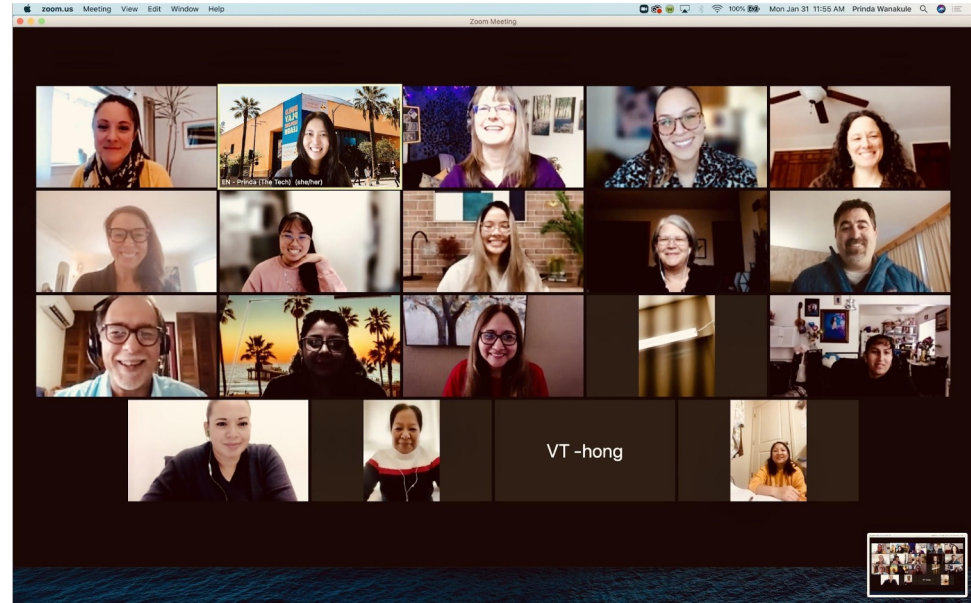
Co-Designing with Community

Caregiver Listening
- peer to peer listening
- community engagement

Pain Points
- Listening was slow to start because too much time was spent finding the "right" way to engage.

What Was Learned?

Listening, actively and honestly listening.

Any relationship with your community needs to start from a point of consideration, empathy, honesty and understanding.

Don't be afraid to just listen. Community members are happy to share their thoughts if you are open and genuine.

Thank You!

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Discussion Framing

- Who are *visitors* thinking about in STEM activities?

- Who are *WE* thinking about when designing STEM learning experiences?

- How can we put others' needs and perspectives at the center?

- Is there a process at your museum that you can imagine bringing an empathy lens to?