

# Engineering with Preschoolers

Learning from the *Engineering and Empathy* and *Head Start on Engineering /Ingeniería y Head Start* projects

# Who are we?



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*Early Childhood  
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# Today's agenda

1. Project Overviews
2. Activity Showcase!
3. Reflection
4. Q&A, Evaluations

# Today you will...

1. Gain more familiarity with engineering and its application in early childhood learning experiences
2. Engage with research-based engineering activities
3. Understand key considerations from two different projects and reflect on how your own context may inflect engineering activities for young children



# Engineering and Empathy

PRE-KINDERGARTEN AND KINDERGARTEN

## 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



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# Overview

## 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 we heard

- 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



BOSTON

## Research Questions

**RQ1.** What contextual factors mediate how pre-K and K educators are able to incorporate integrated engineering and empathy into teaching and learning?

**RQ2.** What pre-K and K educators view as important design considerations for developing high-quality integrated engineering and empathy resources for pre-K and K classrooms?

**RQ3.** What tools and supports can build on and enhance teachers' existing knowledge and practices in order to help them successfully deliver integrated engineering and empathy activities in early childhood settings?



# Formative Findings

## Mediating Factors

- Teachers may be **skeptical** about value of pairing engineering and empathy
- Teachers may **lack of confidence** in their understanding of engineering concepts and how to engage children in engineering activities
- Teachers tend to support empathy development **situationally** (vs. following a curriculum)
- Empathy development may be **mediated by cultural differences** in how families talk about about and express emotions



# Design Implications

## Activity Characteristics

- Collaborative and play-based
- Multi-sensory
- Opportunities to explore different materials
- Adaptable for students at different levels in their development

## Pre-Intervention Professional Development Workshop

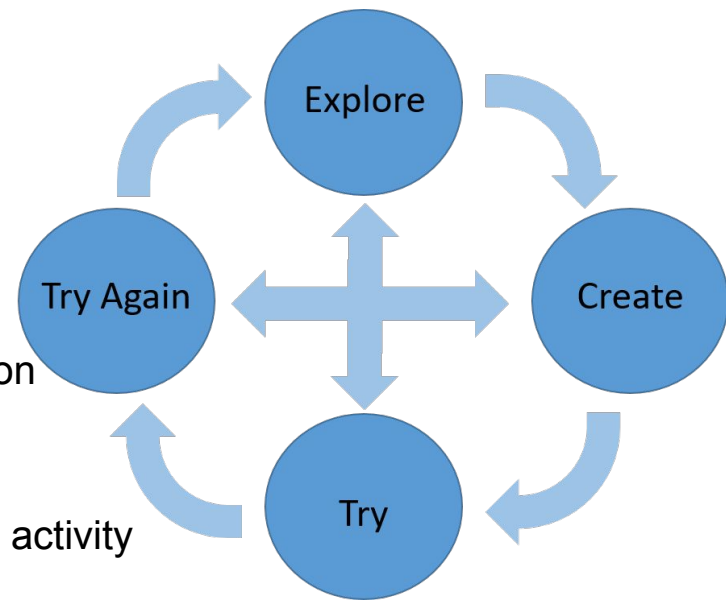
- Demonstrate the rationale and value of pairing engineering and empathy
- Build on teachers' existing practices and knowledge of empathy
  - Provide trajectory of empathy development and how they can support children along the trajectory
- Build on teacher conceptions of engineering and what engineers do



# Design Implications

## Elements of Lesson Plans

- Adaptability
  - Provide ideas for how teachers might adapt the lesson for different types of learners
- Make explicit which elements of empathy development an activity supports (and how) and how that relates to better designs
- Call out examples of:
  - Engineering concept/skill/practice that each activity targets (and where)
  - Different components of empathy
  - The mutually-beneficial link between engineering and empathy.



## Key Findings (so far)

- Teachers see the value of integrated engineering and empathy activities
  - Build on the skills that pre-K/K educators prioritize
  - Fit into the regular routines of pre-K/K classrooms
- Perceptions of children's engineering and empathy skills increased between the start and end of the intervention
- The professional development and educative elements of the lesson plans were instrumental in building teacher understanding of the link between engineering and empathy

*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





# Head Start on Engineering / Ingeniería y Head Start

HSE is an ongoing initiative focused on **empowering families** to use engineering to help their children thrive. We aspire to **collaborate as equal partners** with the communities we serve and **inform a more equitable vision for engineering education** in our society.



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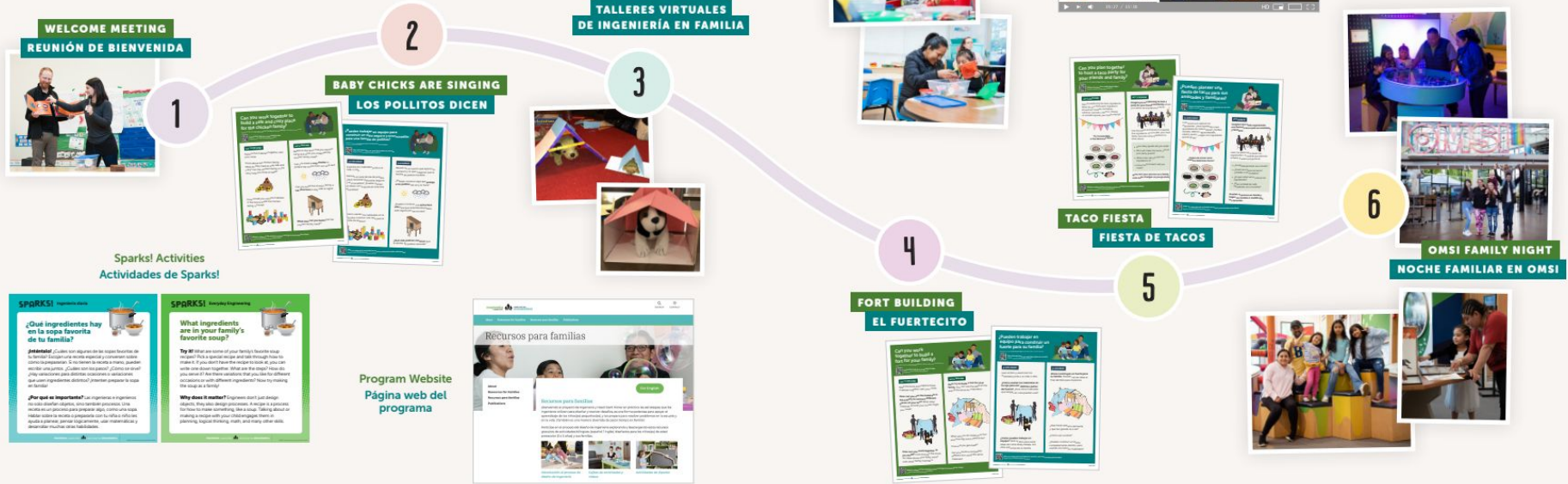
MT. HOOD  
COMMUNITY COLLEGE

UNIVERSITY OF NOTRE DAME  
Center for STEM Education



# Head Start on Engineering / Ingeniería y Head Start

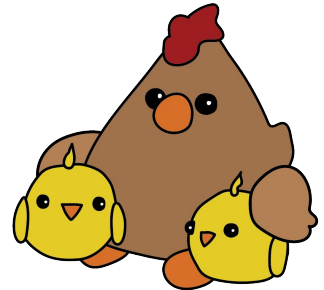
## THE 2021-2022 HEAD START ON ENGINEERING PROGRAM EL PROGRAMA DE INGENIERÍA Y HEAD START 2021-2022



# Head Start on Engineering / Ingeniería y Head Start *Empowering Families*

Families bring their own goals to the program:

- Trying new things
- Fostering sibling relationships
- Spending quality time together
- Practicing problem solving
- Building skills and knowledge



# Head Start on Engineering / Ingeniería y Head Start *Empowering Families*



## **Family Goal: Fostering Sibling Relationships:**

“First she built a house with her brother. Then they made a second house. They made it bigger and taller for the chickens to fit better.”

Al principio ella construyó una casa con su hermano. Luego hicieron otra casa. La hicieron más grande y más alta para que cupieran mejor los pollitos.

# Head Start on Engineering / Ingeniería y Head Start *Empowering Families*



## **Family Goal: Building Skills & Knowledge**

“Pienso que todos los recursos, los materiales que el programa ofrece nos están ayudando a prepararnos para el futuro. Le está ayudando de muchas formas, le provee la oportunidad de utilizar sus propias ideas, su cerebro y empezar a crear cosas. Pienso que le ayuda la actividad y es solo el principio.”

I think that all the resources, the materials that the program offers are helping us prepare for the future. It is helping her in many ways, it provides her the opportunity to use her own ideas, her brain and start creating things. I think the activity helps and it's just the beginning.



# Head Start on Engineering / Ingeniería y Head Start *Empowering Families*

## Family Goal: Practicing Problem Solving

“ [The activities] help her problem solve and deal with situations where she might feel stuck or overwhelmed over a subject and have the ability to work through it. I'm focused on that right now. We work through it on different subjects.

[Las actividades] le ayudan a resolver problemas y lidiar con situaciones en las que podría sentirse atascada o abrumada por algo, y le da la capacidad de resolver ese problema. Me estoy enfocando en eso ahora. Tratamos de resolver diferentes temas.





# Head Start on Engineering / Ingeniería y Head Start *Empowering Families*



## **Family Goal: Spending Time Together**

“I don't know if you know, but we recently adopted them. There was a lot of distraction and trauma involved in the process of adoption. This [program] has helped remove that... It's been a healing experience not just educational. We are learning things about each other and other areas we need to work on as a family.”

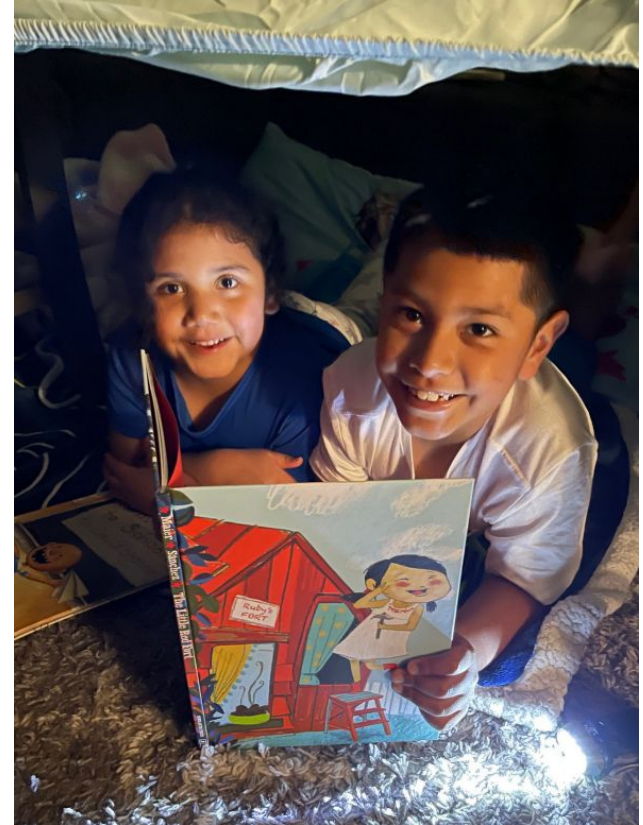
No sé si lo sabía, pero hace poco los adoptamos. Ha habido mucha distracción y trauma en este proceso. Pero esta experiencia nos ha ayudado a eliminar eso... Ha sido una experiencia sanativa, no solo educativa. Estamos aprendiendo cosas sobre nosotros y otras áreas en que necesitamos trabajar juntos en familia.

# Head Start on Engineering / Ingeniería y Head Start *Empowering Families*

## Family Goal: Trying New Things

“We were able to do it. It was nice. We didn't have activities to do before. The only family bonding time we had before was movie night. The engineering program gave us something to work on.”

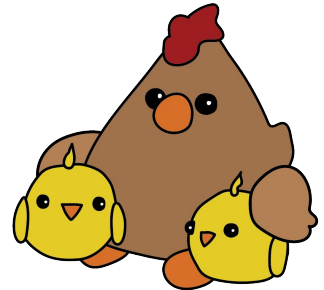
Pudimos hacerlo. Fue bonito. No teníamos otras actividades antes. El único tiempo familiar que teníamos antes era nuestra noche de cine. El programa de ingeniería nos dio algo que hacer.



# Head Start on Engineering / Ingeniería y Head Start *Collaborating as Equal Partners & Informing an Equitable Vision of Engineering Education*

**Two equity-based commitments emerged in collaboration with the project team, partners, and families:**

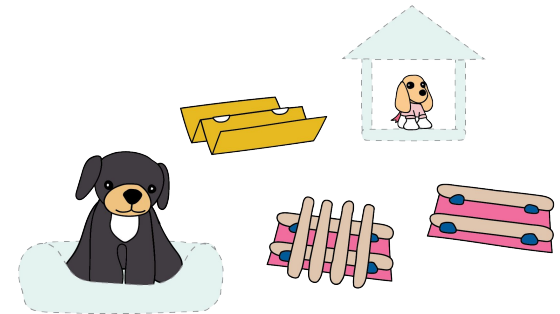
- Finding new ways to work together
- Broadening ways for us to understand engineering  
(What counts as STEM?!)



# Head Start on Engineering / Ingeniería y Head Start *Collaborating as Equal Partners & Informing an Equitable Vision of Engineering Education*

## **Equity Commitment: finding new ways to work together**

- Positioning educators, researchers, and families to work together
  - Creating professional development opportunities for HS staff
  - Empowering Spanish- (and now Arabic!) speaking staff in HS
  - Elevating family voice and perspective through collaborative communication design



# Head Start on Engineering / Ingeniería y Head Start *Collaborating as Equal Partners & Informing an Equitable Vision of Engineering Education*



## **Equity Commitment: finding new ways to work together**

**HS staff reflected on and co-designed professional development trainings:**

- These were good ideas for children. But they're also helpful for adults, such as **thinking about engineering in our everyday lives.**
- Having everyone together in the classroom **makes us accountable to focus and listen.** Make sure to **clarify expectations before the training**, such as that we will be working in our classroom teams.
- Provide **questions for aides and assistants in their preferred language in advance** to give them time to reflect. Make these printed, not emailed. Aides and assistants don't have much access to email.
- These materials can be advanced for some children. **Provide ways for teachers to adapt.** For example, blocks for some children to build with? This may be a lot to ask, but another kit with blocks or simpler materials?
- **More ideas on how to implement in the classroom.** Maybe some small group brainstorm. Curriculum ideas that are easy to implement.
- Like the idea of **doing a project together as classroom teams, all of us equal.** This helps with team building. Some teams write lesson plans this way.

# Head Start on Engineering / Ingeniería y Head Start *Collaborating as Equal Partners & Informing an Equitable Vision of Engineering Education*

## **Equity Commitment: broadening our understanding of engineering**

- Asset-based: amplifies family strengths
- Supportive of child development and family goals
- Flexible!





# Can you work together to protect a hen and her chicks from a hungry fox?



Inspired by the book  
**Oh No, A Fox!**  
by Janet Morgan Stoeke.

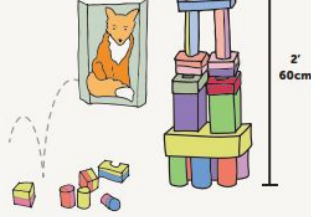
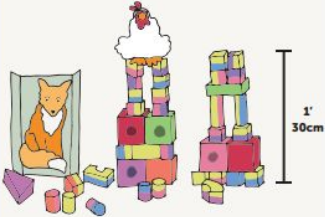
## CHALLENGE 1:

Use these materials to build a structure that is one foot tall to keep the hen and her chicks out of the reach of the fox.

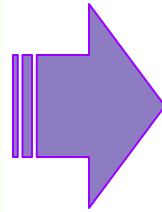
## CHALLENGE 2:

The fox can jump! Keep the hen and chicks safe by building a structure that is twice as tall as the hungry fox.

  
**Redesign!**  
After your first try, can you improve your design?



What challenge will you try next? See more ideas in this activity video:  
[tinyurl.com/HSEFoxEnglish](https://tinyurl.com/HSEFoxEnglish)



# Can you work together to build a safe and cozy place for the chicken family?



Inspired by the book *Los Pollitos Dicen/The Baby Chicks are Singing* illustrated by Ashley Wolff.



Follow this link for a read-aloud video.  
[tinyurl.com/HSEPollitosBook2022](https://tinyurl.com/HSEPollitosBook2022)

## LET'S EXPLORE!

Explore the materials together with your child.

Think about this chicken family. What do they need to stay safe and cozy? Can the chicken family in the story help you think of ideas?



How would you use the materials in the box to build the chicken family a house?



## LET'S DESIGN!

Based on the story that you read (or sang) and what you imagined the chicken family needs...

Can you build a **cozy shelter** to protect the chicks from sun and rain?



Can you build the chicken family a **tall structure** to stay safe at night?



What else can you build that the chicken family needs?



Watch a video of the activity in action and get more extension ideas!  
[tinyurl.com/HSEPollitosEnglish2022](https://tinyurl.com/HSEPollitosEnglish2022)



## ENGINEERING DESIGN PROCESS



The engineering design process is a cycle that engineers follow to create and test solutions to a problem.

We also use this process to solve problems every day, like figuring out a food recipe or building a bookshelf. Talking about the engineering design process with children and families and using the steps during playful learning experiences is a great way to get children interested in engineering and help them develop problem-solving skills.

### ASK

Ask questions to understand the problem and what you need to solve it.

### IMAGINE

Brainstorm as many possible solutions and designs as you can.

### PLAN

Pick a design and decide how you will use your materials.

### CREATE

Build and test your design to see how well it solves the problem.

### IMPROVE

Make changes to your design based on what you learn.



## EL PROCESO DE DISEÑO DE INGENIERÍA



El proceso de diseño de ingeniería es un ciclo que los ingenieros siguen para experimentar y encontrar soluciones a un problema.

Utilizamos este proceso para resolver problemas todos los días, desde preparar una receta de cocina, hasta armar un estante de libros. Hablar sobre el proceso de diseño de ingeniería con los niños y sus familias, y utilizar los pasos durante experiencias de aprendizaje divertidas es una manera excelente de lograr que los niños se interesen en la ingeniería.

### PREGUNTA

Haz preguntas para entender el problema y qué necesitas para resolverlo.

### IMAGINA

Piensa en la mayor cantidad de soluciones y diseños que puedas.

### PLANIFICA

Escoge un diseño y decide cómo usarás los materiales.

### CREA

Construye y pon a prueba tu diseño para ver qué tan bien soluciona el problema.

### MEJORA

Cambia tu diseño en base a lo que aprendiste.



## عملية التصميم الهندسي



عملية التصميم الهندسي عبارة عن دورة يتبعها المهندسون لإنشاء واختبار حلول لمشكلة ما.

نستخدم هذه العملية أيضًا لحل المشكلات كل يوم ، مثل اكتشاف وصفة طعام أو بناء رف كتب. بعد التحدث عن عملية التصميم الهندسي مع الأطفال والعائلات واستخدام الخطوات أثناء تجارب التعلم المرحية طريقة رائعة لجذب اهتمام الأطفال بالهندسة ومساعدتهم على تطوير مهارات حل المشكلات.

### أحسن

قم بإجراء تغييرات على التصميم الخاص بك بناءً على ما تعلمته.

### أخلق

قم ببناء واختبار كيف تستخدم المواد لمعرفة مدى نجاحه في حل المشكلة.

### أخطط

اختر تصميمًا وحدد كيف تستخدم المواد الخاصة بك.

### أطلب

عصف ذهني بأكثر عدد ممكن من الحلول والتصاميم الممكنة.

### أسأل

اطرح أسئلة لهم المشكلة وما تحتاج لحلها.



Want to learn more? Visit the Head Start on Engineering website: [www.terc.edu/hse](http://www.terc.edu/hse)

INGENIERÍA HEAD START ON ENGINEERING



¿Quieres aprender más? Visita la página web de Ingeniería y Head Start: [www.terc.edu/hse](http://www.terc.edu/hse)

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لررد معرفة المزيد؟ قم بزيارة موقع



# Let's Engineer!

Choose two of the four stations\*:

- Make Way for Ducklings
- Los pollitos / The Little Chicks
- Fort Building / El fuertecito
- Taco Fiesta! / ¡Fiesta de tacos!

\*No need for FOMO! Materials on all these activities (and more!) will be shared

# Reflections

- How do you already encourage and support engineering behaviors and attitudes?
- How can engineering activities amplify the strengths of *your* communities of learners?
- What is something that you learned today that you plan to take back with you?

# What questions do you have for us?

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