Engineering an Engineering Experience

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Tweet what you made! #IA18 #CHICAGOCHILDRENSMUSEUM

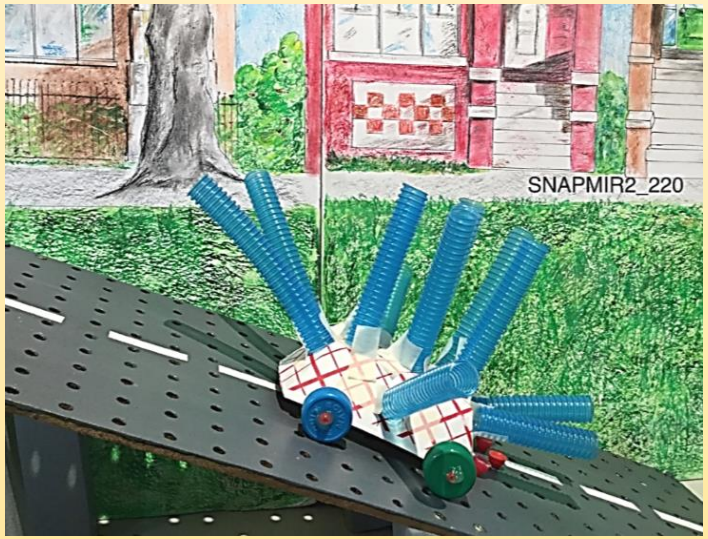
TRAEL

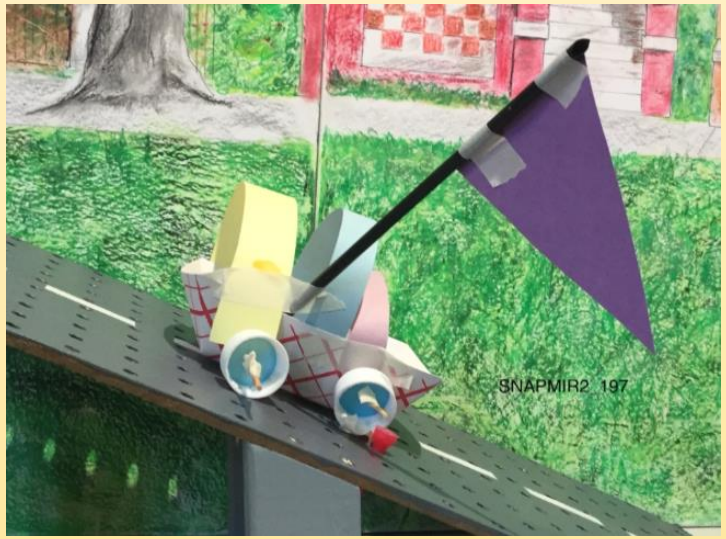
Tinkering,
Reflection
and
Engineering
Learning

Goals for Today

Making something → STEM Learning

- Strategies
  - Designing activities
  - Training staff
- Impact
- Engineering museum experience





You just tinkered!

Three Concepts

Tweet what you made!
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1. Collaborative Learning

Raise your hand if you…

Worked with one or more colleagues

Watched what someone else was doing

Shared ideas or information

- Children's Museums: places of mediated learning

Family as Learning Unit: Caregiver Role

Design elements to support adult-child collaboration

Facilitation to support family interaction

2. Engineering Process

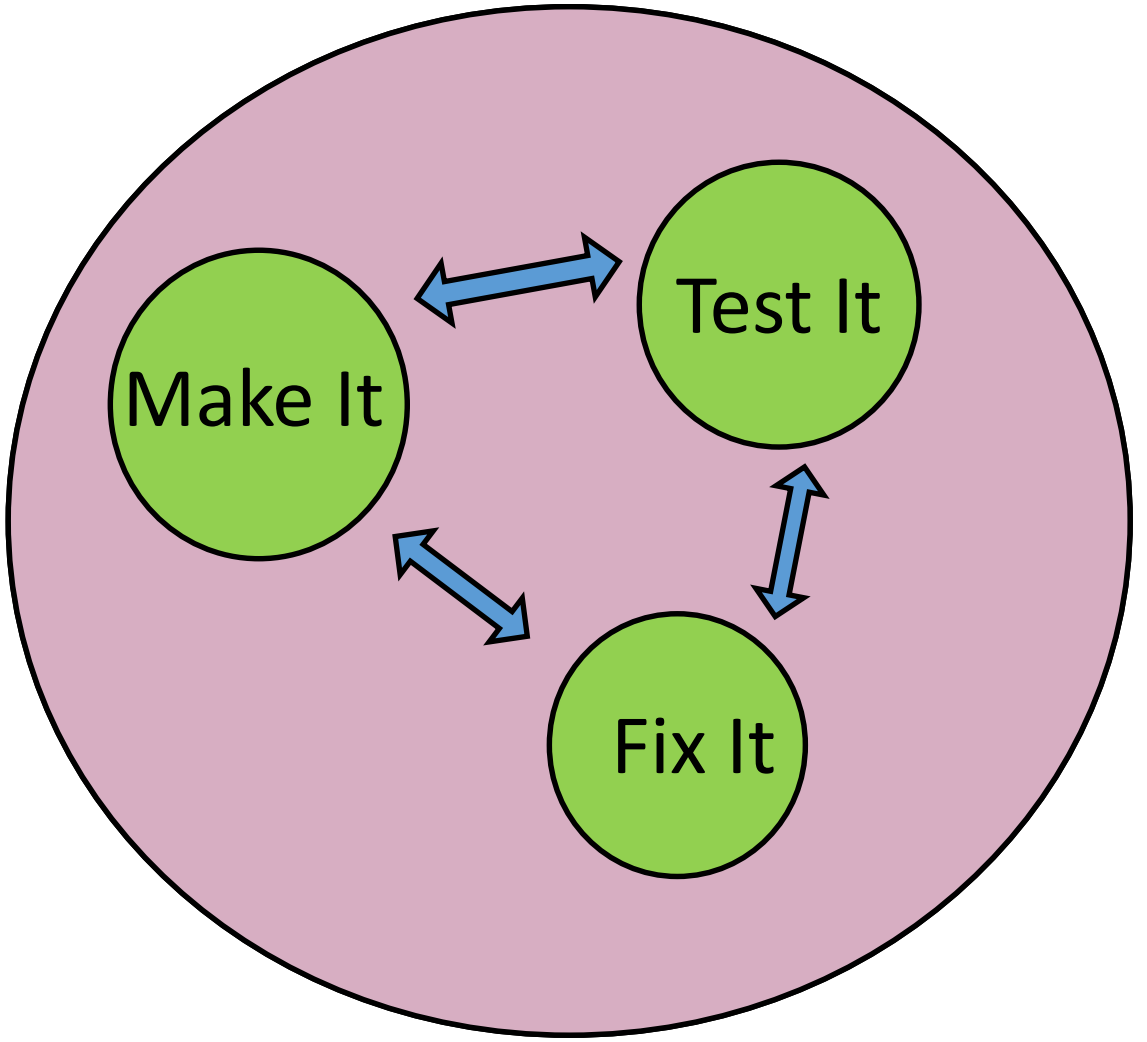
Raise your hand if you…

Set a goal.

Predicted what might happen.

Tested what you made.

Changed it after testing.



3. Reflection: Putting Words to Experience

Raise your hand if you…

Talked about what you tried.

Reviewed your process.

Still thinking about what you might change.

Why is verbal reflection important?

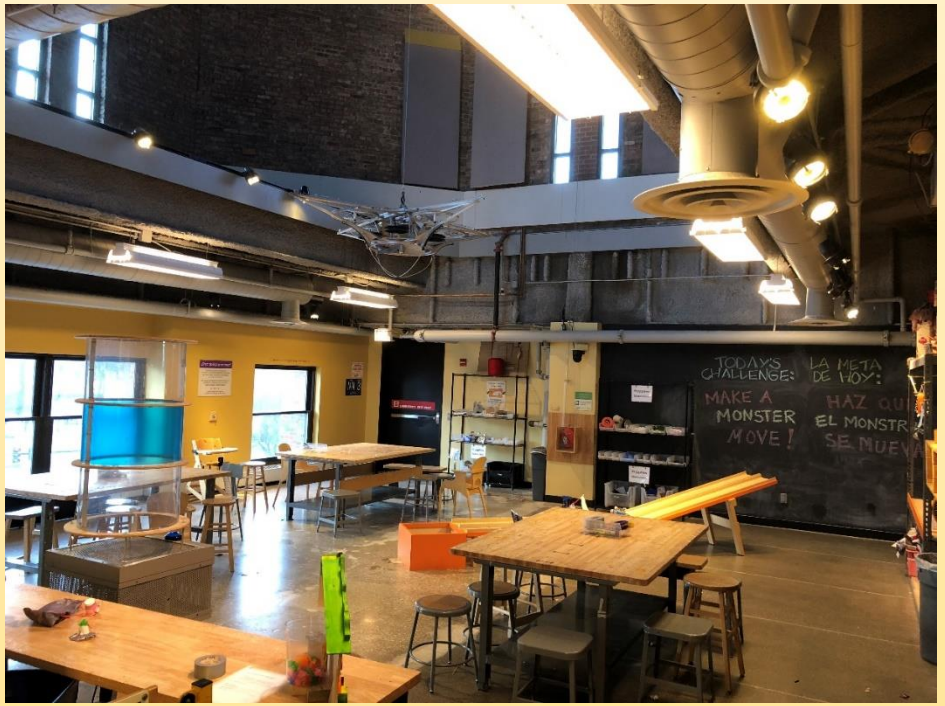
Reflection

- Telling and sharing of experience with others.
- Can happen *during* and *after* an experience.
- Widely considered to be critical for learning

- Goes beyond learning from direct experience with objects
- Fosters understanding of specific scientific and engineering practices
- Consolidates experiences
- Offers a powerful tool for making learning visible

Tinkering Lab: Make it Roll


Do you think there's any chance it'll roll down the ramp?

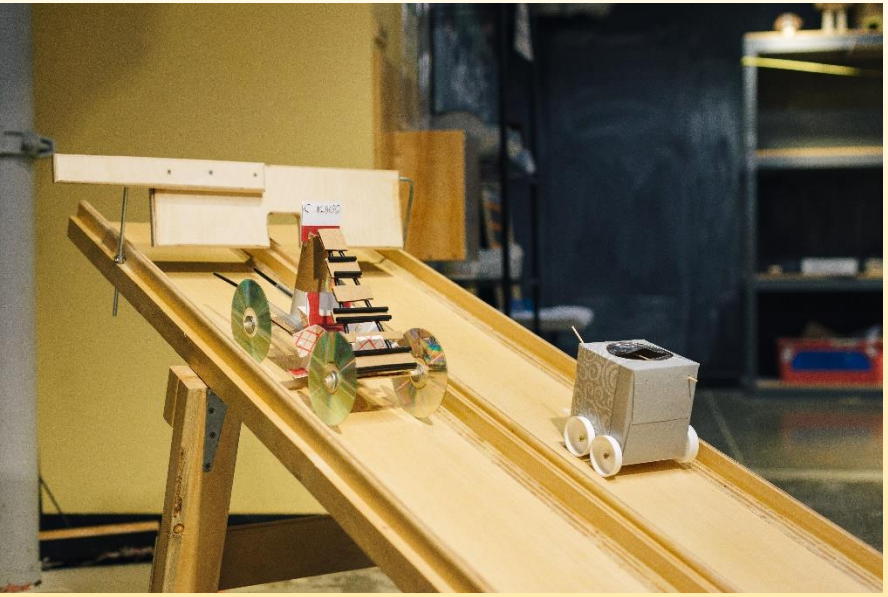


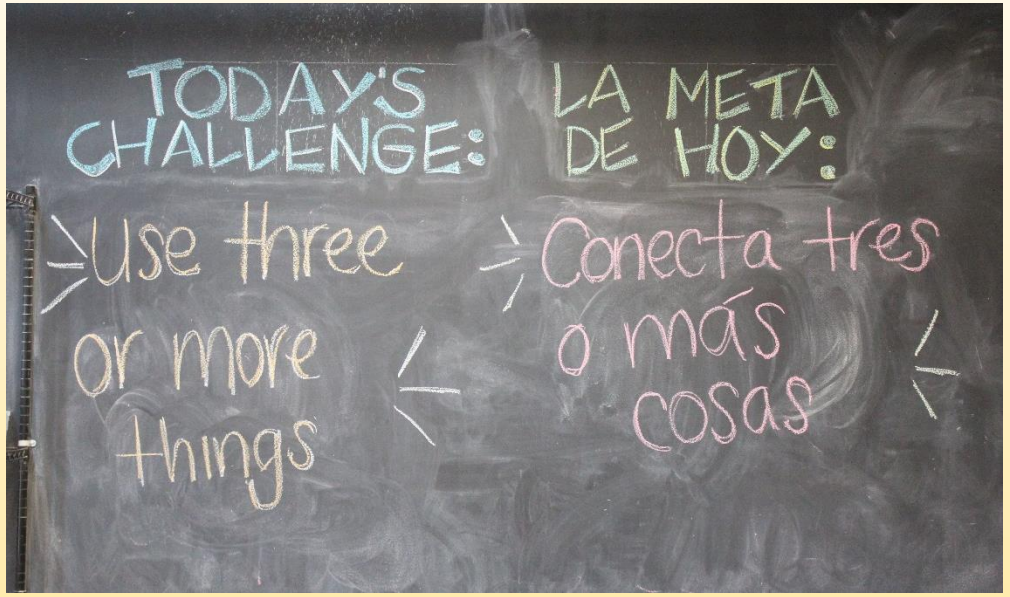
Tinkering Lab

Introduction to the space and staff

Tinkering Lab: Staffing model

- 1-2 facilitators (usually one)
- Rotate each hour
- Welcome, facilitate, manage entry, safeguard tool use, reset space and materials
- 30 to 40 facilitators --all eligible.
- On-going training

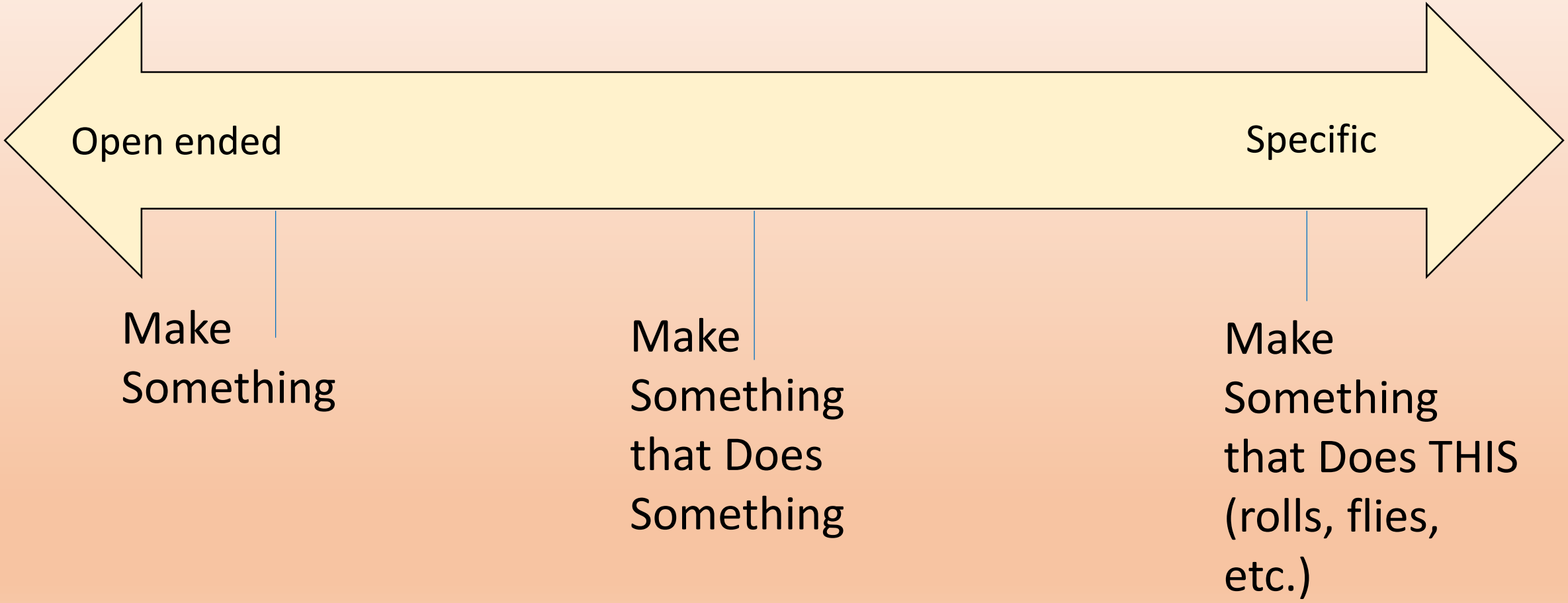




Designing Activities

7 Ways to Engineer an Engineering Experience

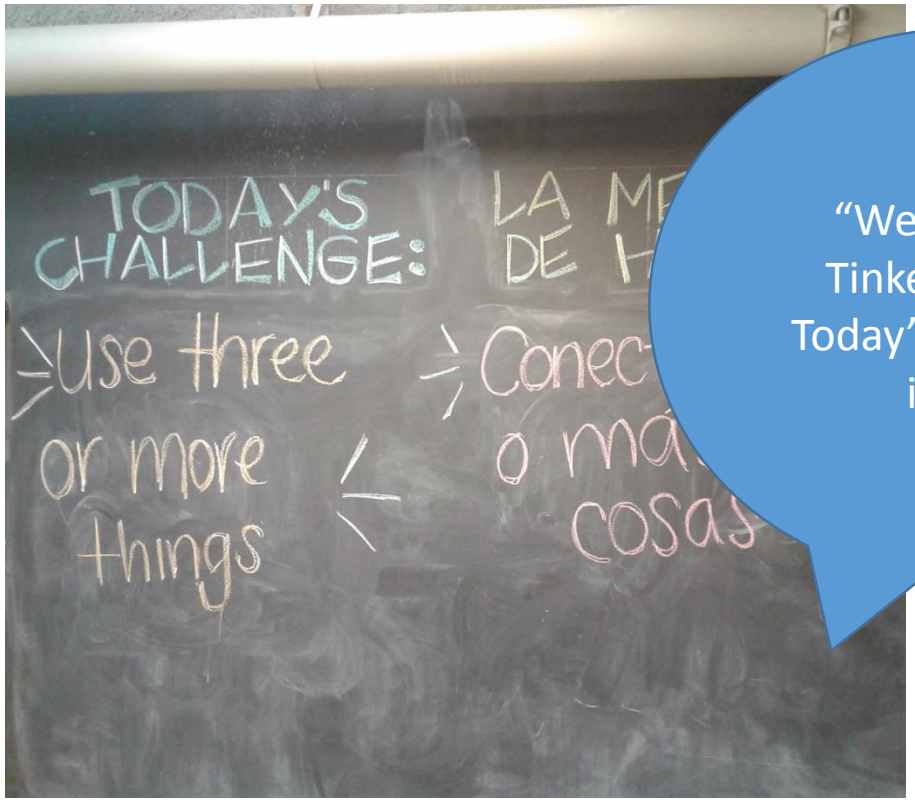
1.The Challenge
How open-ended or specific is the task?



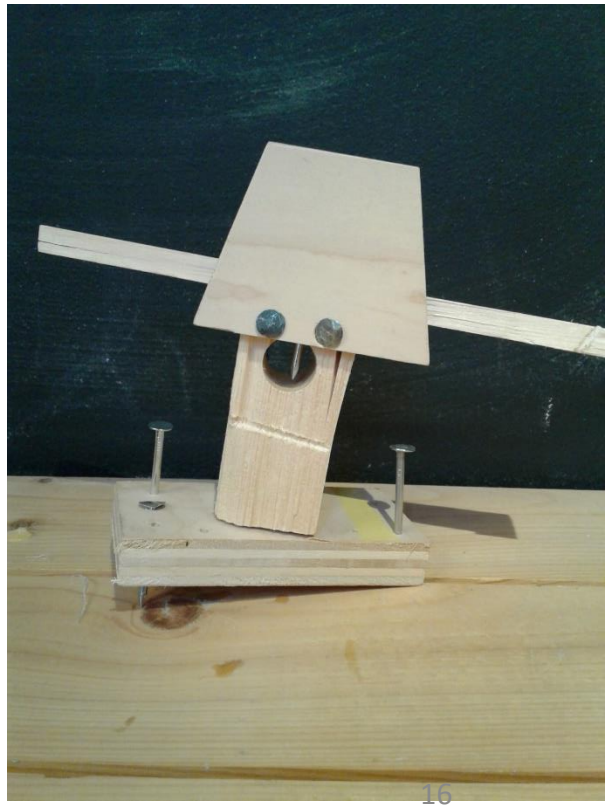
1. The Challenge

Open ended ⟷ Specific

Make Something: Woodshop



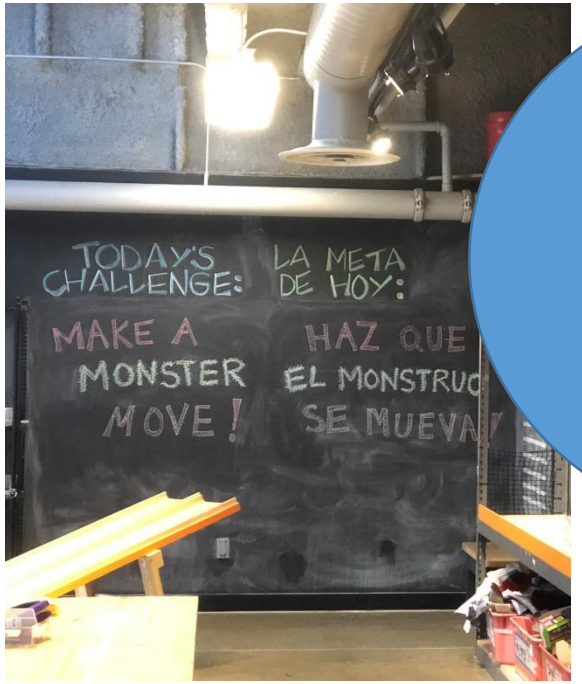
"Welcome to Tinkering Lab. Today's challenge is… !"



1. The Challenge

Open ended ⟷ Specific

Make something that does something:
Make the monster move (fly, roll or sail)

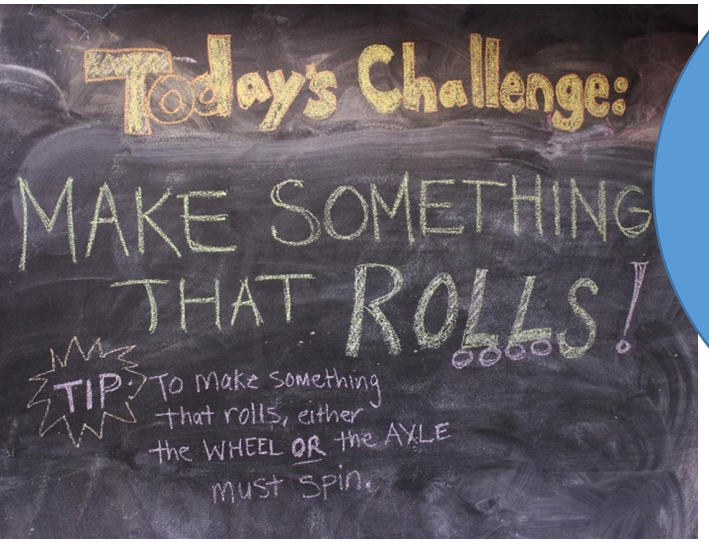


"Today we're helping monsters move. We have wind tunnels, fans and ramps….

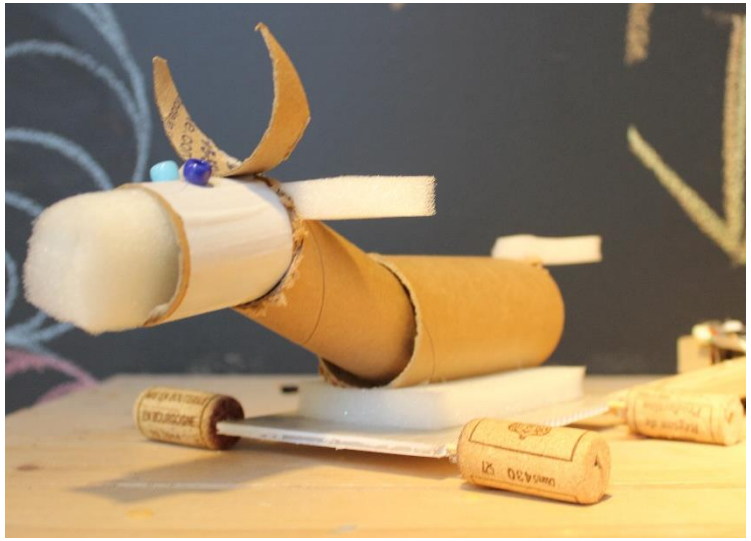
1. The Challenge

Open ended ⟷ Specific

Make That Does THIS:
Make it Roll

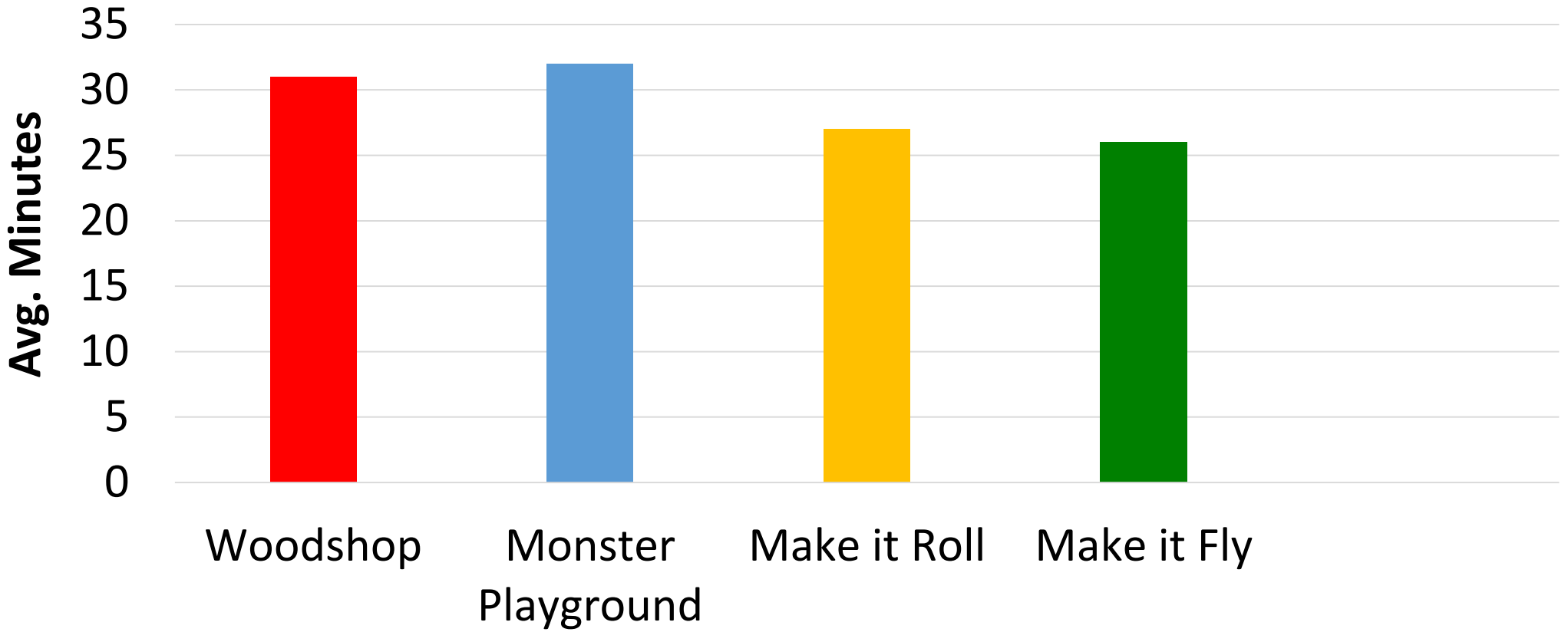


"Today we're making something that rolls! You can test your vehicle on the ramps."



1. The Challenge

Time Spent in Tinkering Lab



1. The Challenge

Engineering Design Process Talk
Goal
Exploring Materials
Examining Others' Creations
Demonstrating
Showing One's Ideas
Planning
Prediction
Explanation
Testing
Redesigning

Planning

Caregiver: So we have our four washers. We have our straws. What else do we need?

Child: I know. This [picks up a piece of cardboard].

Caregiver: Ohh. What do you think we could use that for?

Child: It's cardboard.

Caregiver: Yeah, it's cardboard. What can we use the cardboard for?

Child: The middle of the car.

Caregiver: Ohh, the middle part of the car. Okay.

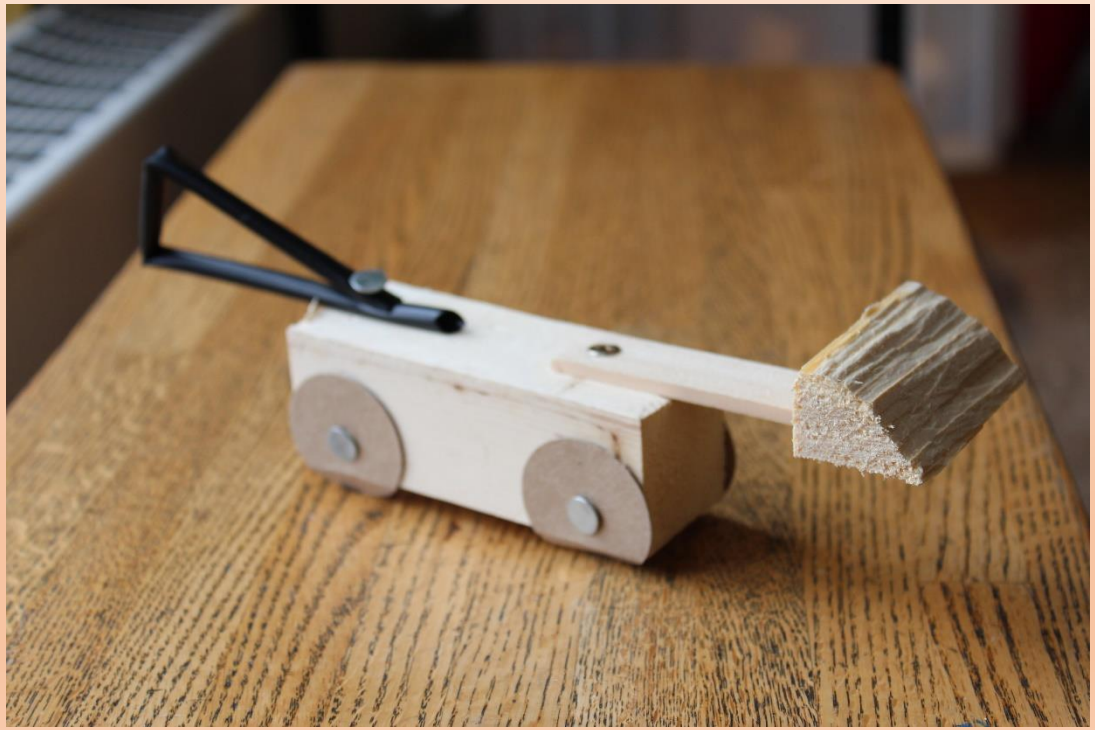
Predicting

Caregiver: Do you think there's any chance it'll roll down the ramp?

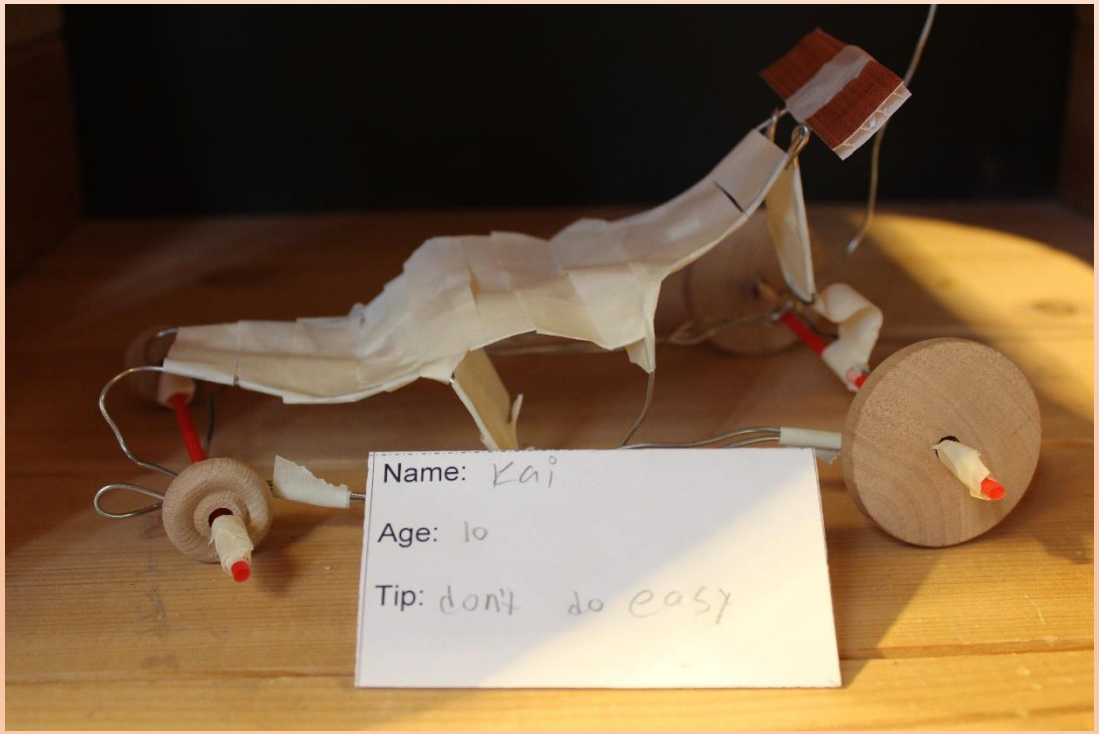
Child: That's not gonna roll.

2. Deliberately chosen materials and tools

General Materials

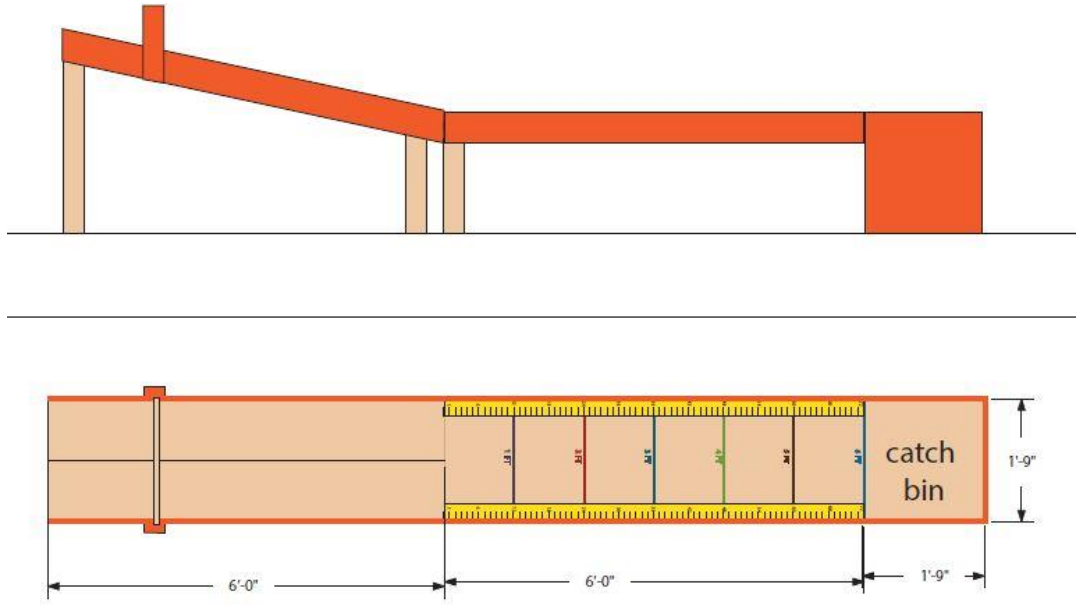


Wheels and Axles Provided



3. Testing opportunities

Engineering Ways to Test



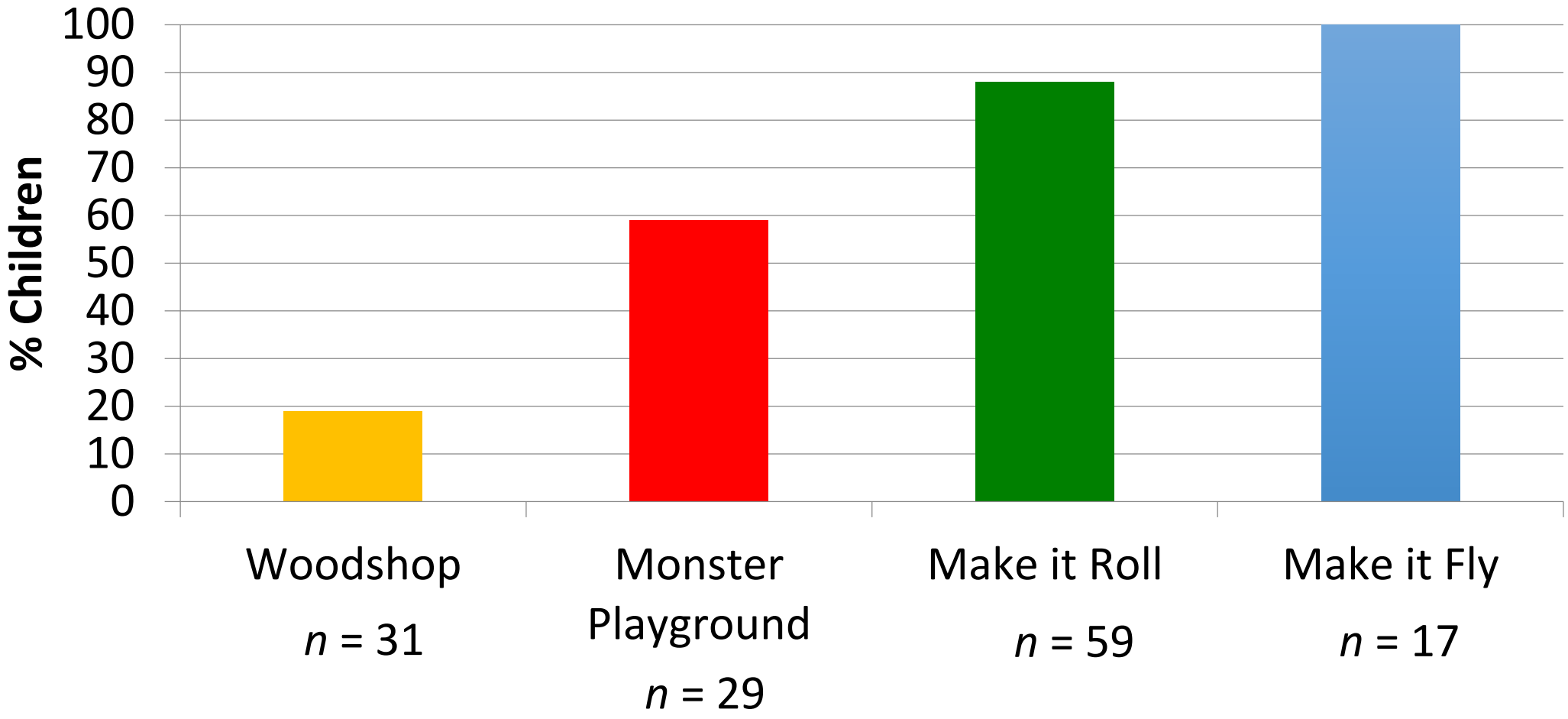
Test on Big Ramp


EMERGENCY EXIT ONLY
Okay.

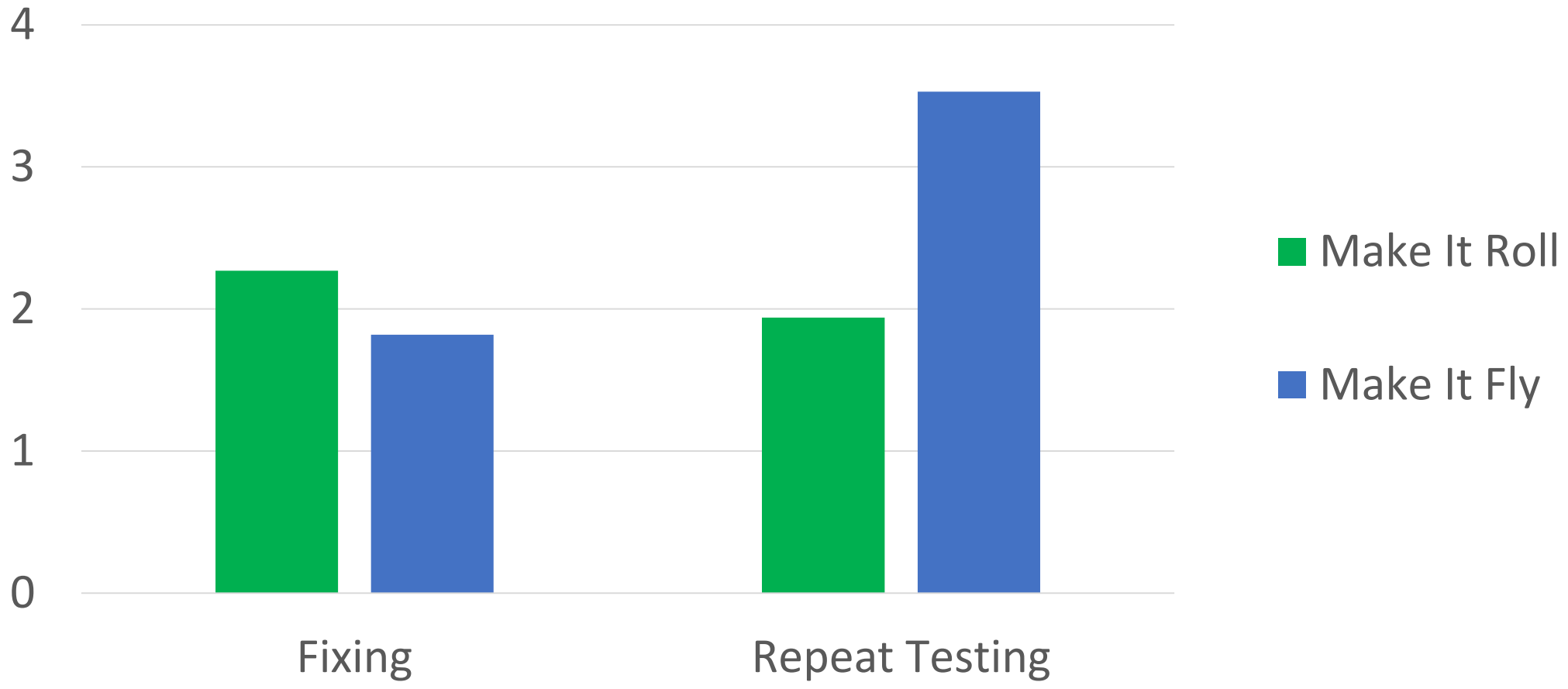
Test on Wind Table and Wind Tunnel


Make it
Hazlo
FLY
FLOAT
SPIN
DE VIENTO
Go try it!

Percentage of Children Who Tested

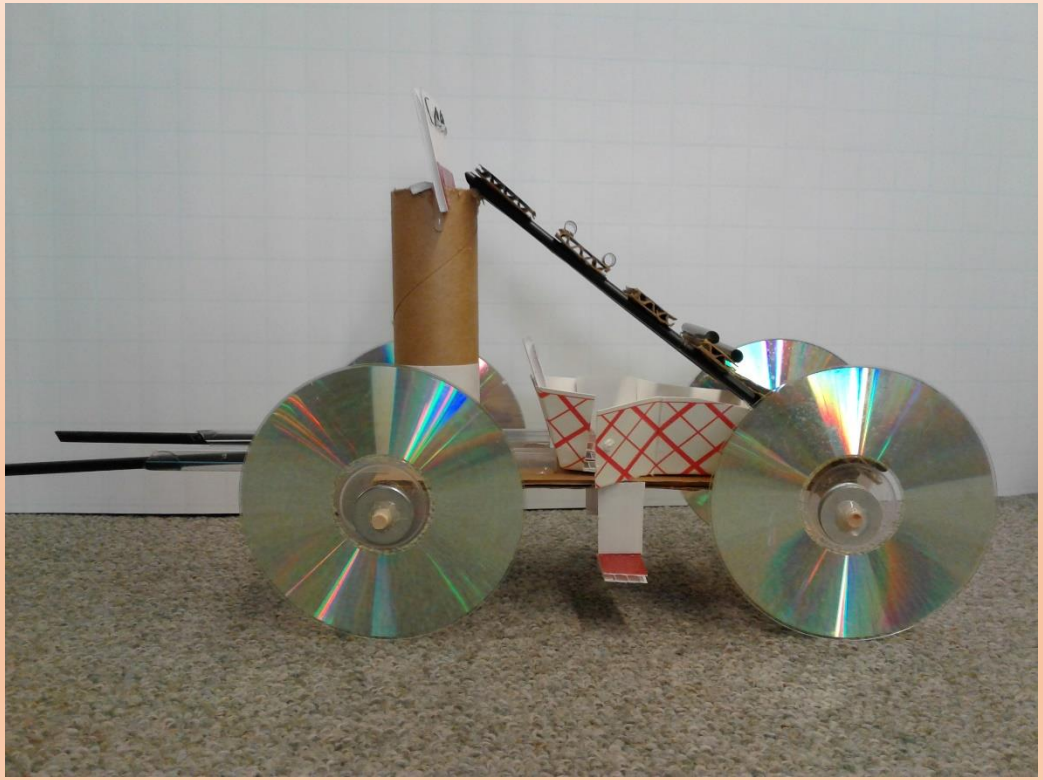


What Happens After Testing?



4. Challenge difficulty: What's the sweet spot?

Make It Roll- build a vehicle to test



Make It Fly- Crumple paper to test

4. Challenge Difficulty

Make It Roll

- More altering, less starting over
- Testing parts: what spins?
- Didn’t test on ramp until the end

REVISIONS:

- More attractive table ramps
- Workable combinations of wheels and axles

Make It Fly

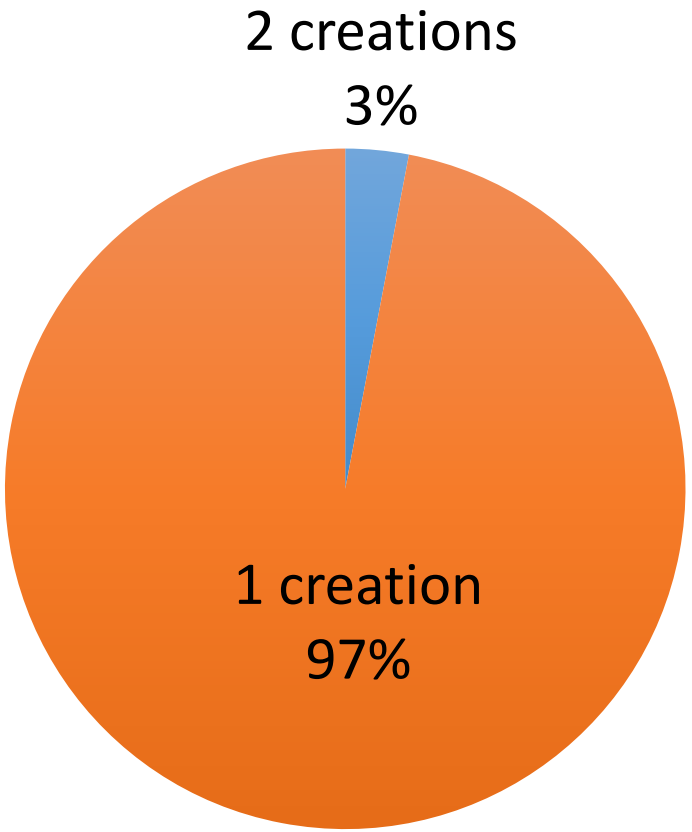
- Many new creations
- Less intentional
- More quick testing

REVISIONS:

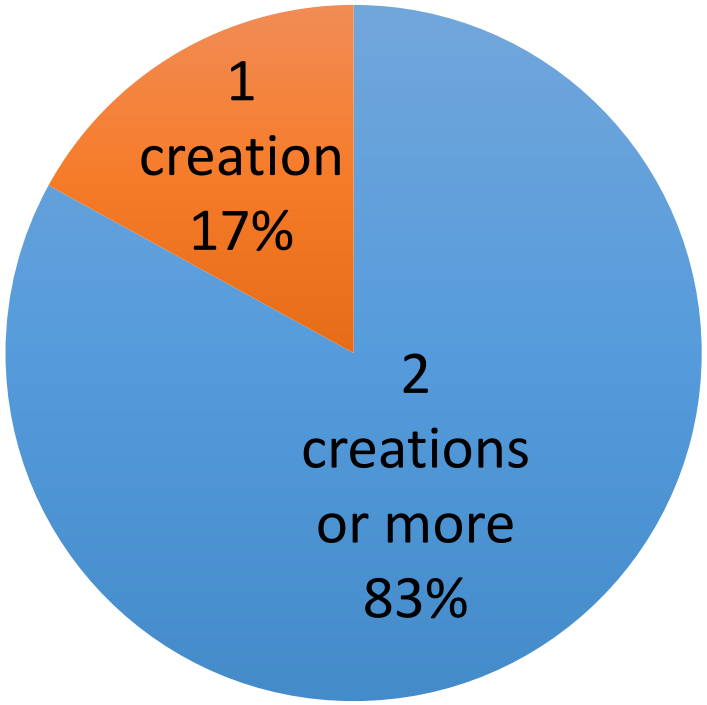
- Added cork challenge
- Redesigned wind table

Number of Creations

Make It Roll
***n* = 64**



Make It Fly
***n* = 18**



5. Activating Knowledge

Facilitator questions and interactions:

- What do you know about cars?
- Have you been on a swing?

Advanced Organizer:

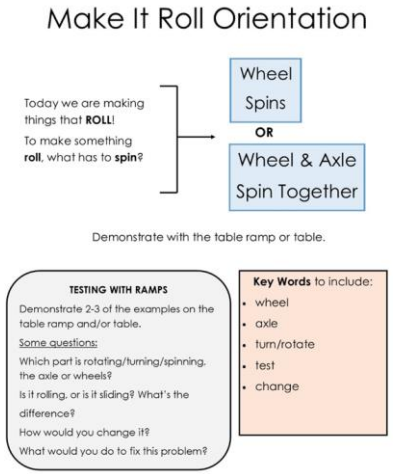
Facilitator interaction before entering

Example (also used for training)

Facilitator: So, <u>when you spin this axle, what happens to the wheels?</u>

Child: They spin with it.

Facilitator: Exactly, that's what I was gonna say. They spin with the axle. Wheels actually spin together. <u>Let's test this one out</u>, see how it rolls [*places creation on table ramp*]. Pretty good, huh?



Example continued

Facilitator: Now let's show you a different one. This one, the axles are taped down so are not supposed to be moving, but the wheels move around the axle. So, in this case, the axle stayed put and the wheels moved by themselves. Let's test this one out [*places creation on table ramp*]. How did it work? Did it roll?

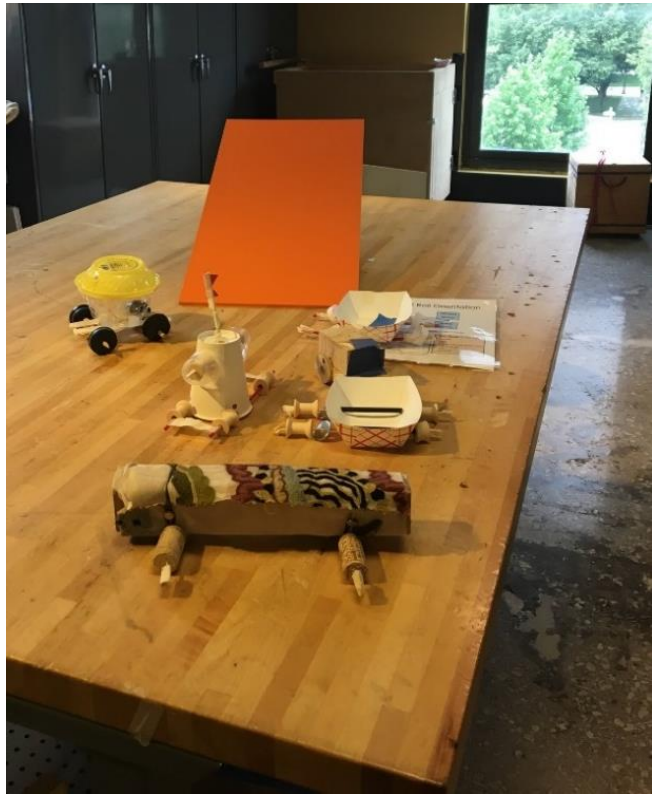
Child: Yeah, it rolled, but the axles didn't move at all.

Facilitator: Exactly! So the wheels are spinning by themselves and it rolled just like that with the axle staying put….

Example continued

Facilitator: So, what have we learned about wheels and axles? If something is to roll, either the wheels move by themselves, like this one, right? Or the wheels move with the axle.

Engineering the Advanced Organizer



6. On-going Staff Training

Initial TL training

- First Aid
- Introduction to space
- Tinkering philosophy
- Shadow a colleague

Repeated morning sessions:

tools, new information, review

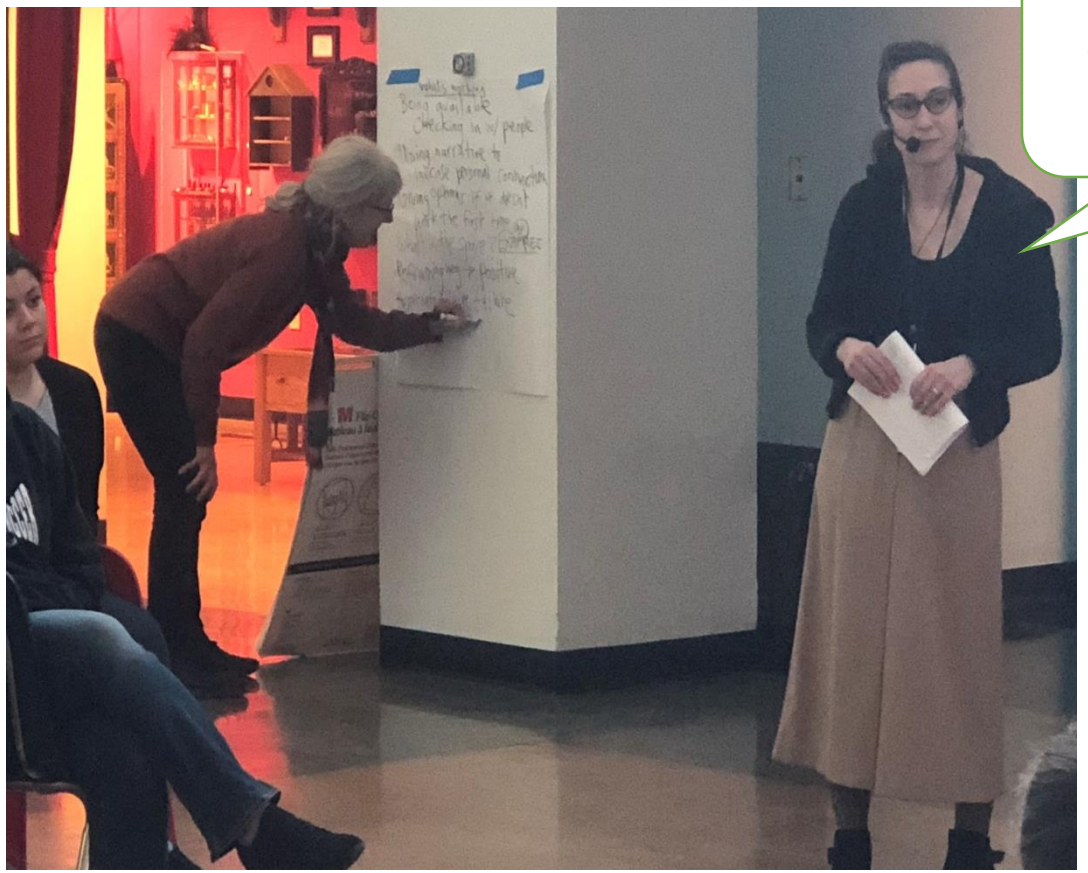
Reflections and peer advice

"Make it Fly" Facilitator Tips:
Interacting w/ Visitors:

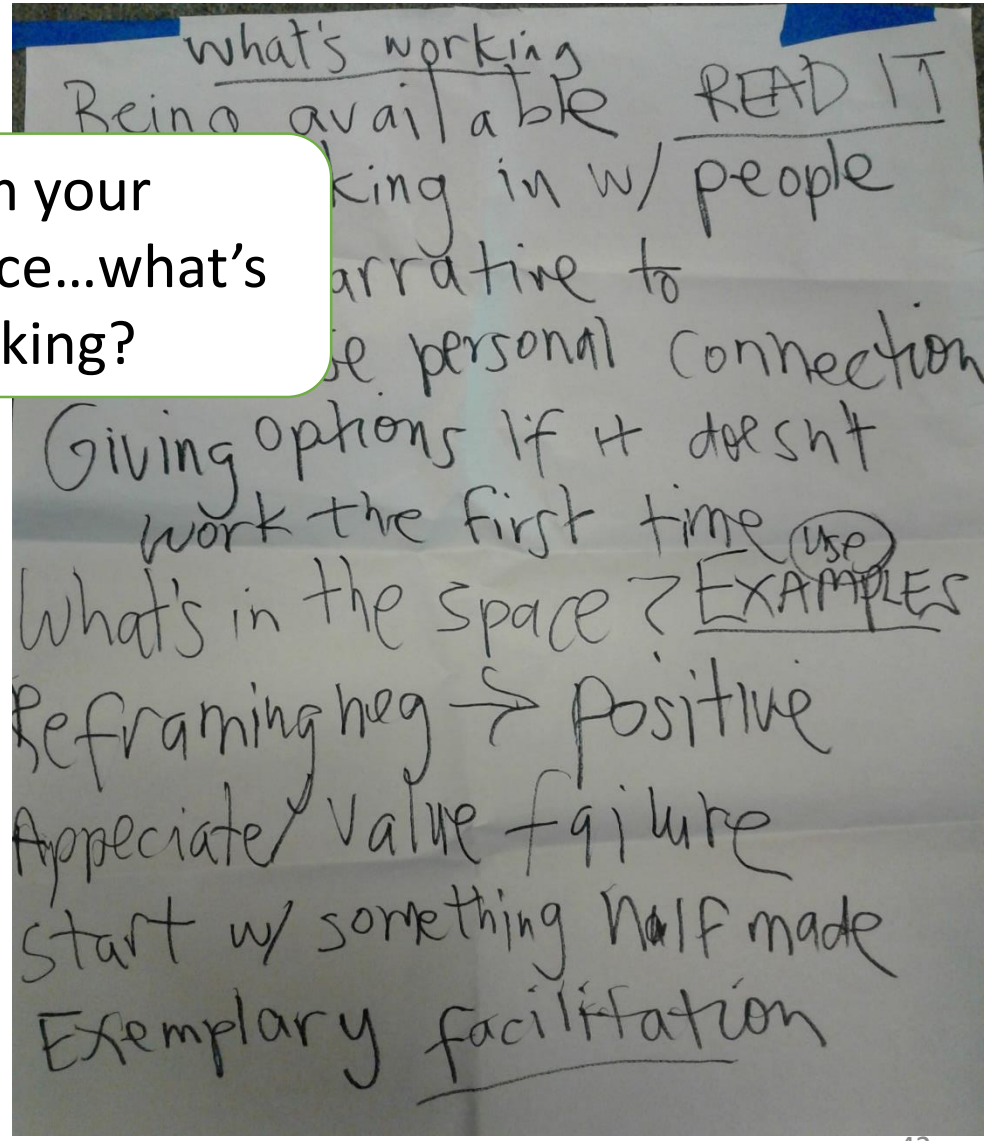
- When welcoming visitors try to encourage them to use multiple materials
- Always indulge a child's questions and encourage them to ask more
- If it fails in the wind tunnel have them try the wind TABLE

Interactive Workshops with Full Group

Self-Reflective Approach



From your experience…what's working?



Role of Staff: Scaffolding for the Scaffolder

- Introduce the challenge
- Be a guide to the exhibit
- Activate (background) information
- Be an active and appreciative presence
- Offer support and expertise
- Promote Observation
- Boost the Engineering Process
- Support reflection

Exploring examples

- Transcripts, video and anecdotes (from their reflections)
- Value their expertise and experience
- Recognize the complexity of addressing situations

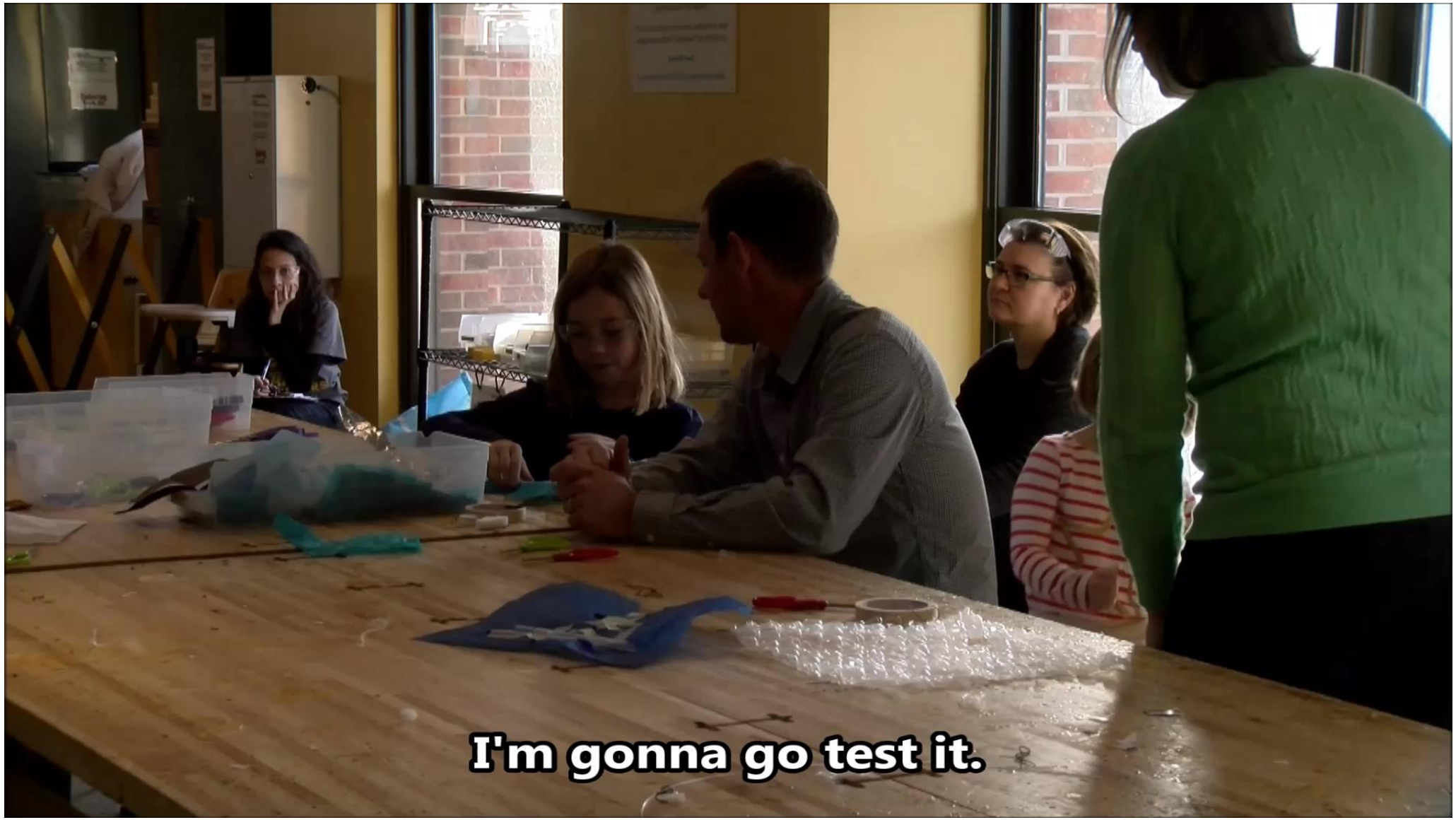

Tinkering
display here


display here
Tinkering

7. Opportunities for Reflection

- SNAP
- Facilitator questions
- Ipad Reflections
- Story Hub

Reflection *During* Experience


I'm gonna go test it.

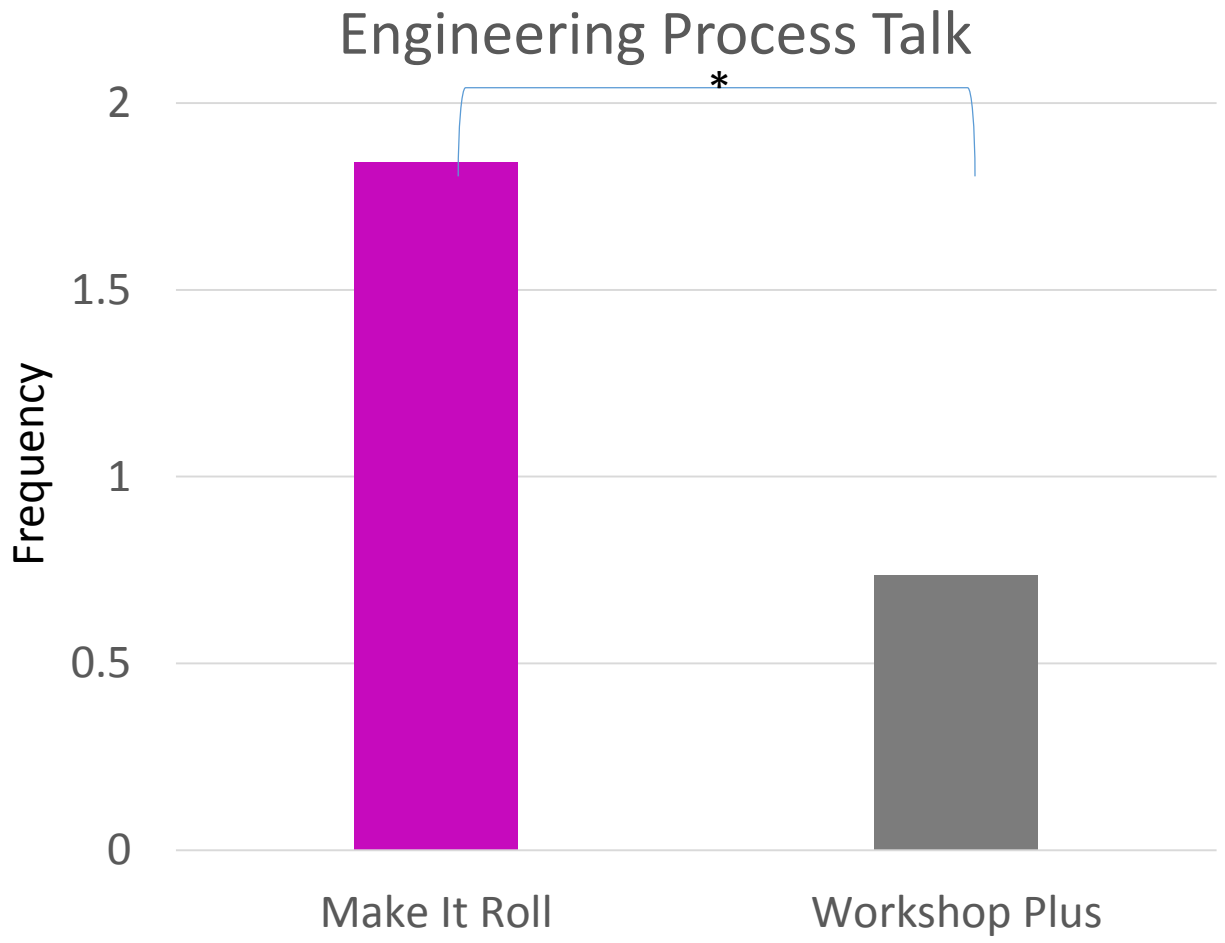
Reflection *After* Experience

Story Hub

Reflection After Experience

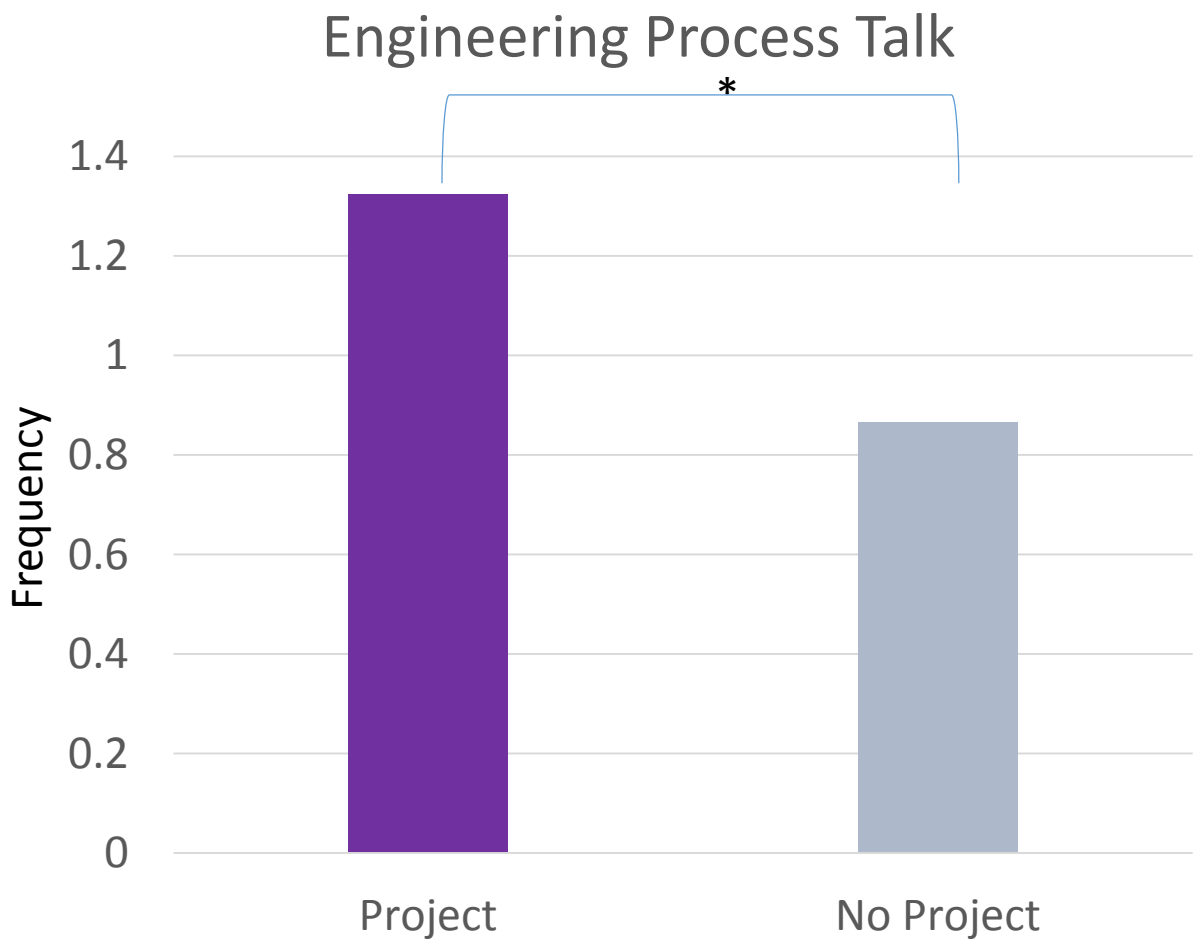

What we did today is I made this rolling thing

Story Hub Reflections

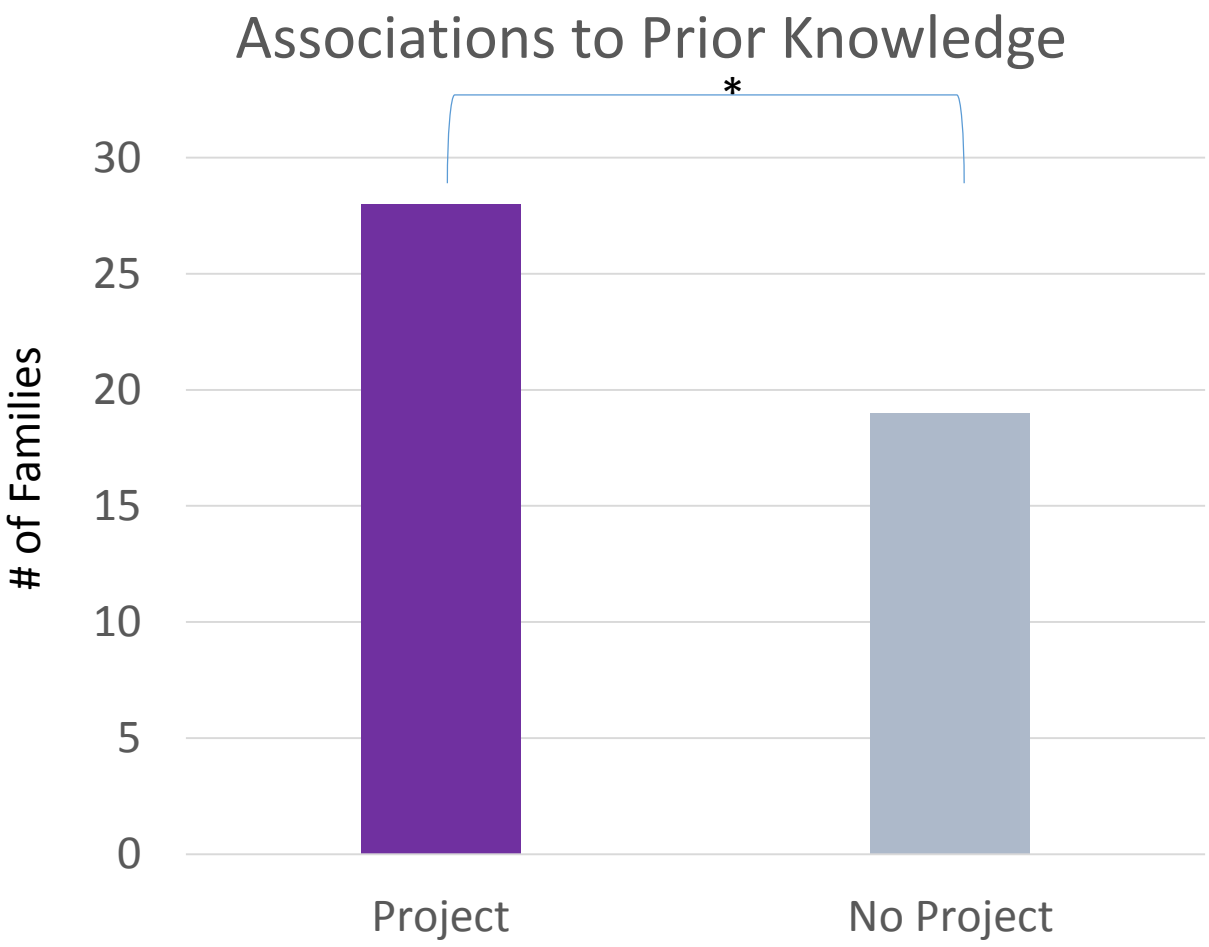


*t(199) = 4.52, p < .001

Reflections After Experience

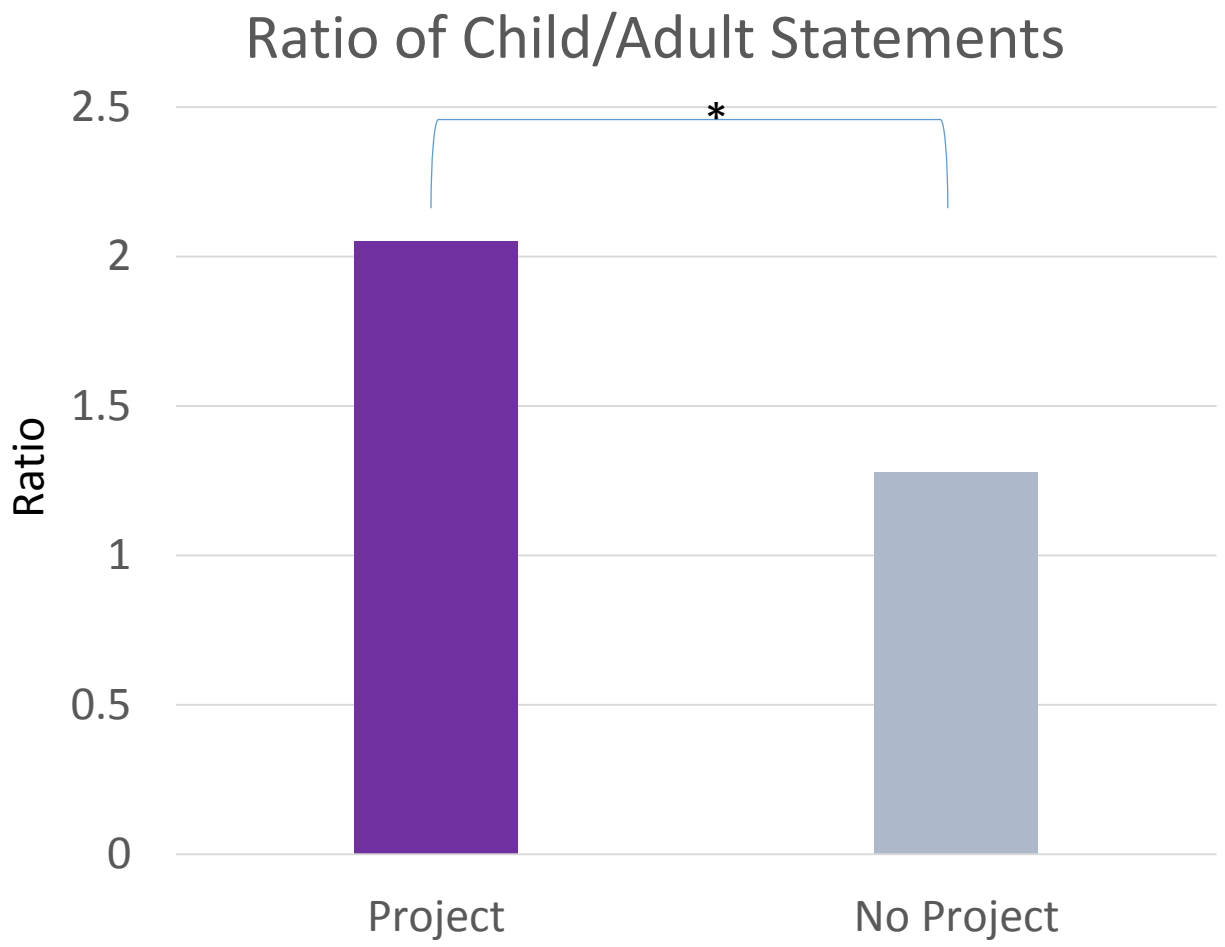


*$F(1,177)= 4.37$, $p < .05$



*$\chi^2= 12.8$, $p < .001$

Story Hub Reflections



*t(125) = 1.9, p =.05

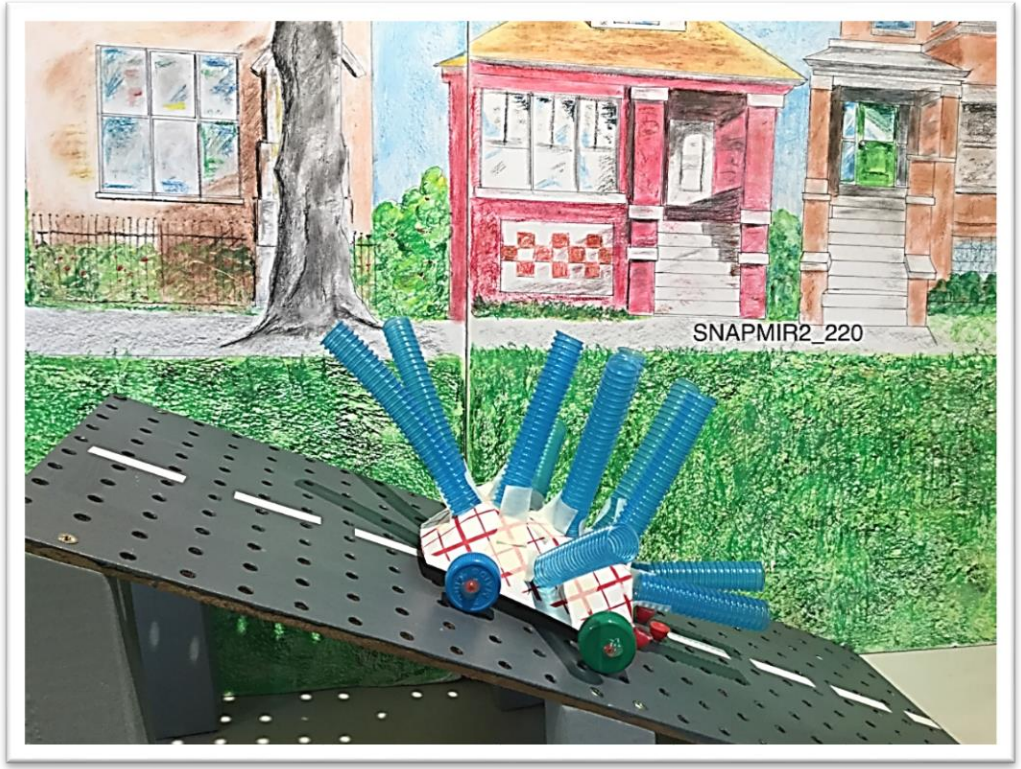
SNAP: Make It Roll

Interviewer: Did somebody help you?

Child: My mom.

Interviewer: Your mom? Okay and tell me how you worked together.

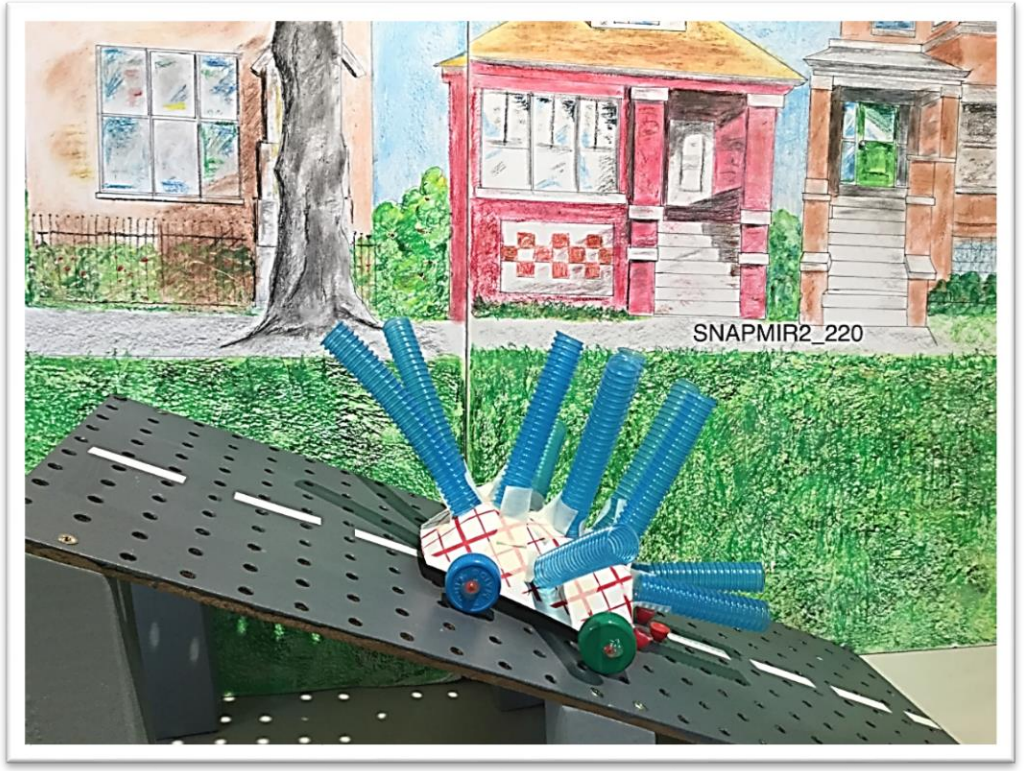
Child: Well [= worked well with mom] because when the first time that I put it in a test, it wasn't working. It only was rolling a little and then we changed it to some wheels. It was rolling but it couldn't go but then we tried again.



SNAP: Make It Roll

Interviewer: And what did you learn today?

Child: I learned that if you want something to roll, you need to have an axle…if you don't have round wheels, it can't roll.



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Autumn Crowe

End of presentation!