Explore the fortune telling fish.

Practice Based Facilitation: Advancing Science Centers' capacity to engage visitors in STEM Practices

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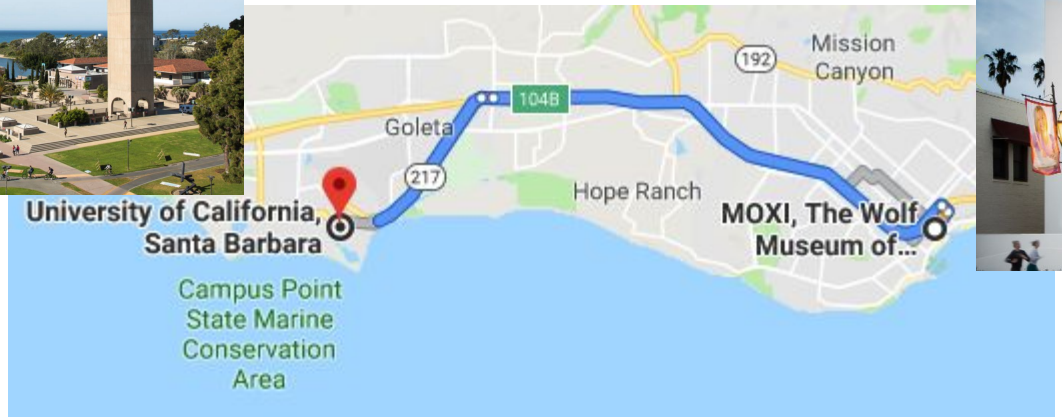


UCSB

moxi

The Wolf Museum of Exploration + Innovation

MOXI, The Wolf Museum of Exploration + Innovation

Open ended exhibits

- Multiple entry points
- Multiple ways of interacting
- Multiple outcomes

+

Diverse visitors

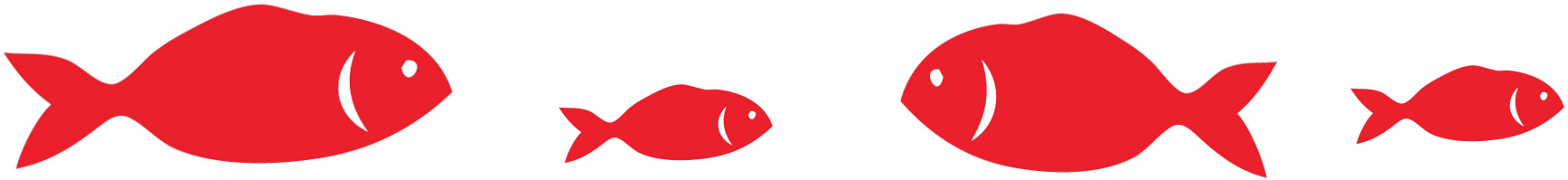
- Age
- Background
- Interest

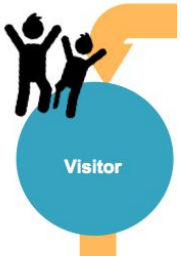
} unobservable

Practice-based Learning

Practice-based Facilitation

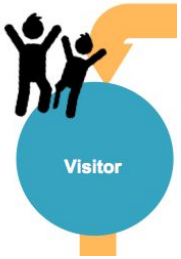
- What are the ways you and your tablemates interacted with the fish?
- What other ways *might* people interact with the fish?





Ways that people might interact with fish.

- Look at the fish.
- Read the instructions on the packaging.
- Read and follow the instructions (e.g., place it on their hand)
- Change temperature of hands (e.g., rubs hands together, puts hands in pockets)
- Use other body parts (e.g. place on knee)
- Use external materials (e.g., wet fish, rub with wool)
- Collaborate with other people by comparing observations.



Engagement levels

- Look at the fish.
- Read the instructions on the packaging.
- Read and follow the instructions (e.g., place it on their hand)
- Change temperature of hands (e.g., rubs hands together, puts hands in pockets)
- Use other body parts (e.g. place on knee)
- Use external materials (e.g., wet fish, rub with wool)
- Collaborate with other people by comparing observations.

●Each level is a brief description of **common activities** that visitors engage in (ideally 5-7 levels).

●Levels are specific to the particular **exhibit/program.**

●Levels are easily identifiable through **observation.**

We use the NGSS Practices of Science and Engineering as a starting place to think about the ways we want visitors to engage with exhibits.

- Asking questions (science) and defining problems (engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (science) and designing solutions (engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Engaging in the practices can lead to productive STEM identities ("identity work") (Kelly, Cunningham, & Ricketts, 2017)

Engagement Level	STEM practices
• Look at the fish.	
• Read the instructions on the packaging.	
• Read and follow the instructions	
• Change temperature of hands (breathe on hands, rub hands together)	
• Use other body parts. (e.g., place on knee, arm)	
• Use external materials to test fish (e.g., wetting fish, rubbing it with static)	
• Collaborate with other people by comparing observations.	

Engagement Level	STEM practices
• Look at the fish.	*Making observations*
• Read the instructions on the packaging.	*Obtaining information*
• Read and follow the instructions	*Making observations*
• Change temperature of hands (breathe on hands, rub hands together)	*Testing ideas, collecting & analyzing data*
• Use other body parts. (e.g., place on knee, arm)	*Testing ideas, collecting & analyzing data*
• Use external materials to test fish (e.g., wetting fish, rubbing it with static)	*Testing ideas, collecting & analyzing data, constructing explanations*
• Collaborate with other people by comparing observations.	*Making observations, constructing explanations*

PIxEL (Practices Inferred x Engagement Level) Matrix

STEM practices

Engagement level	Observing	Asking Questions	Defining Problems	Planning Investigations	Carrying out Investigations	Analyzing and Interpreting data	Designing Solutions	Testing Solutions	Developing Models	Testing Models	Math & Computational Thinking	Constructing Explanations	Engaging in Argument from Evidence	Obtaining/Evaluating Information	Communicating Information	Finding Connections	Perseverance to achieve goal	Taking Creative Risks
Collecting balls	●	⊙									⊙	⊙		⊙	⊙	⊙	⊙	⊙
Playing with an existing track	●	●							⊙	⊙	⊙	⊙		⊙	⊙	⊙	⊙	⊙
Testing an existing track and changing variables	●	●		●	●	●		●	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
Modifying an existing track	●	●	●	●	●	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
Building a new track	●	●	●	●	●	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
Complex building	●	●	●	●	●	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙

● Inferable by observation and listening to visitor conversation
⊙ Likely afforded by level of engagement, but would require interviewing visitor

- We used the NGSS practices as a starting point. We broke some down into smaller pieces and added additional practices we were interested in.
- Identified which of these were *likely* to be found in interactions at each engagement level.
- Engagement levels are *observed*. Practices are *inferred*.

Practice-based Learning:

Experiences in which visitors learn through engaging in STEM practices.

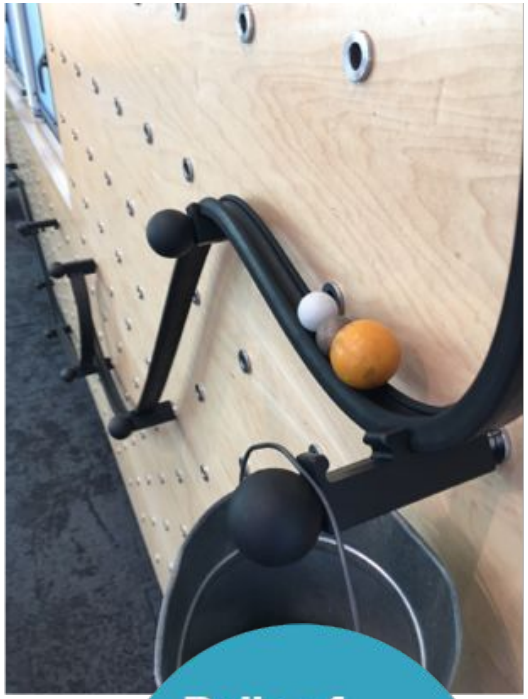
Requires

Practice-based Facilitation

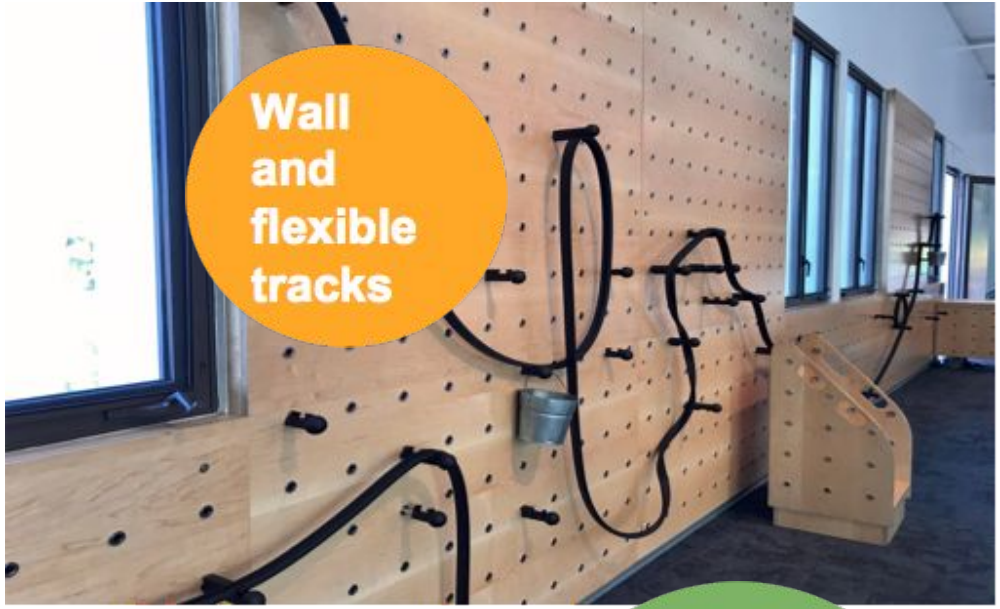
Facilitation which supports visitors' learning through practice-based learning.

Facilitation pathways


MOXI, The Wolf Museum of Exploration + Innovation

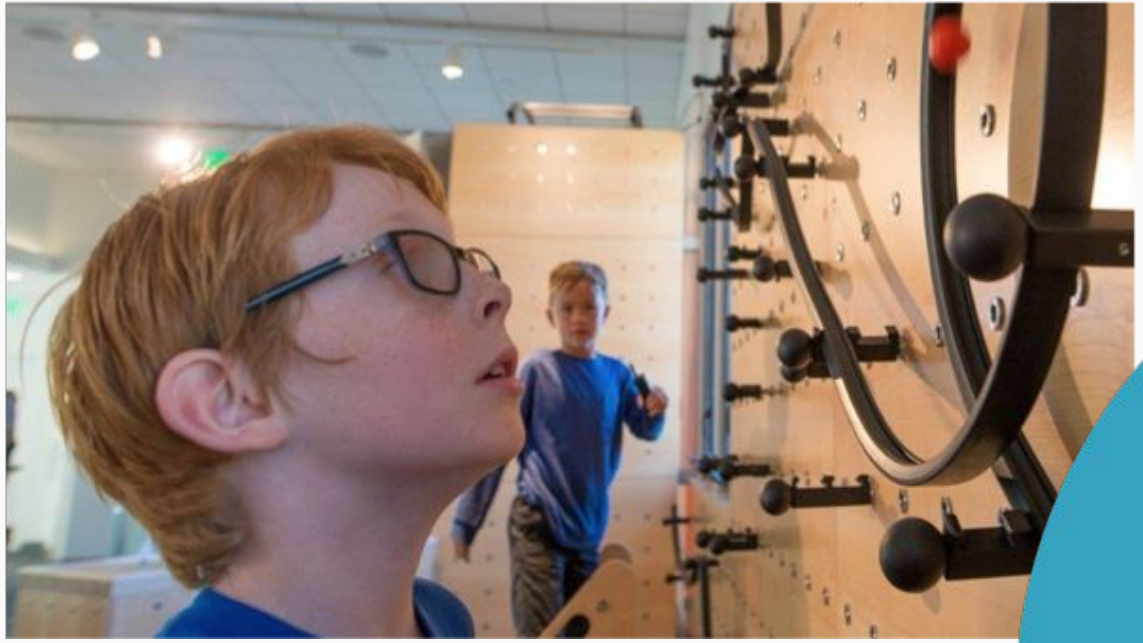


Balls of various diameters, mass, and materials



Wall and flexible tracks

Pegs hold tracks at different distances from wall

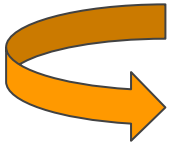


Two visitors repeatedly test an existing track. The ball leaves the track at the same point, not completing the loop.

Facilitator observation

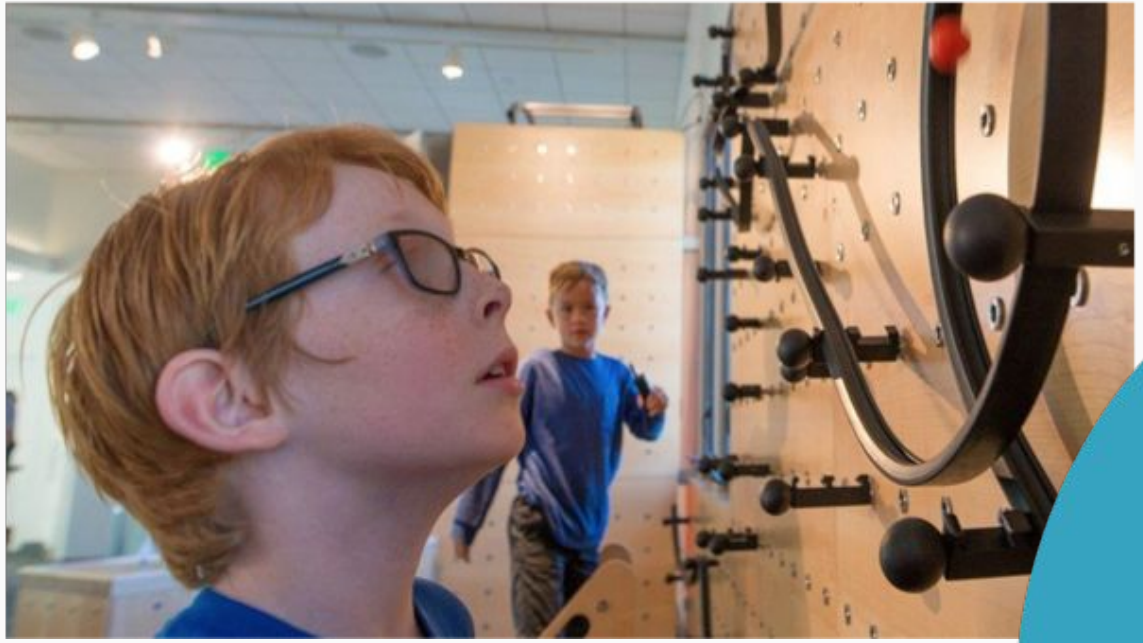
The pegs holding the track vary in length causing the track to curve side to side as it makes a loop.

Facilitation pathway 1: Maximize Engagement



Engagement level	Observing	Asking Question	Defining Proble	Planning Investi	Carrying out Inv	Analyzing and I	Designing Soluti	Testing Solution	Developing Mod
Collecting balls	●	⊙							
Playing with an existing track	●	●							⊙
Testing an existing track and changing variables	●	●		●	●	●		●	⊙
Modifying an existing track	●	●	●	●	●	●	●	●	⊙
Building a new track	●	●	●	●	●	●	●	●	⊙
Complex building	●	●	●	●	●	●	●	●	⊙

● Inferable by observation and listenin

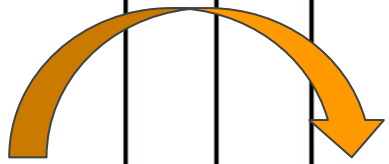


Maximize Engagement

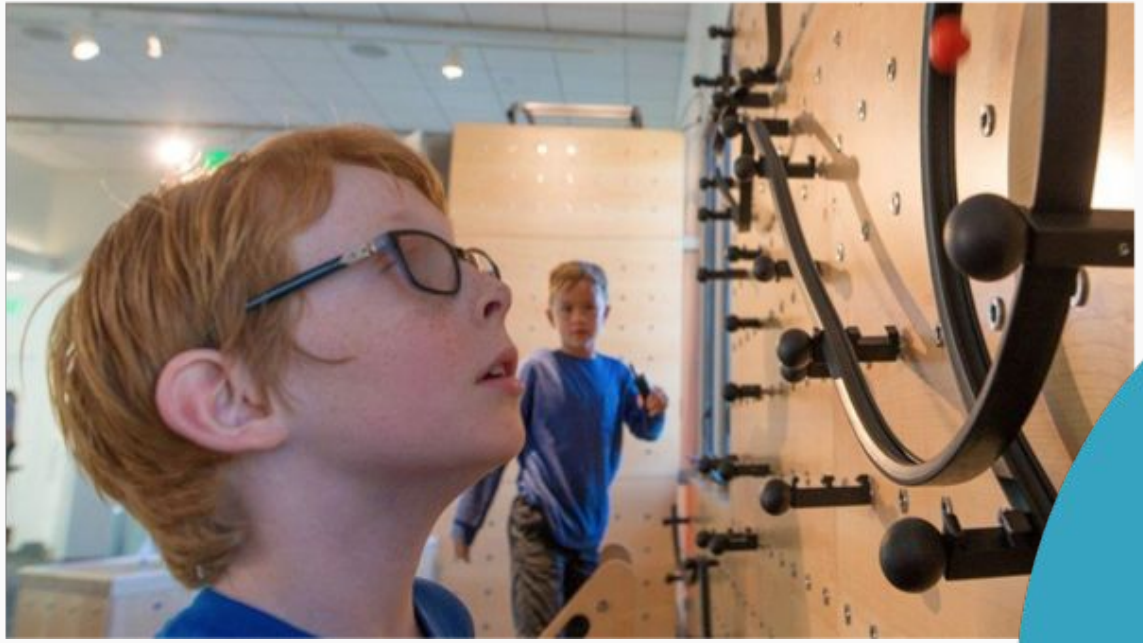
“That’s a wobbly track”

Two visitors repeatedly test an existing track. The ball leaves the track at the same point, not completing the loop.

Facilitation pathway 2: Expand Practices



Engagement level	Observing	Asking Questions	Defining Problems	Planning Investigations	Carrying out Investigations	Analyzing and Interpreting data	Designing Solutions	Testing Solutions	Developing Models	Testing Models	Math & Computational Thinking	Constructing Explanations	Engaging in Argument from Evidence	Obtaining/Evaluating Information
Collecting balls	●	⊙									⊙	⊙		⊙
Playing with an existing track	●	●							⊙	⊙	⊙	⊙		⊙
Testing an existing track and changing variables	●	●		●	●	●		●	⊙	⊙	⊙	⊙	⊙	⊙
Modifying an existing track	●	●	●	●	●	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙
Building a new track	●	●	●	●	●	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙

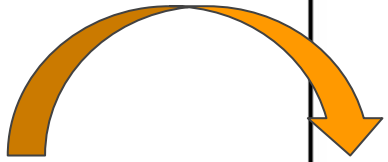


Two visitors repeatedly test an existing track. The ball leaves the track at the same point, not completing the loop.

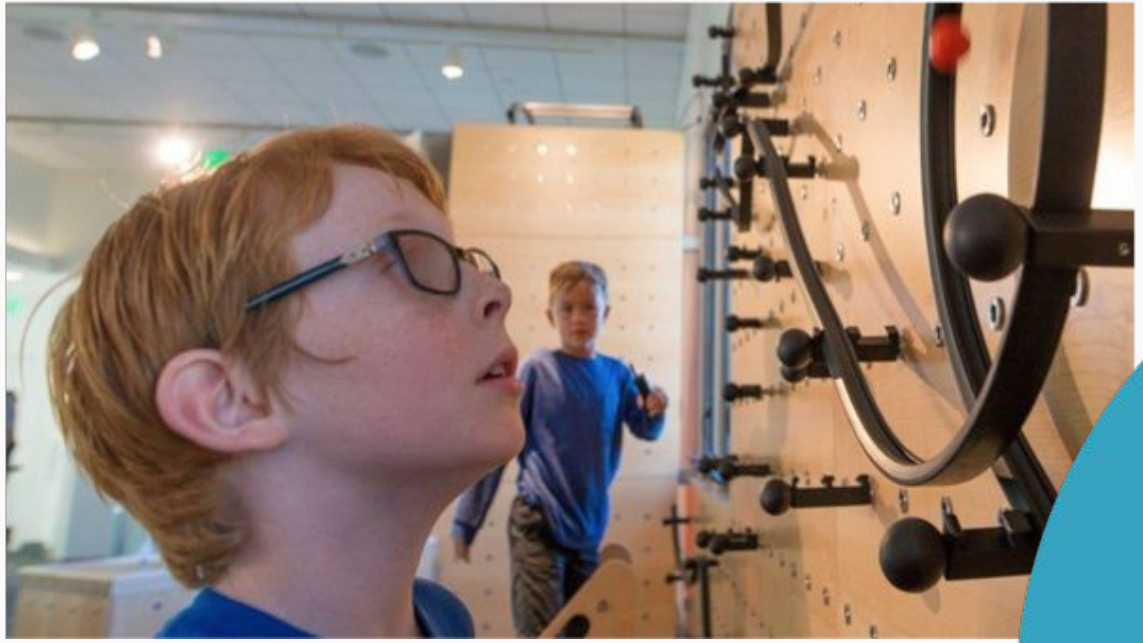
Expand Practices

“What seems to be the problem?”

Facilitation pathway 3: Optimize Practice



ngagement level	Observing	Asking Questions	Defining Problems	Planning Investigations	Carrying out Investigations	Analyzing and Interpreting data	Designing Solutions	Testing Solutions	Developing Models	Testing Models	Math & Computational Thinking	Constructing Explanations	Engaging in Argument from Evidence	Obtaining/ Evaluating Information	Communicating Information
llecting balls	●	⊙									⊙	⊙		⊙	⊙
ying with an existing track	●	●							⊙	⊙	⊙	⊙		⊙	⊙
sting an existing track and changing riables	●	●		●	●	●		●	⊙	⊙	⊙	⊙	⊙	⊙	⊙
odifying an existing track	●	●	●	●	●	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙	⊙
ilding a new track	●	●	●	●	●	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙	⊙



Two visitors repeatedly test an existing track. The ball leaves the track at the same point, not completing the loop.

Optimize a Practice

“What do you each notice about the track?”

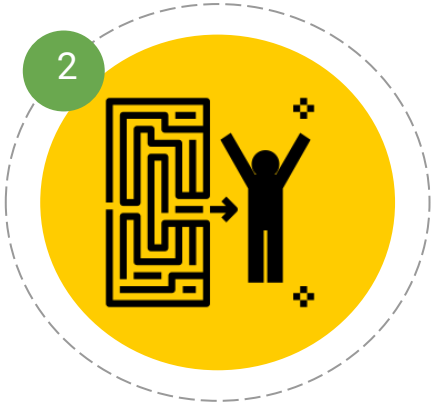
Challenges with Practiced-based Facilitation

Requires skill in observing visitor behavior

1

Requires experience with exhibit - what visitor engagement is possible?

2



Requires practice for spontaneous facilitation

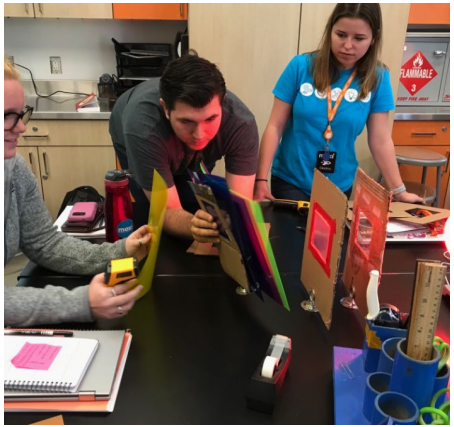
3


WynnWood
Premier

MOXI/UCSB Certificate in Informal STEM Learning

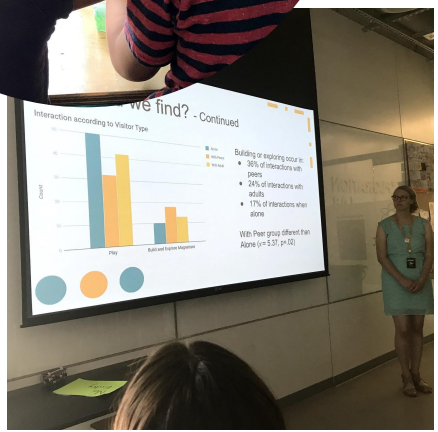
- 12-15 month program
- 1,000 hour paid internship as MOXI floor staff
- 4 quarters of coursework (16 credits)
- Capstone project

Facilitation



Curriculum Development

Education Theory



Research & Evaluation


Improv Training

Practice-based Facilitation

- Observation
- Reflection
- Shared practice

Playful Exploration

- Discovering possibilities
- Building conceptual understanding
- Modeling behavior

Next steps for advancing science centers' capacity to engage visitors in STEM practices

Study training methods

Develop training modules

Build a replicable model

This material is based upon work supported by the National Science Foundation (grant AISL-1906320; AISL-1906322)

Case Studies

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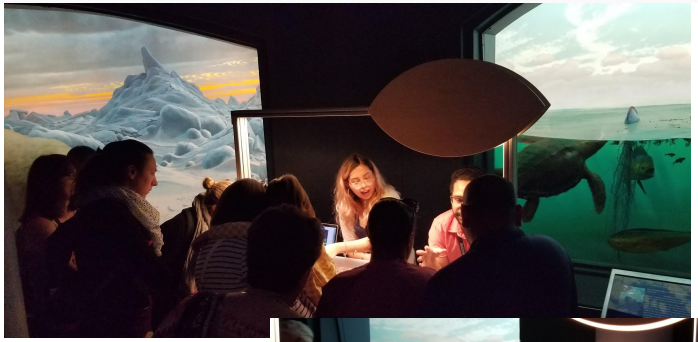
American Museum of Natural History

Tara Henderson
Director of School & Community Programs
Explora

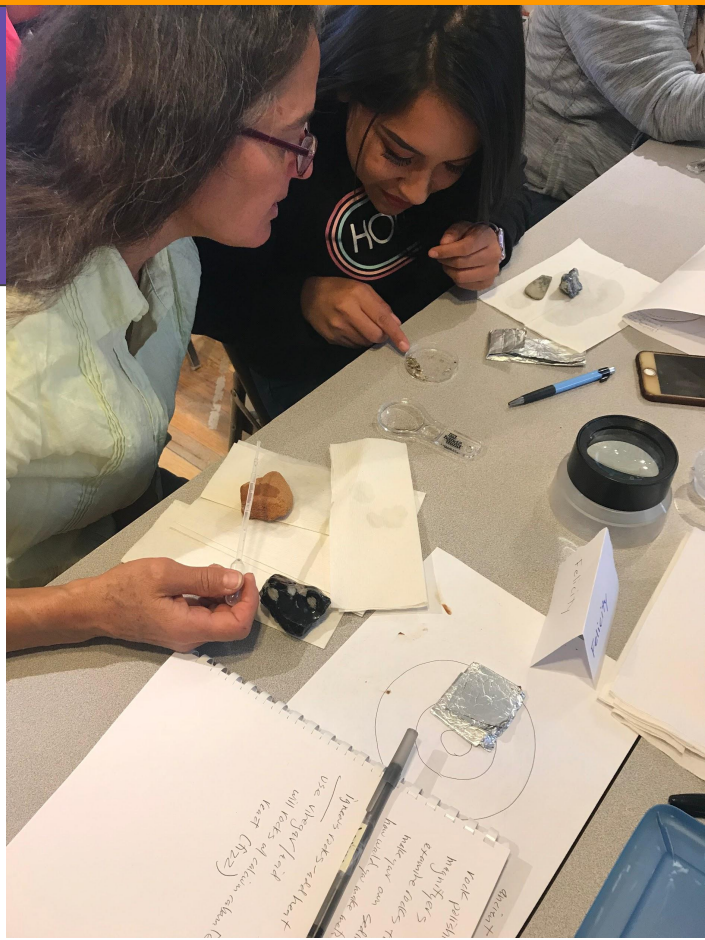
Case Study 1: AMNH



- What does practice-based facilitation look like at a diorama?
- What is possible at a cart?

Internal Professional Development and Training

Education staff: full and part time educators whose job is to facilitate programs both at Explora and in the community.



Case Study 2: Explora

ECME 2096-901 - Math and Science in the Early Childhood Classroom

Offered in collaboration between Explora and the Community College of Central New Mexico

Group Discussion

How does your institution facilitate visitors' engagement in STEM practices?

How might you use practice based facilitation in your institution?

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For more information on Practice-based Learning

Skinner, R., Harlow, D., Wesoloski, K., (in press). Changing Mindsets Through Educator Training, *Connected Science Learning*.

Harlow, D. B., & Skinner, R. K. (2019). Supporting Visitor-Centered Learning Through Practice-Based Facilitation. *Journal of Museum Education*, *44*(3), 298-309.

Harlow, D. B., Skinner, R., & O'Brien, S. (2017, October). Roll It Wall: Developing a framework for evaluating practices of learning. In *Proceedings of the 7th Annual Conference on Creativity and Fabrication in Education* (p. 14). ACM.