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Playful Early Math Learning in Pediatric Clinics

Design and Installation Playbook for
Pediatric Care Teams

Table of Contents

01 Executive Summary

Our Project

**The Why, What, and How
Logistics of the Install**

02 Further Reading: Deeper Dive into Sample Exhibits

03 Further Reading: Deeper Dive into the Design Process

04 Further Reading: Other Considerations

Part 01

01 Executive Summary

Introduction

- Bringing playful early math into pediatric care units provides powerful opportunities to help children build mathematical knowledge critical to success in school.
- This playbook can help you build playful early math learning into the physical spaces and care practices of your clinic.



**"It's been a little light in their
[children's] day."**

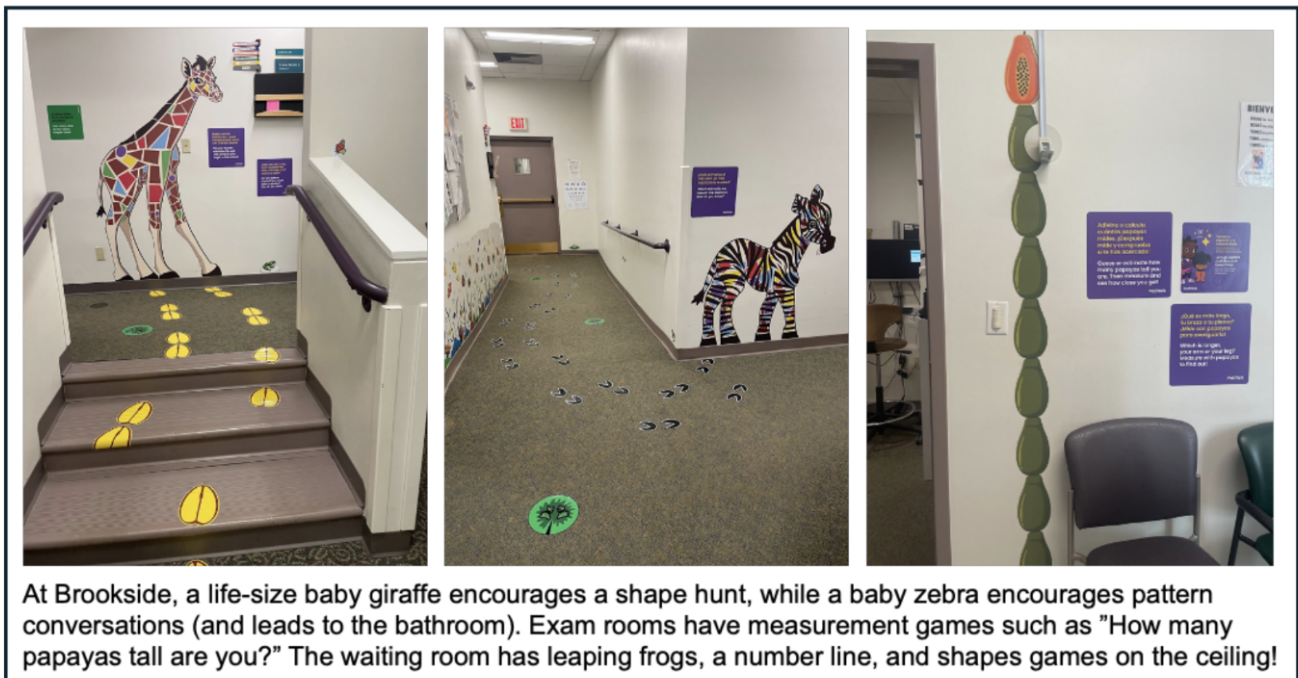
**Pediatrician, Brookside
Community Health Center**

Our Project

This playbook resulted from a collaboration between Brookside Community Health Center* in Boston, MA and child development and early math experts** working together to bring playful math into the Brookside pediatric clinic.

Our goals were to:

- make the clinic aesthetically pleasing and easier for families to find their way around,
- promote joyful math conversations among children, caregivers, and pediatric providers, and
- provide stimuli that help clinicians assess developmental skills.



"They like to see the frogs, they jump with the frogs. They're counting the papayas, and they're counting the soccer balls."

Pediatrician, Brookside Community Health Center

"...the kids like got really excited when they see the zebra or when they see the giraffe or when I tell them when I take the height and I tell them you have to count how many balls are you or how many hands and they start to count. You know the interaction is not just 'Oh, I'm here for the checkup' it's different now, this is different."

Medical Assistant, Brookside Community Health Center

*Brookside Community Health Center is licensed by Brigham and Women's Hospital

**A partnership between MathTalk, a not-for-profit organization in Cambridge, MA bringing math to communities, and DREME researchers at the Mary E. Walsh Center for Thriving Children, Lynch School of Education and Human Development, Boston College.

Why Playful Early Math?

- Young children are natural mathematicians, and early math skills are critical for success in school.
- Early math skills can be developed wherever and whenever children explore the world around them with their caregivers and families.
- Pediatric care and opportunities to develop math skills are particularly important in communities facing poverty, racism, or other marginalizing factors.
- Playful early math in pediatric care facilities can provide all families with opportunities to explore and learn in a trusted setting, while making clinic visits more enjoyable for children and families.



Families are naturally gifted innovators.



Family math is for everyone.



Math learning can take place at home and in informal settings—it's not confined to the classroom.



What Math Skills are Important for Young Children?

Some key math concepts that young children (ages 2–6) can explore in your clinic include:

- Counting objects and learning to figure out “How many are there?”
- Estimating and comparing quantities
- Adding and subtracting
- Measurement
- Understanding spatial relations:- under, next to, in front of, behind
- Learning shapes and shape features (e.g., number of sides, number of angles)

To learn more about these early math concepts and how you can support family math, please visit familymath.stanford.edu



There are different types of triangles, but they all have 3 sides and 3 angles.



The pattern unit is the part of the pattern that repeats over and over again. There are two pattern units shown here.



The butterfly is smaller than the leaf. The leaf is wider than the stick.

How to Help Children Explore These Concepts in Your Space

While there are many ways for children to playfully engage with early math at the clinic, here are a few ideas that have been successful:

Create "I spy" games with shapes and numbers: Children love to hunt for, count, and describe shapes and objects in designs placed on the floors, walls, or ceilings.

Life-sized images can encourage math conversations: Life-sized images (e.g., animals, animal footprints, fruits and vegetables) on the walls or floor are a fun way for children to compare sizes and make measurements.

Math trails: children can explore patterns by hopping on decals that make number lines or other counting patterns while leading them to the exam room.

Signage to spark conversation: While being sure to allow families the freedom to innovate and have fun, signs with simple caregiver-child talk suggestions can help spark fun math conversations.

Logistical Considerations

If you have design ideas but are not sure how to accomplish the logistics of an install, here are some ideas:

Work with Local Artists

Local artists or art students may be willing to create designs for the clinic.

Work with Local Print Shops

Local print shops can help you figure out what types of vinyl decals will stick to your walls, carpets, or floors.



Tap into Family Math Resources Online

Here are some places that have free resources to help with math and playscapes:

[DREME Family Math](#)

[Math Talk](#)

[Playful Learning Landscapes](#)

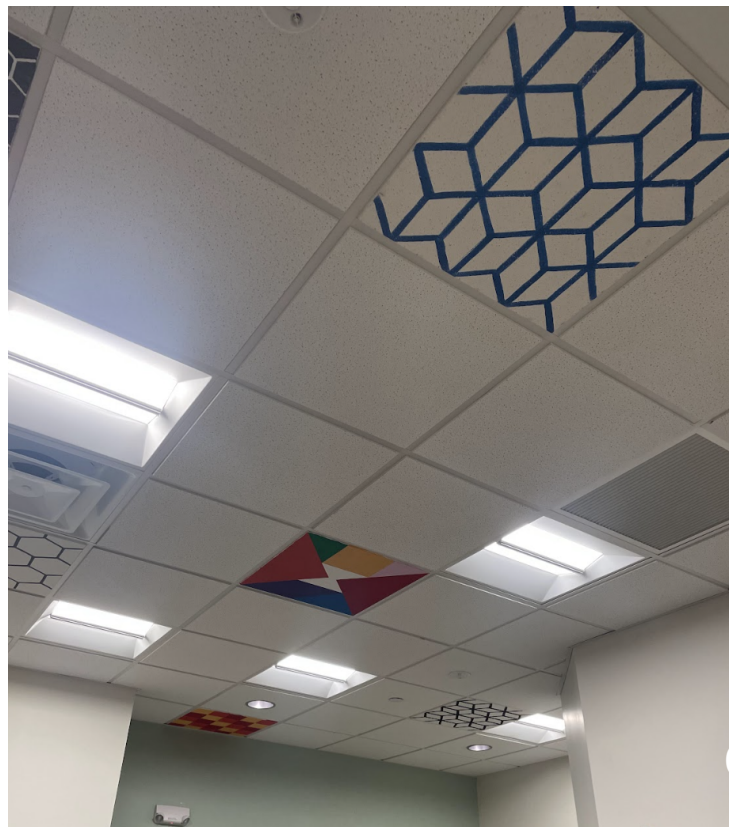
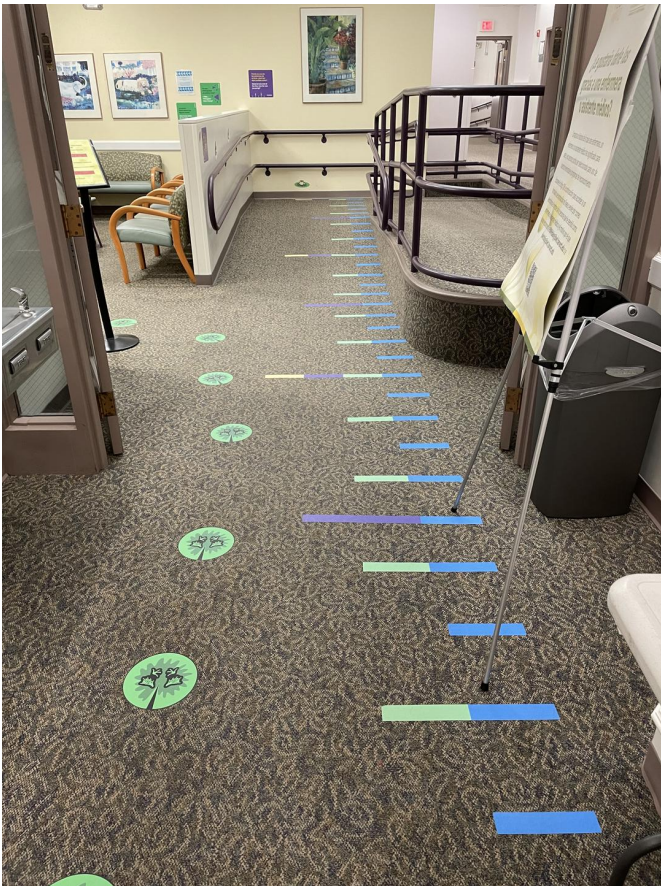
Part 02

02 Further Reading: Deeper Dive into Sample Exhibits

Examples of Exhibits

These examples may help you visualize some of the possibilities. We hope they inspire you to be creative in designing something unique for your clinic.

For more creative inspiration and resources for bringing early math into nutrition and family mealtime, storybook reading, family routines, and family play and games, please visit familymath.stanford.edu



I Spy Games



The Design Element

Near any mural or wall decoration, signage can be used to encourage children to hunt for and talk about math concepts. This can also be a powerful way to use scenes and objects that lift up the cultures of the community your clinic serves.

Where's the math?

I Spy games can be used to:

- look for a certain **number** of objects (e.g., “Find 3 bicycles.”),
- **count** features (e.g. “Find a flower with 4 petals.”)
- identify **shapes** and **shape features** (e.g., “Find windows that are rectangles.” and “How many shapes with 4 sides can you find and name?”)

Talk Prompt













Install details: Install details: I Spy prompts can be used with existing posters or paintings in the clinic, or created by painting (or using decals). For example, we removed a few ceiling tiles, painted them with designs, and then placed them back in the ceiling.

Pro Tip: Not an artist? One idea is to hold a competition with a local art school: the winners get to paint your designs, if you supply the paints.

I Spy Games

i Spy
SANTA ANA

Find 5 of each item below

-  Green Parrot
-  Sleeping cat
-  Single Balloon
-  Cactus
-  Butterfly
-  Aztec Symbol
-  Bell
- EXPERT**
-  Computer v2
-  Taco v2
-  Ant v2



The iSpy mural above was designed by Brian Peterson, who is a muralist, and inspired by the families from the Santa Ana Early Learning Initiative (SAELI). Its installation in Santa Ana, CA was funded by a National Science Foundation AISL award.

The mural depicts the community and the picture prompts on the side ask children to find 5 of each of the objects shown.

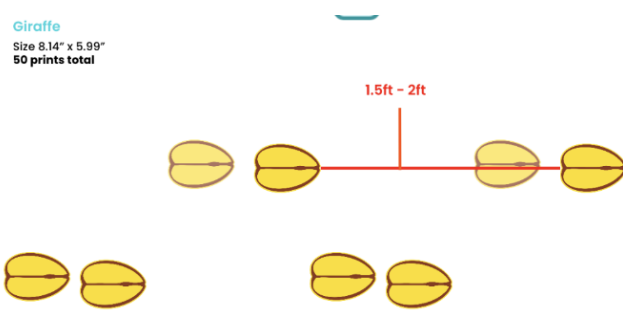
Life-sized Images and Math Trails



The Design Element

Use a scale (actual size) animals or objects on the walls or floor. For example, scale footprints on the floor, spaced at the actual animal stride length (or how far it can jump!) allow children to see how big or small their feet are compared with an animal's and how large or small their own stride length is compared with the animal's. You can also embed shapes and color within the scale objects for further conversation (e.g., In the zebra children can look for and count different colored triangles.)

Giraffe
Size 8.14" x 5.99"
50 prints total



Where's the math?

- **relative size** and **distance** (e.g. "A baby zebra is smaller than a baby giraffe, and I am smaller than both.")

Install details: On walls, scale objects can be applied to the wall with paint, with a printable decal, or painted onto plywood and mounted. On carpeted floors, decals/stickers designed for carpeted surfaces can work well. We used decals on carpet with the actual measurements of these animals' average strides (jumping distances).

Pro Tip: Actual sized footprints on the floor (or any Math Trail, see below) can also be used for wayfinding in the clinic. We used the zebra prints to help lead the way to the restroom, so that clinic staff can now say "follow the zebra prints to the restroom."

Life Size Images for Measurement

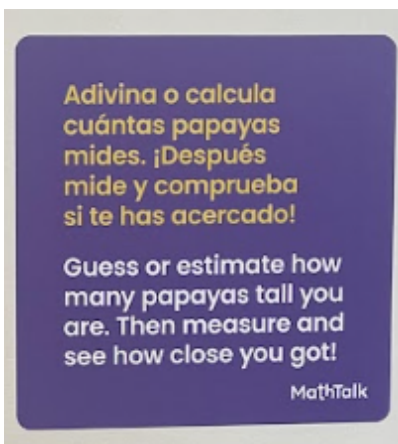


The Design Element

A common object is drawn to scale and repeated vertically up the wall. We used basketballs, baseballs, child hand prints, papayas, apples, and baby bottles.

Where's the math?

- **Measurement** and **measurement comparisons** with nonstandard units (e.g. "My baby brother is only 4 bananas tall, but he is 12 apples tall!").



Install details: Wall decals, paint, or laminated pictures taped to the wall will work, but be sure each object in a set (e.g., all the bananas) are exactly the same and placed without any distance between them.

Pro Tip: Clinicians recommend -if possible- installing these directly under measuring tape to help children to know where to stand to be measured.

Design Floor Pathways

MEASUREMENT
PATTERNS
COUNTING

FLOORS

The Design Element

Number lines can be painted (or placed) on the floor or ground outside. Children can walk and hop directly on the number line. to explore mathematical concepts. For our number line, we used equal measurements between each line with green lines placed two apart (e.g., 2, 4, 6) and the purple lines placed five apart to help underscore number/distance elements of the line.



Talk Prompt

Párate en uno de los extremos de la línea. ¿Qué tan lejos puedes saltar?

Stand at one end of the line. How far can you jump?

MathTalk

Where's the math?

- **measuring** length and distance (e.g. "I can jump as far as 4 lines and my little sister can jump 2.")
- practice **counting** by 1s, 2s and 5s.
- **patterns** (e.g. "Can you find a pattern of repeating line colors?")

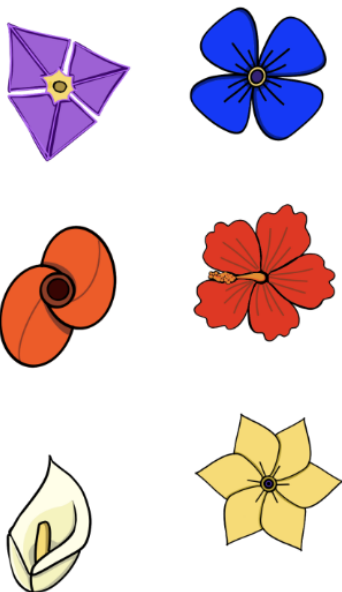
Install details: For permanent outdoor installation of designs like these, use paint. For temporary installation, you can use chalk or tape. Indoors, the design could be painted onto decals made for carpet.

Pro tip: If the number line is placed in an area that has low traffic flow, children can lay down to measure themselves with the number line.

Design Floor Pathways

MEASUREMENT
PATTERNS
COUNTING

FLOORS



The Design Element

Counting patterns can be placed on the floor or ground outside. In this design, each flower has a unique number of petals that is counting up from one, and the number of leaves between each flower increases (e.g. two petals between flower #1 and #2, five petals between flower #4 and #5).



Where's the math?

- **counting** and **one-to-one correspondence** (e.g., “Point to each petal, one at a time, while you count how many there are.”)
- **set sizes** (e.g., “Let’s count the petals on this flower. One, two, three. So, how many petals does this flower have?”)
- **addition** or **subtraction** (e.g., “This flower has three petals, and this one has four. How many petals, in total, are on these two flowers?”)

Install details: Paint or decals. For temporary installations, you can use chalk or tape.

Pro tip: Use objects that are culturally meaningful such as plants that are indigenous to the home country of immigrant families.

Part 03

03 Further Reading: Deeper Dive into the Design Process

Design Considerations

Just starting the process?

This section provides step by step guidance from the beginning of the design process to getting ready for the installation.



Guidance for practical and aesthetically pleasing design



Tips to make the design mathematical but also help the day-to-day functioning of the clinic

How to design an installation at your clinic or practice space, step by step:

1

Choose your design team

2

Decide places and purposes

3

Consider cultural context and existing aesthetics

4

Consider psychology of the space

5

Pilot in the space and adjust

6

Write prompts for engagement with installation

1: Choose your design team

Getting the right people at the table is essential.

Determine the key players

You will want to include stakeholders from families, providers, and staff who interact with patients at other points during their visits (e.g. nurses, medical assistants, front desk staff). Stakeholders from facilities can consider the use of materials and long-term upkeep. It is also helpful to get guidance on the visual images and prompts from someone, such as a local teacher, who knows about math learning in young children.

Center the users

Although families have the most constraints on their time, they will also have vitally important insight into the usability of the exhibits. Andres' Bustamante's team at STEM Learning Lab provides food and childcare to allow families to participate in design meetings for playscapes.

Discuss perspectives and goals

Each group will have different lens on the project:

- Providers will have a sense of how installations could benefit well-child exams
- Families will offer perspective on what exhibits will hold the interest of their children.
- Front desk staff will know what families are already doing while they are waiting and how they make use of the waiting room.
- Artists will have an eye for aesthetics and cohesion but may know less about the flow and use of the space.
- Math experts or teachers will have ideas about the kind of math activities and conversations the exhibits should promote.

It's helpful to take some time at initial meetings to map out what perspectives each person brings to map out what each person's goals for the installation are.

2: Decide places and purposes

Where and why you will place design elements is unique to each space.

Can elements be used in workflow for practitioners?

Start by asking providers and other staff how installations in the space could help with their work. For example:

- include colors and shapes to look at and discuss in the exam room during well-child exams when going over developmental milestones.
- use an installation to help guide children where to stand to be measured.

Can elements be used in wayfinding or directing children in or out of spaces?

Installations on the floor can be used to help families move from one space to another. They can also be used to keep children out of spaces where the clinic would rather they not be.

At Brookside Community Health Center, we installed a number line on a ramp to keep children focused on the floor and to keep them from climbing on the ramp railings.

Where will families spend time? How can elements be used to help with waiting, ease anxiety, or encourage play?

You may want to prioritize places where families will wait the longest and get the most benefit out of the installation.

At Brookside Community Health Center, installations were placed in the pediatric waiting room and the exam rooms because we knew that families spend the majority of their visit there.

3: Consider cultural context and existing aesthetics

The installation will be most impactful if it fits with existing elements in the space, reflects the culture and interests of the families, and looks nice.

What objects, colors, and references are important to the clinic and its families?

Families involved in the design process will be able to tell you if there are particular cultural references that will be meaningful to include in the exhibit.

What already exists in the space?

Rather than approaching the clinic as a blank canvas, consider what art and colors are already present and how design elements could complement them.

At Brookside Community Health Center, the artist developed scale animals that were inspired by framed art that already existed in the waiting room.

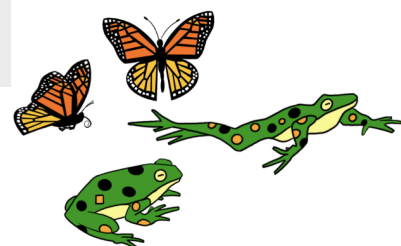
Consider unifying colors and themes

If colors and shapes can be repeated throughout the installation, it helps it to feel cohesive.

At the Brookside Community Health Center install, the artist put different versions of the same frogs and butterflies throughout the clinic in each area of the exhibit to help transition between the different design elements.



Animals inspired by Jiang Tiefeng print found in Pediatric waiting area



4: Consider the psychology of clinic spaces

Design elements can be used to help with transitions and ease anxiety.

Where are thresholds?

Patients and their families may be experiencing anxiety entering a medical environment. Going from the waiting room to the exam room can signal crossing a threshold into a medical space where painful procedures might take place.

Nurses at Brookside reported that they liked having patients follow footprints into the exam room and having the baby giraffe greet patients as they entered the exam room hallway space.

Where are patients likely to experience anxiety?

You can place design elements in other areas that may provoke anxiety, such as the ceiling above where patients may lie down, or in the lab where blood is drawn.

Consider trauma-informed design principles

Trauma informed design can provide guidance for colors and shapes that are calming. Trauma informed design also encourages the use of choice whenever possible in terms of how users can interact with the space.

To learn more about trauma informed design, visit:

<https://www.nationalcouncildocs.net/wp-content/uploads/2018/10/Trauma-Informed-Design-Summary.pdf>

5: Pilot and Adjust

Trying elements in the space and getting feedback from users before you do a full scale installation is strongly recommended.

Placing design elements in the space illuminates practical considerations

At Brookside Community Health Center, once ceiling tile designs were placed, we realized that some of them were placed close enough to overhead lights that they were harsh to look up at.

If you are able to place these elements in the space to pilot them, you can discover these types of practical considerations and make adjustments before doing the larger installation.

Placing design elements in the space allows you to see how families and practitioners use them

You can make sure that design elements are accomplishing the purposes you set out at the beginning of the design phase.

Are visitors spending time in the spaces that you predicted for the amounts of time you were hoping for? Or are installations holding attention in places that you wanted visitors to move through quickly?

Piloting design elements in the space allows you to see what families like and want to change.

If certain design elements prove to be less engaging, piloting will allow you to see that, and you can swap the elements out or make changes to make them more appealing to visitors.

You can do simple surveys or interviews of families who see the pilot materials to gather feedback about the installation.

6: Write prompts to spark conversation

Give families and practitioners ideas for how to interact with the design elements

Write short prompts using simple words, in all languages spoken at the clinic

Prompts like "How many apples tall are you?" are short, linguistically simple, and promote engagement with the math concepts in the installation.

Make it clear what elements you are referring to with placement and arrows

If design elements are on the ceiling tiles, place prompts on the wall where they can be seen but also close to the ceiling.

Consider placing an arrow, or a sign to "Look up!" to help the families match the prompts to the design elements.

Consider technology and staff training to help support use of the prompts.

You can use QR codes to connect families to additional resources related to the installation. At Brookside Community Health Center, we provided QR codes to the MathTalk app "Measure Everything" which allows users to measure objects with augmented reality on their phone.

It's helpful for staff who are near the installations (such as front desk staff) to know about the prompts and QR codes so that they can help families interact with the exhibit and/or answer questions.

MathTalk Design Principles

These general principles were developed by MathTalk through the experience of installing math trails in playgrounds, parks, museums, etc.

Design Principles

Enjoyment and Fun

How can we design an experience that brings enjoyment and fun to learning math?

Flexibility

How do we design experiences so that users can explore and learn math in different ways?

Active Exploration

How can we build opportunities for users to guide their own path and show learning in their own way? How do we give users agency and autonomy?

Meaningful Context

How might we design experiences that matter to our users and speak authentically to them?

Collaboration

How can we design experiences that promote collaboration, playful competition, and social context?

MathTalk's What to Avoid in Design

These general principles were developed by MathTalk through the experience of installing math trails in playgrounds, parks, museums, etc.

What to Avoid in Design

- Heavy instruction can cause overwhelm, confusion, reduced autonomy, decreased creativity, increased stress, and loss of interest.
- Too many visual cues can be overstimulating and confusing.
- Not enough strategic scaffolding can leave children and families feeling frustrated over not understanding the goal of the activity, or how to jump in.
- Forgetting about the fun! Engagement is key to drawing kids in and to encourage staying and playing. Kids will be less likely to engage - and stay engaged - if they don't feel the fun factor!
- Ignoring cultural context misses a key opportunity. Recognizing and valuing cultural context is essential for creating inclusive and equitable environments where children feel seen, valued, represented, and celebrated.

Part 04

04 Other Considerations

Other Considerations

Here are some additional questions and possibilities that arose from our collaboration with Brookside Community Health Center. While we intend to further explore these considerations in our future work, we present these questions and ideas here in the hopes that they are helpful considerations, and welcome reports of your own innovations in these areas.

Framing for Families and Staff

Families and staff might benefit from having more framing about the exhibit- what to expect, where the installations are, and what types of activities are possible to do.

One idea is to make a BINGO board or scavenger hunt so families can track completion of different parts of the exhibit e.g. "measure your height using apples in the exam room" or "count the number of triangles in a ceiling tile design"

Staff might benefit from a walkthrough of the installation so they are better able to answer families' questions or make recommendations.

Supports for Families Under Stress

Practitioners at Brookside Community Health Center noted that families' capacity for interaction with the exhibits is partially determined by the levels of stress they are feeling- families with the most stress and challenge are less likely to interact with the exhibit.

For these families, additional scaffolding may be needed. Ideas to explore include receiving light coaching from clinic staff or using instructional videos to help families learn how to engage with the exhibit.

Taking the Learning Home

Families in our project loved the colors and aesthetics of the installation, but wished for ways to continue the learning at home.

We are developing some coloring book pages that mimic some of the animals in the installation so that families can color and discuss shapes at home and have a souvenir of the exhibit to take home.

You could explore other take home possibilities such as DREME family math kits, stickers, or puzzles.