Page 1 is for the grown-ups

Mirror Books & Infinity Rooms

infinitely big & small things ⇒ CALCULUS
patterns & transformations ⇒ GROUP THEORY

Family Math Circle
2023

Family Math Circle is an informal learning space where participants make advanced mathematics accessible to everyone in kind ways.

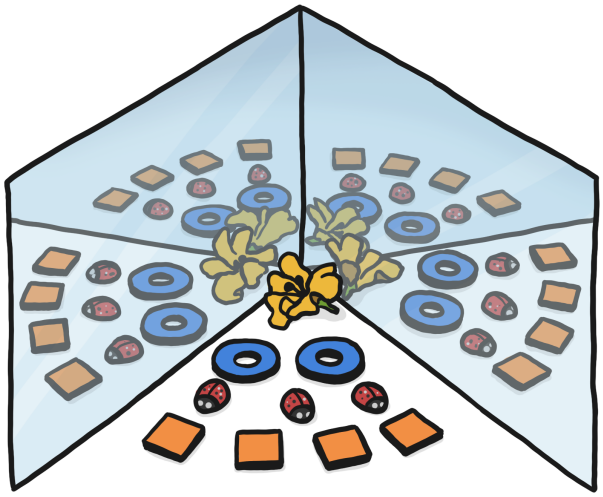
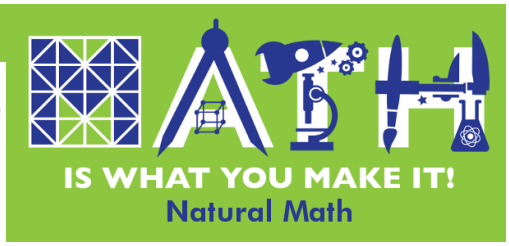


Image from *Moebius Noodles: Adventurous Math for the Playground Crowd*

Make Mathematics

Make sculptures with mirrors, toys, and light. Experiment with mirrors to find, build, and draw patterns. Share photos of your art and short videos about your moving sculptures. Create models of multiplication.



Buzz Words

reflect, rotate, multiply, transform
point, line, angle, circle
repeat, fill, tessellate

symmetric, asymmetric, isometric
infinite, infinitesimal
pattern, kaleidoscope, wallpaper group

Choices, Choices

Choose *the number* of mirrors, favorite things to reflect, and *angles* between mirrors to create different sculptures. Make clear *patterns* as perfect as crystals, or piles of pretty *chaos* multiplying in a kaleidoscope. To notice transformations, grow your math eyes with mathematicians who study *group theory*. Or imagine infinitely tiny angles and infinitely many reflections with the math friends doing *calculus*.

Toolbox

Physical (gray=optional):

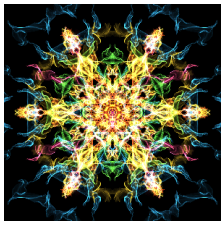
- paper, colored pencils or markers, scissors
- mirrors and mirror books
- small toys and treasures
- fabric, patterned paper, pictures

Virtual:

- WeaveSilk.com symmetry art
- EscherSket.ch tessellation art
- Yayoi Kusama https://youtu.be/vebDk7xQmCw

NaturalMath.com/circles/

Extra activities, videos, math connections, books, and other resources for math circle leaders.



by Scott Kim

Page 2 is for reading with children and making math together. Mind the spoilers!

Math Circle: Mirror Books & Infinity Rooms

Math Journal by _____

Write your name above. Write or draw anything you want below. Add more pages if you want!

1. Make Mirror Art

Open a mirror book. Put some objects or draw inside. Choose how to place your objects and mirrors. Photograph your mathematical sculptures.

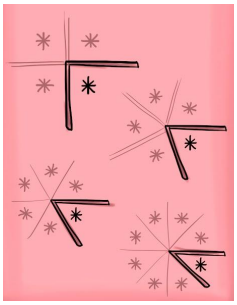
2. Live Mirrors Improv Game

Stand in front of each other. Choose how to move and make faces. Copy each other's moves. That's it!

SPOILER You are exploring mirror symmetry.

Images: Natural Math, My Little Pony, Spiderman

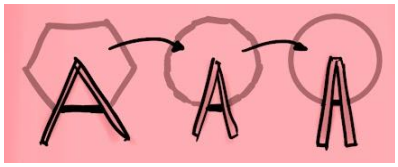
3. Grow Your Treasure



Choose a whole number from 3 to 10. Put a toy into your mirror book. Change the angle until you see as many total toys as your number. Now put several treasures in. Your mirror book will automagically make your treasure grow by your number!

SPOILER You are building models of multiplication.

4. So Many Reflections

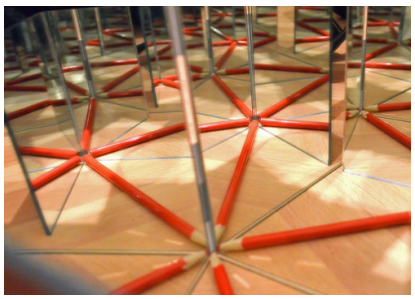


Put the mirror book in front of your face or put a small toy inside. Slooowly close down the book. Watch more and more and more copies appear. Try to imagine the angle growing infinitely small (infinitesimal). There will be infinitely many copies! That's pure abstract math, impossible for real. If you choose to stay real, like an engineer, imagine a tiny angle and a huge number of copies.

SPOILER You are building models of infinity and infinitesimals.

5. Mirror Rooms

Put several mirror books together, as if they are walls in a room. Choose the shape of your room: triangle, square, hexagon, etc. Put toys or flashlights inside. Put your eye close to the top edge of your room and look inside. Imagine the infinite pattern—or a very large pattern, if you choose to stay real.

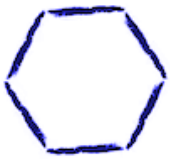


6. Mirror Puzzles

One-Line Puzzles Draw a short, straight line. Move a mirror book over your line until you see a shape that you like. Draw that shape on a card: it's your one-line mirror puzzle. Can your friends figure out how to make the same shape with one line and the mirror book?

Some shapes are impossible to make with only one straight line and a mirror book. For example, the letter F. Mix impossible shapes with your puzzles to surprise your friends. (But they may surprise you if they figure out a clever solution!) You can make some shapes in several different ways. Try to find different solutions to the puzzles.

Puzzle



Solution

Letter Puzzles & Art Move the mirror book over words. Some letters turn into different ones in the mirror. Other letters are symmetric: they look the same in the mirror book, if you place them just so. Find the symmetry secrets of the letters, then turn them into puzzles for your math friends or mathematical art.

7. The Nature Mirrors, Too

Go on a scavenger hunt for creatures, plants, and human creations that could have been made with mirrors. Put your mirror book on top of pictures or objects to check what works. Warning: some things have a lot of repeating parts, but no mirroring!