



The Making of MoMath: America's Only Museum of Mathematics

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On the numerically propitious date 12/12/12, an opening ceremony will welcome a new museum in Manhattan: the Museum of Mathematics. New York City hardly lacks for museums: Some 110 call one of its five boroughs home—more if zoos and botanical gardens are included. But MoMath, opening to the public December 15, will be something special: a museum devoted to conveying the passion, wonderment, puzzlement, and intrigue that mathematicians feel toward their subject.

Imagine walking across a floor covered in a tile pattern that stands the monotony of the omnipresent right-angled grid on its ear. The wall on your right undulates in



a strange rhythm created by the interaction of traveling waves moving in opposite directions. Along the left-hand wall stand entry kiosks where patrons receive badges containing RFID chips, ensuring that the electronic exhibit displays are keyed individually to each visitor's comfort level with mathematics. Another station allows patrons to create for themselves one-of-a-kind iterations of the MoMath logo.

And that's just the entryway, setting the tone for a strange place full of mathematical wonders. At the far end of the hall, a doorway beckons to the museum proper, a cavernous space on two levels filled with exhibits of all kinds, from *Polypaint*, a wall-sized computer screen where you can play with different kinds of symmetry, to *Hoop Curves*, a carnival basketball game where you can optimize your own aim or that of a robotic ball-thrower.

Visitors who arrive believing that number crunching is the essence of math will encounter a panoply of patterns, shapes, and surfaces—and will leave with a clearer sense of the rich diversity of mathematical ideas. Children who come in thinking that math means drudgery will engage in open-ended exploration of such concepts as tiling, symmetry, and

isomorphism.

A museum is both an assertion and a measure of cultural prominence. In the second half of the 20th century, science and technology museums sprang up all across America, but today there is no extant museum centered on math. By contrast, Korea, Spain, Italy, and Japan each has one—and Germany no fewer than four. MoMath will fill a crucial gap and will do so at the heart of America's museum capital, New York City.

AN IDEA IS BORN

MoMath is the brainchild of Glen Whitney, a former algorithm manager at a leading hedge fund, Renaissance Technologies. Whitney is a slight man, with boyish good looks, big ideas, and the winning grace of a natural storyteller. He never lets slip an opportunity to elucidate mathematical principles using common-sense examples and language. When the *New Yorker* wanted to do a profile back in 2009, at a moment when the museum hardly existed even on the drawing board, Whitney wasn't fazed: He took the reporter on a tour of Manhattan, "lingering over the math-y bits." And when the math department at UCLA invited him to give a speech at its graduation this past spring, Whitney spent his allotted time running a demonstration of how remote improbabilities become reliable likelihoods in any decent-sized crowd, due to the sheer mounting of opportunities for something unusual to occur.

Let's say you realized in the shower one morning that you needed to start a math museum. What would it take to carry out that vision? How many years of brainstorming, fundraising, and public awareness raising would it take? The answer would seem to be 4.356—four years, four months, and eight days from



Tim Nissen, Cindy Lawrence, and Glen Whitney.

the first, ad-hoc meeting of interested volunteers to the gala event when doors will open to the public for the first time.

THE MOMATH TEAM

But the crucial factor wasn't really time—or even money, though raising \$23 million was no cakewalk. The crucial factor turned out to be people. Whitney was fortunate in finding Cindy Lawrence, a CPA and the director of a program for gifted math students. An auburn-haired dynamo who was the museum's first major volunteer, Lawrence now runs the organization's day-to-day operations.

More broadly, Lawrence is an indefatigable champion of good ideas—the crucial individual who makes concrete plans in the wake of brainstorming sessions. For example, when David Eisenbud of the Simons Foundation casually remarked that math enthusiasts, unlike amateur astronomers, lacked a venue for gathering and discussing their mutual passion, Lawrence

spearheaded the effort to create *Math Encounters*, MoMath's highly successful presentation series. It took just a single meeting to flesh out the core idea: not math lectures, but hands-on presentations by top-flight mathematicians, giving pride of place to audience participation.

The real work was in bringing this idea to fruition. Lawrence made it her business to organize the MoMath team to confront all the challenges involved in setting up the program—securing a formal commitment from the financial backer, finding an appropriate venue, and lining up a series of speakers. The results were phenomenal, as witness the first presentation, delivered by Eric Demaine, MIT's resident guru of computational origami.

In its 17 sessions to date, *Math Encounters* presenters have uncovered unexpected math lurking in other everyday pursuits such as juggling, knots, and bubbles. The presentation series was, in sum, a clever way for MoMath to embark

on its educational and cultural mission at a time when its physical exhibit space was still in the planning stage.

No one has contributed more to the museum's look and feel than Tim Nissen, MoMath's resident designer. A modest man with a passion for his work, Nissen has a long and highly regarded career in the field of exhibit design. An architect by training,

he worked for seven years on the design staff at the American Museum of Natural History, where he was the lead designer on the renovation of the Hall of Ocean Life, as well as a long series of traveling exhibits including *Water*, *Darwin*, and *Petra*. After the American Museum of Natural History, Nissen worked at Ralph Appelbaum Associates, a leading force in exhibit design famous for the Holocaust Memorial Museum in Washington, D.C.

In early 2009, MoMath was looking to create a traveling exhibit that could serve as a proof of concept for a permanent museum dedicated to mathematics. The resulting *Math Midway* was first displayed at the 2009 World Science Festival to widespread acclaim, including press coverage in the *New York Times*.

Nissen so enjoyed working on the *Math Midway* that when, in 2010, the MoMath board began planning for a permanent exhibition space, Nissen left Appelbaum to work full time as the new museum's resident designer. He has played a key role not only in designing exhibits, but also in selecting the new museum's location, on two floors of a 1930s department store, and in structuring the space inside.

Nissen sees his mission at MoMath as creating exhibits that

don't simply present but manage to embody mathematical concepts. Unlike traditional museums, which house and display precious objects, MoMath has no physical collection at its core. It focuses instead on certain choice abstractions, given physical embodiment in wood, metal, glass, plastic, and string.

According to Nissen, a core conceit of the new exhibits is to treat those embodiments as precious, one-of-a-kind objects "collected" by the museum's curators. And in a sense they are indeed precious, for they make abstract truths knowable by rendering them in visual and tactile form.

As Nissen explains, quoting Shakespeare, "The poet's eye, . . . Doth glance from heaven to earth, . . . And as imagination bodies forth / The forms of things unknown, the poet's pen / Turns them to shapes, and gives to airy nothing / A local habitation and a name."

A MUSEUM OF MATHEMATICS

Most of the exhibits in MoMath's collection aim to interest visitors by means of paradox: presenting a puzzle or apparent contradiction to stimulate curiosity and the desire to learn more. For example, the museum's *Hyper Hyperboloid* confronts the visitor with a curved

surface formed from taut lines of string: How can straight lines create a curved surface? By seeing such a surface firsthand, visitors come to understand how a surface can be both straight and curved.

Similarly, MoMath's signature square-wheeled tricycles can be pedaled effortlessly—so long as they are pedaled along a specially designed ridged roadway.

As Whitney remarks, "For every wheel, there is a perfect road." No matter how unround the wheel, on the right road it will turn smoothly.

The visitor comes away realizing that round wheels and flat roads are but one of many solutions to the problem of rotational transport—even if they remain the simplest and most practical.

Such realizations are what the MoMath team likes to call "Aha! moments." The phrasing is reminiscent of Martin Gardner's collections of mathematical puzzles, *Aha! Insight* and *Aha! Gotcha*. And, indeed, MoMath's eclectic, puzzle-centered approach to math education shares a lot in common with Gardner's method—not only in his books, but in his beloved column "Mathematical Games," published in *Scientific American* for 25 years. Enthralling readers with paradox and puzzlement, Gardner taught a generation of readers to think of math not as an eight-year-long forced march through hostile territory but as a garden of delights to play in.

In October 2009, as plans for a permanent museum were taking shape, Whitney and Lawrence were part of a small group who flew out to meet with Gardner at his home in Norman, Oklahoma. Though



close to his 95th birthday (he died seven months later), Gardner was sharp as a whip and excited about the prospect of a math museum of national prominence. Gardner recommended two favorite puzzles for the museum's use: "Get off the Earth," which MoMath developed into *Monkey Around*, and a curious grid of numbers where, if you pick one from each row and one from each column, the sum of the selected numbers always ends up equal to 111. MoMath calls that one *Sixth Sense*.

But Gardner's influence can be felt at a deeper level, in MoMath's emphasis on open-ended exploration. Where museums often settle for vivid demonstrations of scientific or mathematical principles, the MoMath team has adopted a higher standard: Their exhibits not only must embody a mathematical phenomenon, but also must allow visitors to interact with that principle, resulting in a visceral, hands-on sense of how it plays out. For example, MoMath's *Twisted Thruway* exhibit allows visitors to drive remote-controlled vehicles along a Möbius strip.

In one sense, the exhibit hearkens back to the endless monorail that ran down the center of a Möbius strip in *Mathematica*, an installation designed in 1961 by Charles and Ray Eames for the California

Museum of Mathematics

www.momath.org

The museum's opening ceremony is December 12. Other opening week festivities include a sneak preview for members only on December 14 (become a member at momath.org/join), opening day for the public on December 15, the first annual MoMath Puzzle Hunt on December 16, and a teacher preview night on December 17. MoMath is offering early reservations for group visit slots beginning on December 17, 2012.



Museum of Science and Industry—and still viewable today at the Museum of Science in Boston and the New York Hall of Science in Queens, New York.

But a monorail necessarily treats museum patrons as passive observers, since the train executes the same maneuver each time the button is pressed. By contrast, *Twisted Thruway* will feature a steerable car—and will set that car's endless single-surface track side-by-side with a second track in the shape of a trefoil knot.

Such playful exhibits will doubtless be mistaken by some visitors as an effort to apply an attractive candy coating over the bitter pill

of mathematics. And, indeed, some patrons of MoMath's traveling show worried that there wasn't enough of the medicine, expressing reservations along the lines of "*The Math Midway* was really fun, but where was the math?"

But what if math isn't a bitter pill? The radical proposal of MoMath is that mathematics isn't a set of rote practices for solving problems; those are merely what remain when discoveries harden into techniques. To the contrary, the essence of math is play: a form of reasoned discovery motivated by curiosity and insight. Starting on 12/12/12, when passersby peer in the plate glass window of the new museum's entryway, the undulating wall will beckon them in, mutely gesturing "Here is a place where math's wonders are made palpable: Come and play!" ■

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