Composite: MoMath's Intersection of Math and Art

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Abstract

That there are meaningful connections between art and mathematics is intuitively clear to mathematicians and mathematically-inspired visual artists, but the connection is often less clear to others, especially to those whose negative associations with mathematics during school-age years trigger emotions counter to feelings inspired by beautiful artworks. At the National Museum of Mathematics, the *Composite* gallery has been a laboratory of temporary art exhibitions. The introduction of tactile interactivity as a bridge between art and geometric forms in *Solid Math*, and the presentation of origami art through its often-overlooked mathematical makeup in *Math Unfolded*, highlighted these interconnections for visitors of all ages.

New in *Composite*

Since 2014, *Composite*, the gallery at the National Museum of Mathematics (MoMath) [2], has housed a series of temporary exhibitions of the work of mathematically-inclined artists including Antal Kelle ArtFormer, Miguel Berrocal, Matthew Brand, and Trevor and Ryan Oakes. In 2019, two exhibitions explored the connections between mathematics and art through multi-artist curated shows and physical interactives. Characteristic of the Museum proper, the collection of works and interactives encourages visitors to engage deeply with the content, integrating an array of models and artworks..

Solid Math, which ran from April through July of 2019, explored the geometry of regular polyhedra and showcased art based on these forms. Platonic, Archimedean, and Catalan polyhedra provided the formal constraints as well as the rhythmic underpinnings for the artists' pieces presented in the show. An array of interesting shapes that could be placed in open kaleidoscopic mirror stands allowed visitors to instantly create three-dimensional images of regular polyhedra. The exhibit also encouraged open exploration using Zometool, a sophisticated geometric construction toy that can be assembled into all the polyhedra represented in the exhibit.

Math Unfolded: An Exploration of Mathematical Origami Art, which ran from August 2019 through January 2020, demonstrated how origami artists can persuade paper to embody the beauty of mathematics. *Math Unfolded* featured the creations of more than 20 artists who use mathematical inventions and interpretations to create compelling works of art. The show opened in conjunction with the fourth biennial MOVES Conference (MoMath's conference on the Mathematics of Various Entertaining Subjects), which featured keynotes by master origami artists Robert Lang and Erik Demaine, both of whom lent several pieces that were featured in the show. In the months that followed, the exhibition (co-curated by MoMath with Charlene Morrow and Wendy Zeichner of OrigamiUSA) was accompanied by a *Meet the Artist* series for the public. In this series, prominent origami artists featured in the gallery led hands-on demonstrations of the mathematics and artistry behind the folding techniques in their work.

Solid Math: Exploring Regular Polyhedra

The central feature of the *Solid Math* gallery exhibit was a wall of models of the Platonic, Archimedean, and Catalan solids organized into three strata representing the tetrahedral, octahedral, and icosahedral symmetries (Figure 1). Next to each model was a label identifying the basic distinguishing features of the adjacent solid. The wall offered the visitor opportunities to discover the relationships between these families of objects and the intricate and precise nature of each mathematical form.
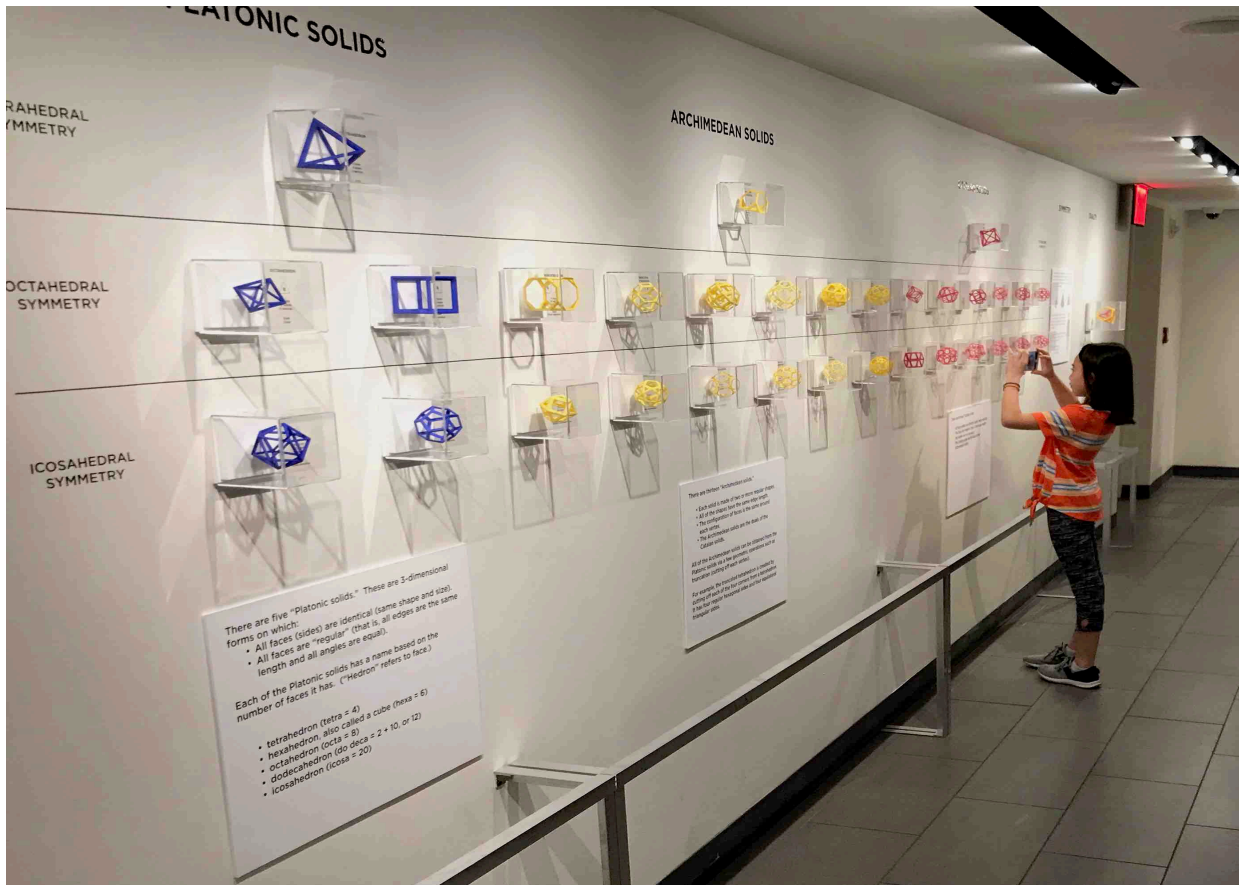
Figure 1: *The wall of solids.*

Works by artists including Bathsheba Grossman, Rinus Roelofs, Hans Schepker, Henry Segerman, Carlo H. Séquin, and Phil Webster were also featured throughout the gallery (Figure 2).
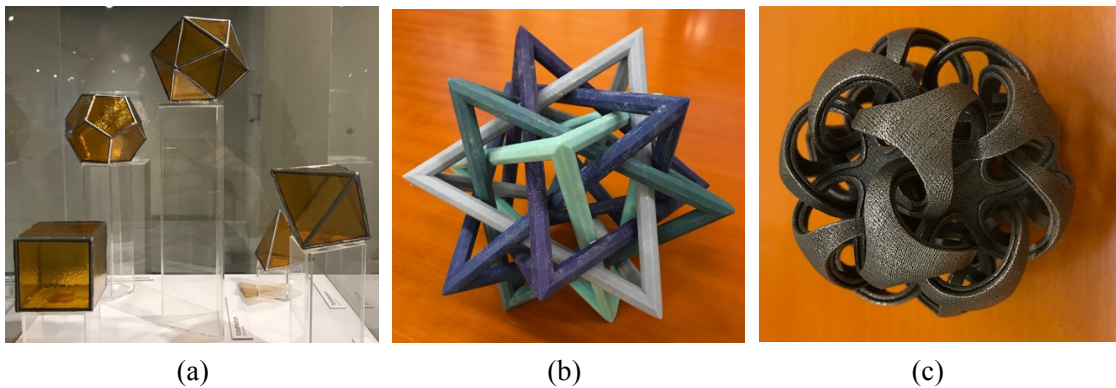

(a)   (b)   (c)

Figure 2: *Polyhedra in sculpture: (a) the five Platonic solids, rendered in glass by Hans Schepker, (b) compound of five tetrahedral frames with dodecahedral symmetry, by Carlo H. Séquin, (c) design in steel by Bathsheba Grossman, featuring icosidodecahedral symmetry with a twist.*

The open exploration area allowed visitors to engage in hands-on constructions inspired by the artworks and models (Figure 3), and the results were often illuminating.
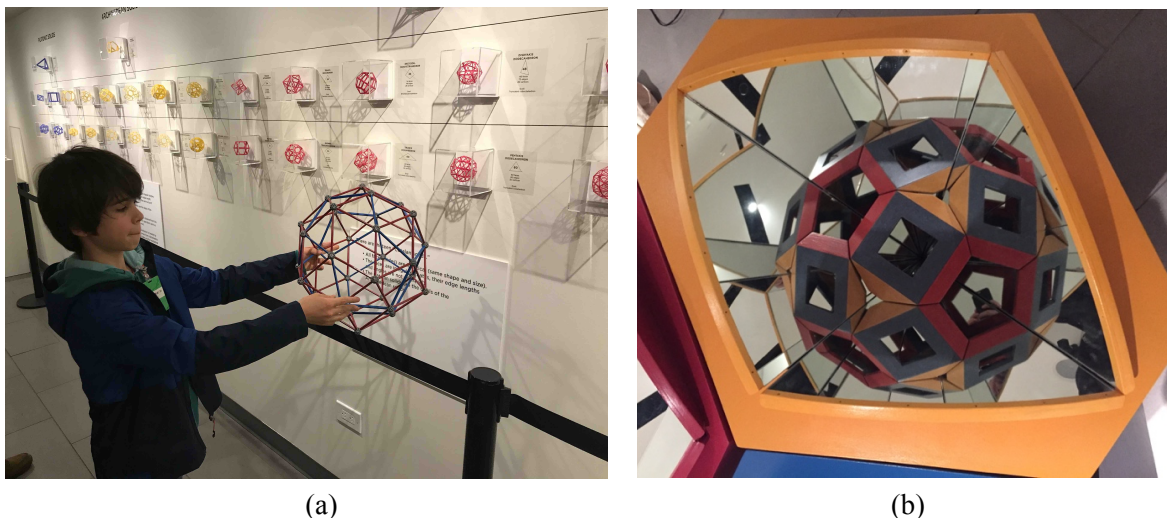

(a)   (b)

Figure 3: *Interactive components of* Solid Math*: (a) A young mathematician from France built a pentakis dodecahedron without prompting, while (b) the kaleidoscopic mirror stand allowed visitors to create virtual polyhedra, including this rhombicosidodecahedron, using mirror reflections (b).*

*Math Unfolded***: Delving into the Mathematics of Origami Art**

Robert Lang and Erik Demaine, keynote speakers at MoMath's 2019 MOVES Conference, are professional scientists who view origami folding methods as a medium for tackling difficult questions in science as well as for creating beautiful physical works of art. Their work was featured in the company of more than 20 other origami artists from around the world (Figure 4a). Signage described the function of grids in creating tessellations and how the study of connections and symmetry allows creators to reverse-engineer objects. Erik and Martin Demaine's circular crease sculptures (Figure 4b) provide vivid illustration of the way in which folding along curves creates a natural equilibrium form, even as these equilibria are not yet entirely understood mathematically.

(a)   (b)

Figure 4: Math Unfolded*: (a)* Composite *gallery and (b) sculpture by Erik and Martin Demaine.*

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In conjunction with *Math Unfolded*, the Museum was able to offer visitors nine unique, interactive *Meet the Artist* programs. Artists discussed their methods (Benjamin Parker on exploring dimensions with pleat patterns), their materials (Jeannine Mosely on building Menger sponges with business cards), and the connections between their artistic objects and scientific research (Matt Shlian on how his folding techniques help top scientists visualize cellular division and solar cell development). Engineer-turned-artist Uyen Nguyen's study of origami mechanics inspired a collaboration that culminated on the runway of Vancouver Fashion Week with origami-inspired skirts and a purse (Figure 5). Her workshop allowed participants to fold the multistable columns that underlie her amazing origami purse.

(a)   (b)

Figure 5: *Uyen Nguyen's origami (a) skirts and (b) purse (photo by Christopher Bierlein).*

Conclusion

Museum visitors responded enthusiastically to the interactive and mathematical elements of MoMath's 2019–2020 gallery season. *Math Unfolded*, the first-ever New York City art exhibit highlighting the mathematics of origami, attracted enough interest and attention to be featured in the Arts section of the Sunday *New York Times*, which called the exhibition "almost a cerebral vortex where art intersects with math" [1]. That there are meaningful connections between art and math is intuitively clear to mathematicians and mathematically-inspired visual artists, but the connection is often less clear to the general public, especially to those whose negative associations with mathematics during school-age years trigger emotions counter to feelings inspired by beautiful art objects. *Composite*, the gallery at MoMath, has succeeded in breaking ground as an attractive space in which to engage the general public, illuminate the mathematics of visual artworks, and bring to light the beautiful connections between the two seemingly disparate disciplines of mathematics and art.

References

1. Janet Morrissey. "Art by the Numbers: At the National Museum of Mathematics, origami helps bridge the gap between art and math and finds the beauty in both." *The New York Times*, Oct. 23, 2019.

2. National Museum of Mathematics, *Composite*, the gallery at MoMath, https://momath.org/upcoming-events/composite-gallery/.