SEEING THE UNSEEN
MATH AND ART

Chaffey College

WIGNALL MUSEUM *of*
CONTEMPORARY ART

This was printed on the occasion
of the exhibition

Seeing the Unseen: Math and Art
January 8 – March 9, 2024

Wignall Museum of Contemporary Art

5885 Haven Avenue,
Rancho Cucamonga, CA 91737

www.chaffey.edu/wignall

Cover:
Kevin Box and Robert J. Lang, *One in a Billion (White)*, 2018.
Painted cast bronze (ED/50, AP/6). 12.5 x 9 x 4 inches. Courtesy of the artists.

INTRODUCTION

Seeing the Unseen: Math and Art is a group exhibition featuring works of art that investigate the intersections of mathematics and the arts. The featured artists approach their work from unique perspectives, some trained as mathematicians that create visual and dimensional expressions of their studies, some as studio artists that use mathematics as a conceptual foundation and guiding system in their creative practices. These artists make explicit reference to mathematics in their practices and produce forms and images of mathematical principles as works of creative art.

Seeing the Unseen: Math and Art is the second of two exhibitions presented during the 23-24 academic year at Chaffey College that explores the intersections of the arts and STEM. Both exhibitions are presented in collaboration with the STEM Academic and Career Community. *Seeing the Unseen: Math and Art* is curated by Professor Morgan Rea, Professor Hannah Seidler-Wright, and Wignall Museum Assistant Curator Roman Stollenwerk.

PROGRAMMING

Free and open to the public

Am I Really Just a Coffee Cup? A Donut's Existential Crisis

MONDAY, JANUARY 29
12:30–2 PM
Wignall Museum Patio
(CAA-210 in case of wind or rain)

Join co-curators and Professors of Math, Morgan Rea and Hannah Seidler-Wright, and Professor of Ceramics, Stanton Hunter to play with clay and paper while learning about mathematical concepts. No math or clay experience required! Please note, clay is a messy media. You might get clay on your clothes; disposable aprons are provided for attendees. Enjoy coffee and donuts, all supplies are provided.

PrintZine Workshop

WEDNESDAY, JANUARY 31
12:30–2:30 PM
CAA-210

Join local artists Cesar Omar Garcia and Adam Aguilar from the San Bernardino-based artist collective Grafica Nocturna to learn some simple printmaking techniques that you can use in zine-making or your art/craft practice at home. No experience is necessary, all supplies are provided.

Zines & Comics as an Act of Resistance: A Panel Discussion

WEDNESDAY, FEBRUARY 7
12:30–2 PM
WH-142

Join Professors of English, Adam Martinez and Neil Watkins as they moderate a panel discussion with zine/comics creators and artists Tamara Cedré, Michael Segura, and Daniel Whitfield. This event will instruct attendees on how writing, art, and self-publishing are acts of creative expression as well as acts of resistance in an age of censorship and political turmoil, and ultimately how these art forms can act as catalysts for change. Students, faculty, and staff will learn how to create their zines and comics. They will also learn about the interconnections between writing, literature, illustration, graphic design, and social justice.

The Infinite Expanse: Marveling at the Sizes and Scales of the Universe

MONDAY, FEBRUARY 12
1 PM & 2 PM
Planetarium

Join Professor of Astronomy, Bradley Hughes and Professor of Math, Morgan Rea to take a mind-blowing journey through our Universe's grandest structures and sizes. Buckle up for a ride to witness the vastness of the solar system, the enormity of our galaxy, and the mind-boggling size of the Universe itself!

Would a Piano by Any Other Math Still Sound as Sweet

TUESDAY, FEBRUARY 13
4–5:30 PM
TAE-106

Join Professor of Commercial Music Garrett Kenehan for an interactive discussion on timbre. What makes a piano sound like it does? Why does a guitar sound different? We will discuss the nature of sound and the complexities of our instruments as they deliver their sonic palette of beauty. Limited to 20 participants.

Please visit our website www.chaffey.edu/wignall for more information about our programs. All programs are free and open to the public.

Mathemagami: Folding the Numbers

WEDNESDAY, FEBRUARY 14
12:30–2 PM
CAA-210

Join co-curators and Professors of Math, Morgan Rea and Hannah Seidler-Wright to learn about how NASA and JPL use origami to explore the universe and learn some easy origami folds in this workshop to create your very own Starshade or other paper creation. No experience is necessary, all supplies are provided.

Feminist Love Letters

WEDNESDAY, FEBRUARY 14, 3–5 PM
Wignall Museum

Join artist Cindy Rehm and the Chaffey College Evolve Club at this workshop. Feminist Love Letters is a project that invites participants to pen a letter to their favorite feminist. Collaborators are invited to profess their love, send words of support and encouragement, or unleash their feminist fury in a letter to a contemporary or historic feminist. Create a love letter to your favorite femme or feminist this Valentine's Day. All supplies are provided, including light refreshments.

Poemetrics: How Math and Poetry Intersect

TUESDAY, FEBRUARY 20, 4–5:30 PM
CAA-211

Join Poet and Professor of English Arthur Kayzakian, Poet and Statistician Beth Marquez, and Poet Cyrus Sepahbodi. They'll read and discuss their creative practice which blends mathematics and poetry.

Beauty: A Discussion

WEDNESDAY, FEBRUARY 21
12:30–2 PM
CAA-218

Join co-curator and Professor of Math, Hannah Seidler-Wright, who will moderate a discussion between Professor of Art, Brody Albert; Professor of Philosophy, Ryan Falcioni; and Professor of Biology, Sarah Chamberlain, as they discuss beauty from a cultural, philosophical, mathematical, and biological point of view.

Let's Make a Strandbeest!

THURSDAY, FEBRUARY 22
2–4 PM
Wignall Museum Patio
(CAA-210 in case of wind or rain)

Join STEM faculty and students from the Inventors Club to build a kinetic wind-powered sculpture. Designed by Theo Janson, Strandbeests are large sculptures that move and are made of Dutch electricity pipe. The kits feature small prototypes of the large sculptures, allowing the maker to create their own kinetic Strandbeest. Kits are provided for participants, no experience necessary, although the number of kits are limited. Please arrive on time.

Mathtivities Family Day

SATURDAY, FEBRUARY 24
10 AM–2 PM
Wignall Museum and CAA

Join us at this family-friendly event featuring math and art activities for all ages. Mathtivities will feature a screening of *Flatland* (2007, 34 min.), an animation based on Edwin Abott's book about geometric characters living in a two-dimensional world, with main character "Hex" voiced by Kristen Bell. Mathtivities will also include special guests and other activities. Be sure to visit the current Wignall Museum exhibition, *Seeing the Unseen: Math and Art*. Lunch will be provided for attendees while supplies last, provided by EOPS and Student Equity. Free and open to the public.

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PROGRAMMING

Hyperbolic Crochet

MONDAY, FEBRUARY 26
12:30–2 PM
CAA-210

Join Dr. Berit Givens, Professor, Department of Mathematics & Statistics at Cal Poly Pomona with co-curators and Professors of Math Morgan Rea and Hannah Seidler-Wright, Department of Math at Chaffey College to learn about the links between math and crochet. This is a hands-on workshop and all attendees will learn basic crochet skills. All supplies provided, limited to 20 participants.

Music + Art

TUESDAY, FEBRUARY 27
1–2:30 PM
Wignall Museum

Join Professor of Commercial Music, Garrett Kenehan and his commercial music students who will perform original or curated works of music, inspired by artworks from *Seeing the Unseen: Math and Art*, currently on view at the Wignall Museum. Standing room only, light refreshments after the performance.

Math in Nature

WEDNESDAY, FEBRUARY 28
12:30–1:30 PM
CAA-211

Join co-curator and Professor of Math, Morgan Rea. Rea will share the many ways that mathematics appears in unsuspecting ways in the beautiful world we live in.

The 5th Annual Hip Hop Studies Summit

FRIDAY, MARCH 1
7–8 PM
Wignall Museum Patio

Join the culminating program from the 5th Annual Hip Hop Studies Summit schedule of events. The final show features performances from live beatmakers, UMOJA Region 5 Performers, and others TBD. Learn more about this and other HHSS programs at @chaffeyhiphop.

Game-a-Palooza

Rancho, Wignall Museum:
MONDAY, MARCH 4, 12:30–2 PM
Chino, Quad:
WEDNESDAY, MARCH 6, 12:30–2 PM
Fontana, FNAC Student Lounge:
THURSDAY, MARCH 7, 10 AM–1 PM

Join us to learn a bit about Pi Day (March 14), eat pie, and play classic math games like Tangrams, Dominos, and many others with classmates, faculty, and staff. All games are provided for participants to play on-site. Light refreshments provided for attendees.

Zomics: A Festival of Zines and Comics

WEDNESDAY, MARCH 6
12–2 PM
Wignall Museum Patio

Join local artists and distributors at Zomics: A Festival of Zines and Comics! Meet and greet more than 20 artists from the region. Enjoy light refreshments, music from DJ Abstractmachine, and live screenprinting with Duan Kellum (while supplies last). The festival is free and open to the public, although artists may sell their items. This event was made possible in part due to the generous support of the Rancho Cucamonga Community & Arts Foundation.

3-dimensional.space
Rémi Coulon
Sabetta Matsumoto
Henry Segerman
Steve Trettel

Rafael Araujo

David Bachman

Kevin Box

Katy Ann Gilmore

Susan Goldstine

Bathsheba Grossman

Richard Hammack

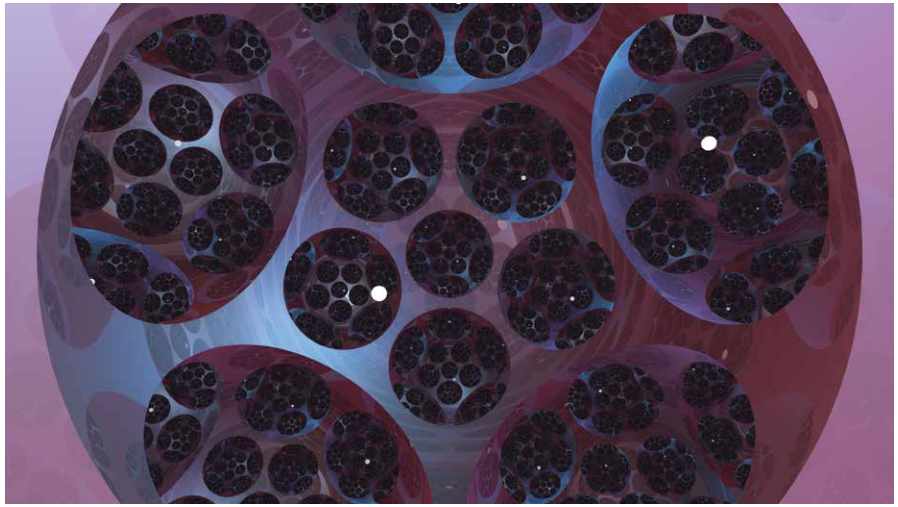
David Harris

Robert J. Lang

Nervous System

Christine Wertheim and Margaret Wertheim

3-DIMENSIONAL.SPACE



Rémi Coulon, Sabetta Matsumoto, Henry Segerman, and Steve Trettel, "Thurston's Geometries," 2023. Digital video (1080p), TRT: 12:02. Courtesy of the artists.

3-dimensional.space is joint work by Rémi Coulon, Sabetta Matsumoto, Henry Segerman, and Steve Trettel to render accurate images of the eight Thurston geometries and their quotients. We make this software accessible to explore and encourage you to visit our website that hosts various demonstrations we have created along the way, as well as tutorials and documentation for the code.

https://3-dimensional.space
https://github.com/henryseg/non-euclidean_VR

RÉMI COULON is a Senior Researcher in mathematics at the CNRS (Le Centre national de la recherche scientifique / The French National Centre for Scientific Research). His research interests include geometry, topology, dynamics, as well as mathematical illustrations.

http://rcoulon.perso.math.cnrs.fr
twitter.com/lamiremimath

SABETTA MATSUMOTO is an Associate Professor in the School of Physics at the Georgia Institute of Technology, Atlanta, GA. She is passionate about using textiles, 3D printing, and virtual reality to teach geometry and topology to the public.

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instagram.com/sabetta_m
youtube.com/@SabettaTalksMath
twitter.com/sabetta_

HENRY SEGERMAN is an Associate Professor in the Department of Mathematics at Oklahoma State University, Stillwater, OK. His interests include geometry and topology, 3D printing, virtual reality, and spherical video.

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https://mathstodon.xyz/@henryseg

STEVE TRETTEL is an Assistant Professor in the Department of Mathematics and Statistics at the University of San Francisco, San Francisco, CA. His interests include geometry, topology, and computer graphics for mathematical illustration.

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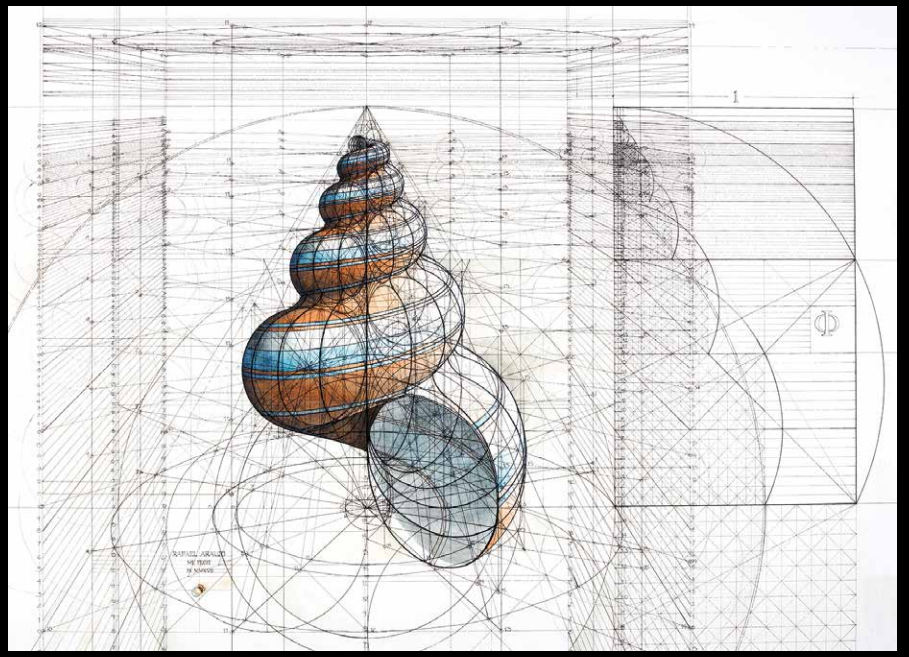
RAFAEL ARAUJO

As an autodidact, my work is the outcome of years of persistence, trial and error upon the theme of tridimensional geometry and the "platonic" search of the illusion of the "Truth," by means of the development of structures which could perfectly be described as illustrated equations of natural subjects: shells, butterflies' spirals, etc. I do all by hand, on my drawing board with classical architectural drawing tools (a compass, protractor, squares and rules) and I do not use any kind of computer software whatsoever.

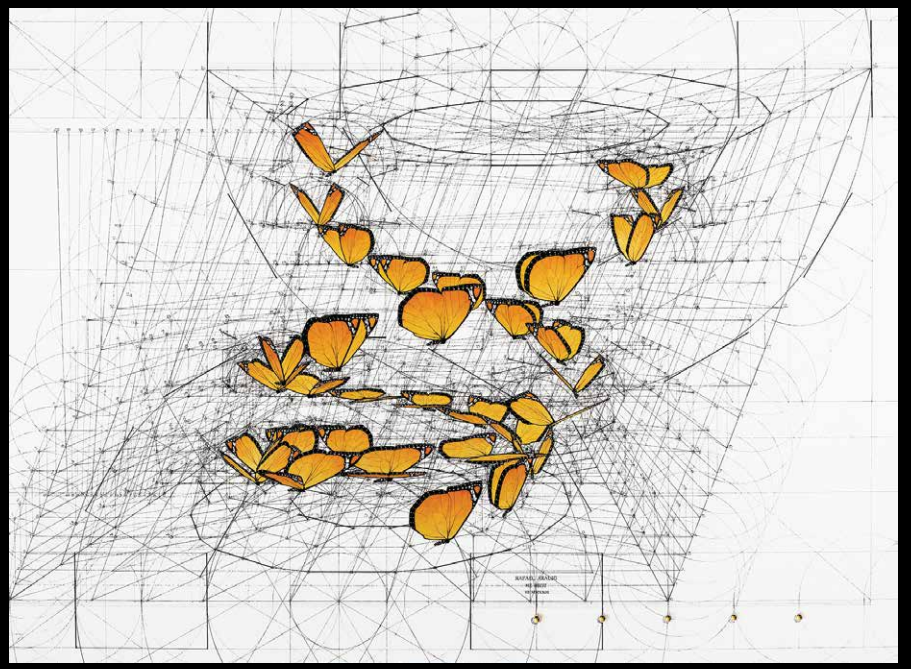
My approach to the Golden Ratio and its use within my work has a geometrical character rather than a mathematical one. The Golden Mean as well as the Fibonacci Spiral (directly related as quoted above) could be calculated with utter precision by using the classical tools of technical drawing. So, there I place the challenge for those who dare to try their geometrical skills into this area.

For instance, when a shell is calculated by the use of a Golden Ratio's series, you achieve, amongst other things, a certain kind of proportion which you can describe as "harmonic" at first sight. It doesn't mean, however, that all shells have the Golden Ratio in their origin, or that any shell calculated with other proportions is, so to speak, unworthy. It's more a matter of the appropriated use of a means for an end. For any given circumstance, there will always be the proper set of proportions which would suit it in the best way possible, Golden or, for instance, logarithmic. I'd love to say that the Golden Ratio is the magic number which produces the perfect results. In my own experience, it's another tool in the search of that perfection.

www.rafael-araujo.com
instagram.com/rafaelaraujo1618
instagram.com/rafaelaraujo2222



Rafael Araujo, *Golden Shell*, 2017. Archival pigment print. 54 x 75 centimeters. Courtesy of the artist.



Rafael Araujo, *Monarch 3*, 2023. Archival pigment print. 55 x 75 centimeters. Courtesy of the artist.

DAVID BACHMAN

I explore ways in which advanced mathematics can be used to produce art. The results are sometimes precise, pre-planned shapes, but often they are things that have evolved from the mathematics in ways I could not exactly predict, imitating nature. The discordance between the precision of mathematics and the unpredictable nature of what it can produce is what fascinates me most.

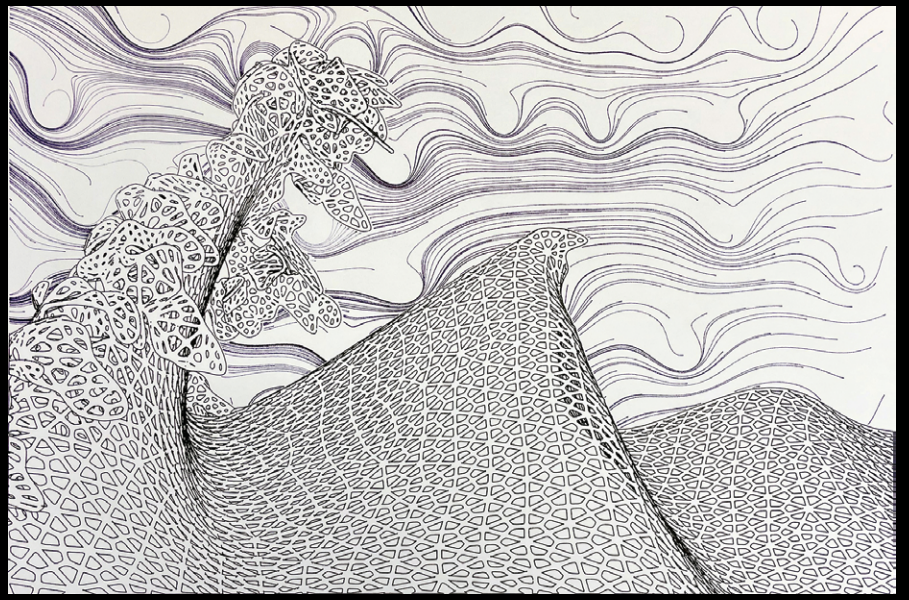
My design process typically begins with the creation of a mathematical model or algorithm to guide the construction of a physical object. This model is then put into a computer using various CAD software packages, where I blend scripted components with (virtually) hand-built elements. All or part of this design is then sent to a digital fabrication machine such as a 3D printer, CNC router, laser cutter, or pen plotter. Finally, the fabricated piece is often finished by more traditional hand techniques.

David Bachman is a professor at Pitzer College, Claremont, CA, where he teaches courses on mathematics, computer science, and data science, and has co-taught classes with faculty in the art department. He has a PhD in mathematics from the University of Texas at Austin, and has published over 20 research articles, three books, and received two grants from the National Science Foundation.

Fourteen years ago David's background in mathematics and his affinity for working with his hands converged when he began to experiment with 3D printing. Since then he has created unique two and three-dimensional pieces by using several CAD modeling packages, a variety of laser cutters, 3D printers, and pen plotters, and a garage full of power tools. David is a certified level 2 specialist in Rhino (a popular CAD package) and has written a book on Grasshopper, its visual scripting language.

When he's not teaching, doing research, or producing mathematical art, David remodels houses with his wife. In the past he studied martial arts (earning black belts in Karate and Kobudo), played the drums in several rock bands, and in his younger days was a "roadie," setting up for such acts as The Rolling Stones, U2, The Grateful Dead, Metallica, and Aerosmith.

http://davidbachman.org
instagram.com/davbachman
facebook.com/david.bachman.12327
twitter.com/bachmandesign



David Bachman, *Water*, 2023. Pen plotter print (ink on paper). 22 x 30 inches. Courtesy of the artist.

David Bachman, *Fire*, 2023. Pen plotter print (ink on paper). 22 x 30 inches. Courtesy of the artist.

KEVIN BOX

To inspire or be inspired,
not necessarily in that order…

Kevin Box graduated from the School of Visual Arts, New York, NY, and now resides in Santa Fe, New Mexico. His background as an art foundry production manager enabled him to pioneer a unique process that transforms the delicate nature of paper into museum quality metals. In 2004 he was elected as the youngest member of the National Sculptors Guild and was recognized by Southwest Art Magazine as one of the top 21 artists under 31 in the southwest. Box now collaborates with some of the world's most renowned origami artists, foundries, fabricators, and engineers to create work that is displayed in collections across the country. Kevin and his wife Jennifer Box, created a traveling exhibition called Origami in the Garden that opened at the Santa Fe Botanical Garden in 2014 and has since inspired audiences in over 20 Botanical Gardens throughout North America.

https://kevinboxstudio.com
instagram.com/origamiinthegarden
facebook.com/origamiinthegarden

Kevin Box and Robert J. Lang, *Unicorn Unfolded, One in a Billion, Opus 736*, 2018. Painted cast aluminum (Ed/24, AP/5). 33 x 33 x 2 inches. Courtesy of the artists.

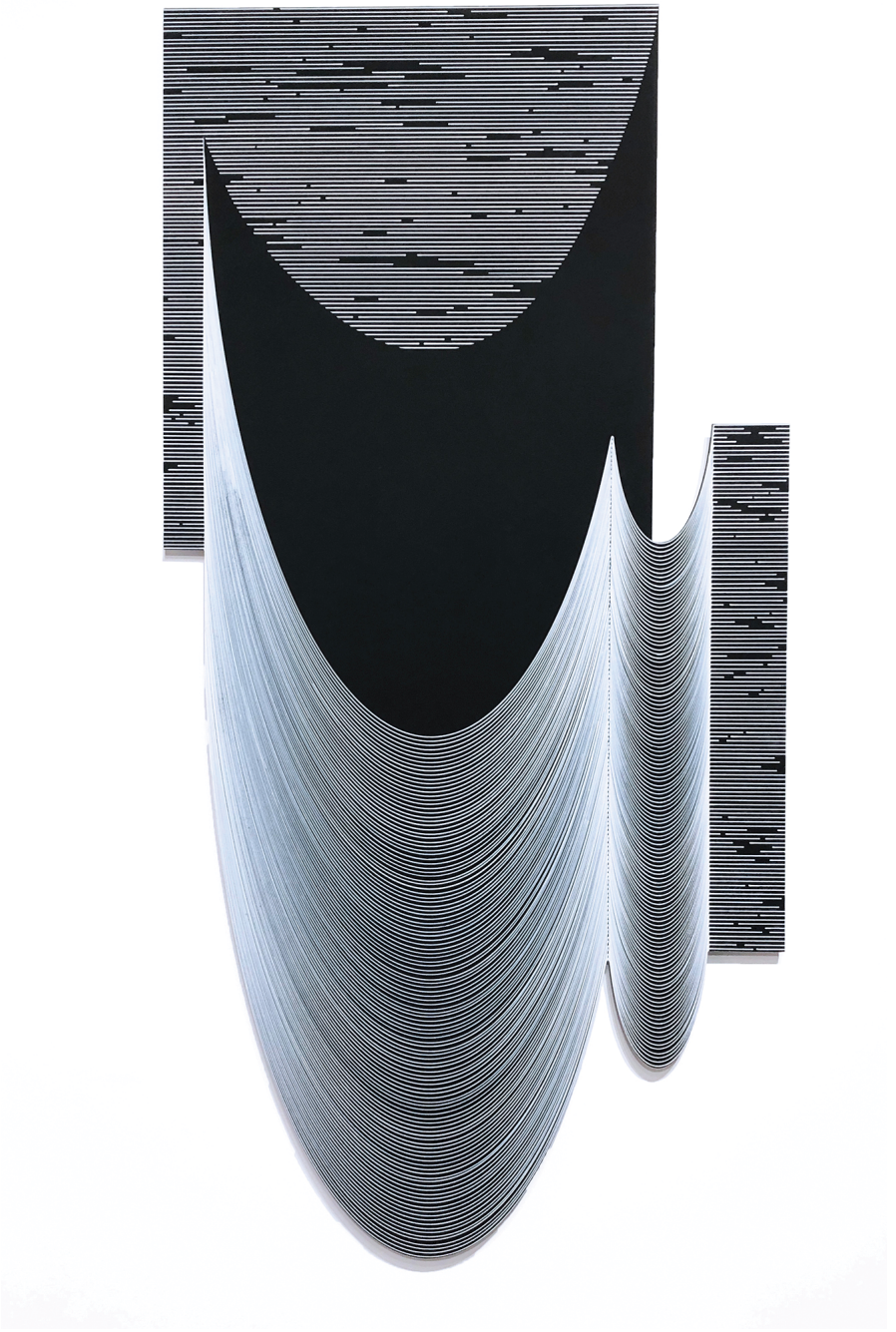
KATY ANN GILMORE

I have always been interested in both mathematics and art. Not willing to abandon one interest for another, I'm happy to have found a way to explore my curiosities about the ways we perceive depth and understand the spaces around us. Playing with scale, I have created work from just a few inches wide to one hundred feet long. This fluctuation in scale serves to work through ideas and convey sensations of depth in both small and large formats.

Katy Ann Gilmore is a Los Angeles-based artist who has exhibited both nationally and internationally in galleries such as DENK Gallery, Los Angeles, CA; Galerie Wenger, Zurich, Switzerland; and Macadam Gallery, Brussels, Belgium. She has also completed store window commissions for Hermes in Kuwait City, Kuwait. Gilmore has murals in corporate collections such as Google, Mountainview, CA; Vans, Costa Mesa, CA; Facebook, Menlo Park, CA; Uber, San Francisco, CA; TrueCar, Santa Monica, CA; and Northeastern University, Boston, MA.

Gilmore has been included in publications such as *The New York Times*, *Design Milk*, *High Fructose*, *The Creators Project*, and others. Her work has been shown at Art Market San Francisco, San Francisco, CA; Seattle Art Fair, Seattle, WA; Art Palm Springs, Palm Springs, CA; VOLTA, Basel, Switzerland; and VOLTA, New York, NY.

www.katyanngilmore.com
instagram.com/katyanngilmore



Katy Ann Gilmore, *Catenary Drip 7*, 2019. Acrylic on dibond. 73.75 x 37 inches. Courtesy of the artist.

SUSAN GOLDSTINE

There are two things I have done for as long as I can remember: explore mathematics, and create things with my hands. In my professional academic life, these impulses have merged into my specialization in mathematics and the arts. I am particularly devoted to exploring handcrafts, especially those in the fiber arts traditionally viewed as feminine. The interplay between mathematics and fiber arts is endlessly fascinating, both in the ways that mathematics allows for a deeper understanding of knitting, crochet, weaving, and so forth, and in the ways that these crafts can illuminate complex concepts in mathematics.

Fundamental Frieze Scroll II, *Makeri Mosaic*, and *Float Free*, *Bumblebee* come from a series of works that catalog symmetry types. You can view *Fundamental Frieze Scroll II* as a legend for all three works: the colored beads mark the different types of symmetries present in the various strip patterns. White beads mark reflection axes, yellow beads mark glide reflection axes, blue beads mark centers of 180° rotations, and red beads are reference points for the translations along the centerline of each design. *Fundamental Frieze Scroll II* and *Makeri Mosaic* both depict the seven types of frieze symmetries. As part of our research, fellow mathematician and fiber artist Carolyn Yackel and I classified the two-color symmetries that are possible in mosaic knitting, a popular style of color work developed by Barbara Walker in the 1970s. There are seventeen two-color frieze symmetry types, and *Float Free*, *Bumblebee* depicts the fourteen of them that are compatible with mosaic color work.

Hyperbolic Constellation and *Redistribution* both incorporate negatively curved surfaces, but generate them in different ways. In the beaded piece, which is crocheted in one continuous spiral, there is an extra stitch added on every sixth bead, following mathematician and artist Daina Taimina's pattern for crocheting hyperbolic planes. The gold beads mark the positions of these increases, demonstrating that the pattern they form is far less regular than the process that generates them. The geometry of *Redistribution* comes from the branched structure of the two-color brioche knitting. Generated by a simple recursive rule that constructs the Virahanka numbers (a.k.a the Fibonacci sequence), the branched tree in the top section is a mirror reflection of the branched tree in the bottom section. Below, the levels of branching are evenly spaced, producing negative curvature as the number of branches explodes. Above, they are staggered to produce a flat fabric. The total area of the knitting inside the I-cord border is the same in each half.

http://faculty.smcm.edu/sgoldstine/gallery/mathart.html
instagram.com/sgoldstine106

Susan Goldstine, detail of *Makeri Mosaic*, 2019. Merino/cotton yarn, wooden dowels. 10.75 x 8.75 inches. Courtesy of the artist. Photograph by Boyden Gallery, St. Mary's City, MD.

BATHSHEBA GROSSMAN

I like to think about shapes. Sometimes I think of a new one, it's something I do without wanting very much to explain it. The shapes I want aren't moldable, which means most art-making and manufacturing methods don't work well, and that is why I got into 3D printing and other CAD/CAM methods.

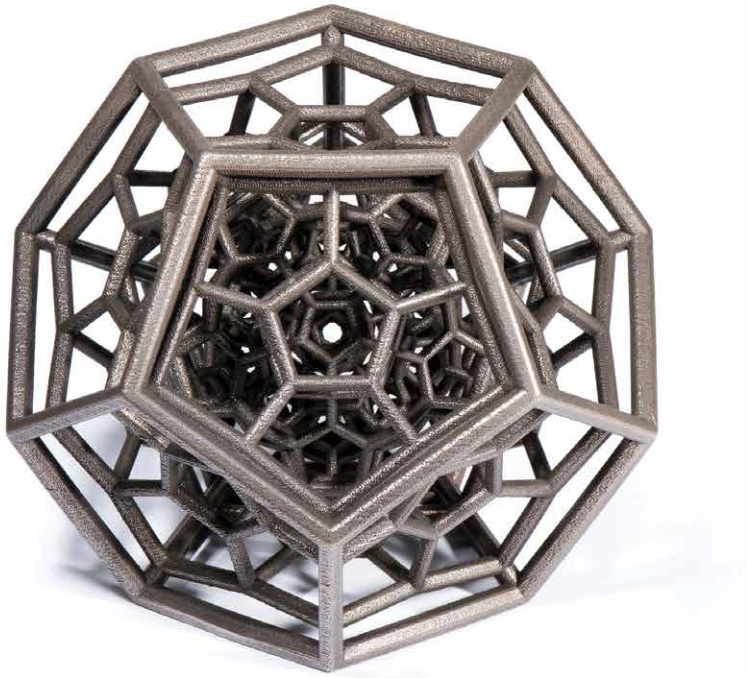
My main sculpture medium is binder jetted steel. I love the immediacy as this process goes directly from CAD model to solid metal, the freedom of geometry, and the material aesthetic as it supports traditional finishing—I still chase many pieces with hand tools. I also work with a great variety of scientific subjects using subsurface laser damage in glass, which (within the confines of its glass blocks) is as free as a physical 3D medium can be.

I'm a simple business: I sell steel and glass on my own site, priced as the costs of the technology permit, without representation. I don't limit editions as I feel that is a natural and generous direction for digital art. Profits vary, and in parallel I continue to do scientific data physicalization in glass, as financial backup and as a window on that fascinating world.

In the 20th century I studied first with Erwin Hauer whose modular constructivist pieces opened my math-major eyes to sculpture, and later with Robert Engman, whose work with knots and minimal surfaces showed more paths. Then at the turn of the millennium a window opened as 3D printing began to hit the street: the technology suited what I was doing, and the engineer appeal of that work opened doors. Thus, I became an early adopter and evangelist of the technology, demonstrating that geometry and art were natural subjects, close neighbors, and interesting to a broader public than either mathematical or manufacturing specialists.

Since then I've strayed into more biomorphic modeled work, and later generative sculpture, studying algorithmic methods with physics simulation and machine learning. More recently I've taken a turn into glass casting, enjoying being a studio artist again after a few decades with the machines. There is of course plenty of geometry to think about, now with 3D printing as a settled part of the toolbox, and I'm still looking for the next thing.

https://bathsheba.com



Bathsheba Grossman, *120-Cell*, 2016. Binder jetted steel. 4 x 4 x 4 inches. Courtesy of the artist.

RICHARD HAMMACK

My recent work is a mixture of printmaking, publishing and pedagogy. I make small-scale paper constructions that can be quickly printed on an office copier, then scored, cut, folded, glued and assembled in large quantities. In these small visual mathematical essays, I strive to hit a sweet spot between humor and pedagogy. I always want the viewer to laugh or smile, or wonder. Each piece should present a new idea or an unexpected twist on an old one.

The series on exhibit here is a collection of mailing envelopes with nonstandard topologies. They are simultaneously everyday objects, exotic mathematical surfaces, and messages.

Richard Hammack is a professor of mathematics at Virginia Commonwealth University, Richmond, VA. He sees making mathematics and making art as almost the same thing, and often builds models as an aid in exploring (or explaining) mathematical structures.

www.people.vcu.edu/~rhammack

Richard Hammack, *Topological Envelopes*, 2023. PDF-LaTeX, laser-printed paper, cardstock, and glue. Approximately 4 x 9.5 inches each. Courtesy of the artist.

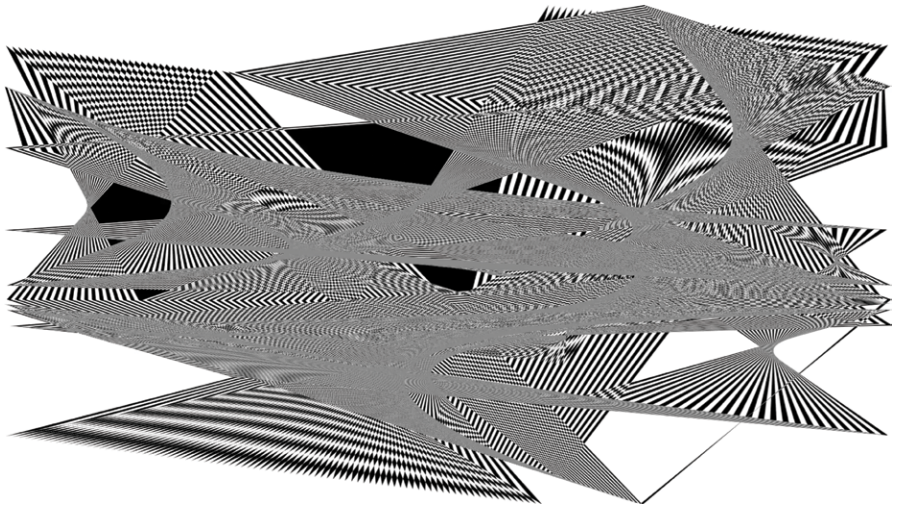
DAVID HARRIS

Three-body Problem originates from a classic mathematics problem in celestial dynamics. It looks to understand how three bodies, such as galaxies, stars, planets, or moons orbit around each other, a typically extremely complex and chaotic pattern, except for a few cases where the orbits are stable and regular. The mathematical problem is not analytically solvable in the most general case and requires detailed numerical computer simulations to calculate the orbits. Although it was first explored by Newton in his 1687 treatise *Philosophiæ Naturalis Principia Mathematica*, in the case of the Sun, Earth, and Moon, research into the problem is ongoing to this day.

The name also evokes the "two-body problem," a social condition particularly prevalent in academia and worsening in modern life, in which partners struggle to find employment in the same city or town. The partners are sometimes forced to live in each other's orbit, moving closer or further from each other, inexorably pushed around by societal forces largely beyond their control. However, those patterns can become stable and predictable, for a time at least. As partners bring other people into their orbits, a third body, whether a member of an enlarging family or another key person, the once stable patterns are disrupted, potentially never to be stable again, just as for the bodies in the mathematical problem.

In this work, a set of three celestial bodies with randomly chosen masses, positions, and velocities are set in orbit around each other in a computer simulation. However, rather than showing the typical orbit paths, the bodies are connected as a triangle, ever-changing in shape and size. In the original exploration of the problem, the striated patterns emerged unexpectedly. At the most fundamental level, these patterns arise because computer screens are made of pixels, with finite resolution. This glitch outcome reveals the underlying approximateness of simulations and the representations of them. The visual effect, reminiscent of works in the Op Art movement, can be entrancing while disorienting as the bodies seem to fall into patterns only to suddenly be disrupted again.

The work shown is a compilation of video capture of ten random simulations with different starting conditions. Each has its own character and feel, perhaps only truly apparent after viewing a variety and acclimating to the visual language emerging from the underlying process.



David Harris, *Three Body Problem*, 2019. Digital motion simulation written in Processing (1080p digital video), TRT: 05:10. Courtesy of the artist.

As the three bodies orbit each other, they find close encounters, influence at a distance, and leave a remnant of their paths indelibly on the canvas of the space they move within.

David Harris is a new media artist, interactive designer, lecturer, and researcher. He teaches at the Queensland College of Art and Design, Griffith University, Brisbane, Australia. He is founder of Entanglement Lab, an independent transdisciplinary artscience studio.

https://sciartica.net

ROBERT J. LANG

Robert J. Lang has been an avid student of origami for over fifty years and is now recognized as one of the world's leading masters of the art, with over 800 designs catalogued and diagrammed. He is noted for designs of great detail and realism, and includes in his repertoire some of the most complex origami designs ever created. His work combines aspects of the Western school of mathematical origami design with the Eastern emphasis upon line and form to yield models that are at once distinctive, elegant, and challenging to fold. His exhibitions include: Museum of Modern Art, New York, NY; Carrousel du Louvre, Paris, France; Salem; Peabody Essex Museum, Salem, MA; Mingei Museum of World Folk Art, San Diego, CA; and Nippon Museum of Origami, Kaga, Japan.

In 1992, Dr. Lang became the first Westerner ever invited to address the Nippon Origami Association's annual meeting; he has since been an invited guest at international origami conventions around the world. He lectures widely on origami and its connections to mathematics, science, and technology. He teaches workshops on both artistic techniques and applications of folding in industrial design.

Dr. Lang is one of the pioneers of the cross-disciplinary marriage of origami with mathematics; he has been one of the few Western columnists for *Origami Tanteidan Magazine*, the journal of the Japan Origami Academic Society, and has presented refereed and invited technical papers on origami-math at mathematical and computer science professional meetings. He has consulted on applications of origami to engineering problems ranging from air-bag design to expandable space telescopes. He is the author or co-author of twenty-one books and numerous articles on origami art and design and in 2011 was elected an Honorary Member of the British Origami Society.

Dr. Lang was born in Ohio and raised in Atlanta, Georgia. Along the way to his current career as a full-time origami artist and consultant he worked as a physicist, engineer, and R&D manager, during which time he authored or co-authored over 80 technical publications and 50 patents awarded on semiconductor lasers, optics, and integrated optoelectronics. He is a Fellow of the Optical Society of America, a member and past Vice-President of the IEEE Photonics Society, and from 2007–2010 was the Editor-in-Chief of the *IEEE Journal of Quantum Electronics*. In 2009, he received Caltech's Distinguished Alumni Award and in 2013, he was chosen as one of the inaugural Fellows of the American Mathematical Society. Dr. Lang resides in Altadena, California with his wife, Diane, a children's book author, naturalist, and wildlife interpreter, and assorted dogs, tortoises, and diverse arthropods.

https://langorigami.com

Robert J. Lang, *Seedpot24*, 2012. One uncut 24-gon of elephant hide paper. 4 x 4 x 3 inches. Courtesy of the artist.

NERVOUS SYSTEM

We are a generative design studio that works at the intersection of science, art, and technology. We create using a novel process that employs computer simulation to generate designs and digital fabrication to realize products. Drawing inspiration from natural phenomena, we write computer programs based on processes and patterns found in nature and use those programs to create unique and affordable art, jewelry, and housewares.

Nervous System was founded in 2007 by Jessica Rosenkrantz and Jesse Louis-Rosenberg. They have pioneered the application of new technologies in design, including generative systems, 3D printing, and webGL. Nervous System releases online design applications that enable customers to co-create products in an effort to make design more accessible. These tools allow for endless design variation and customization.

Nervous System's designs have been featured in a wide range of publications, including *WIRED*, the *New York Times*, the *Guardian*, *Metropolis*, and *Forbes*. Jesse and Jessica have given talks on their generative design process in many forums, including MIT, Cambridge, MA; Harvard, Cambridge, MA; SIGGRAPH, and the Eyeo Festival. Their work is a part of the permanent collection of museums including the Museum of Modern Art, New York, NY; the Cooper-Hewitt, Smithsonian Design Museum, New York, NY; and the Museum of Fine Arts, Boston, MA.

Nervous System's studio is located in the Catskills in Palenville, New York.

http://nervo.us
instagram.com/nervous.system
twitter.com/nervous_system
facebook.com/NervousSystemStudio

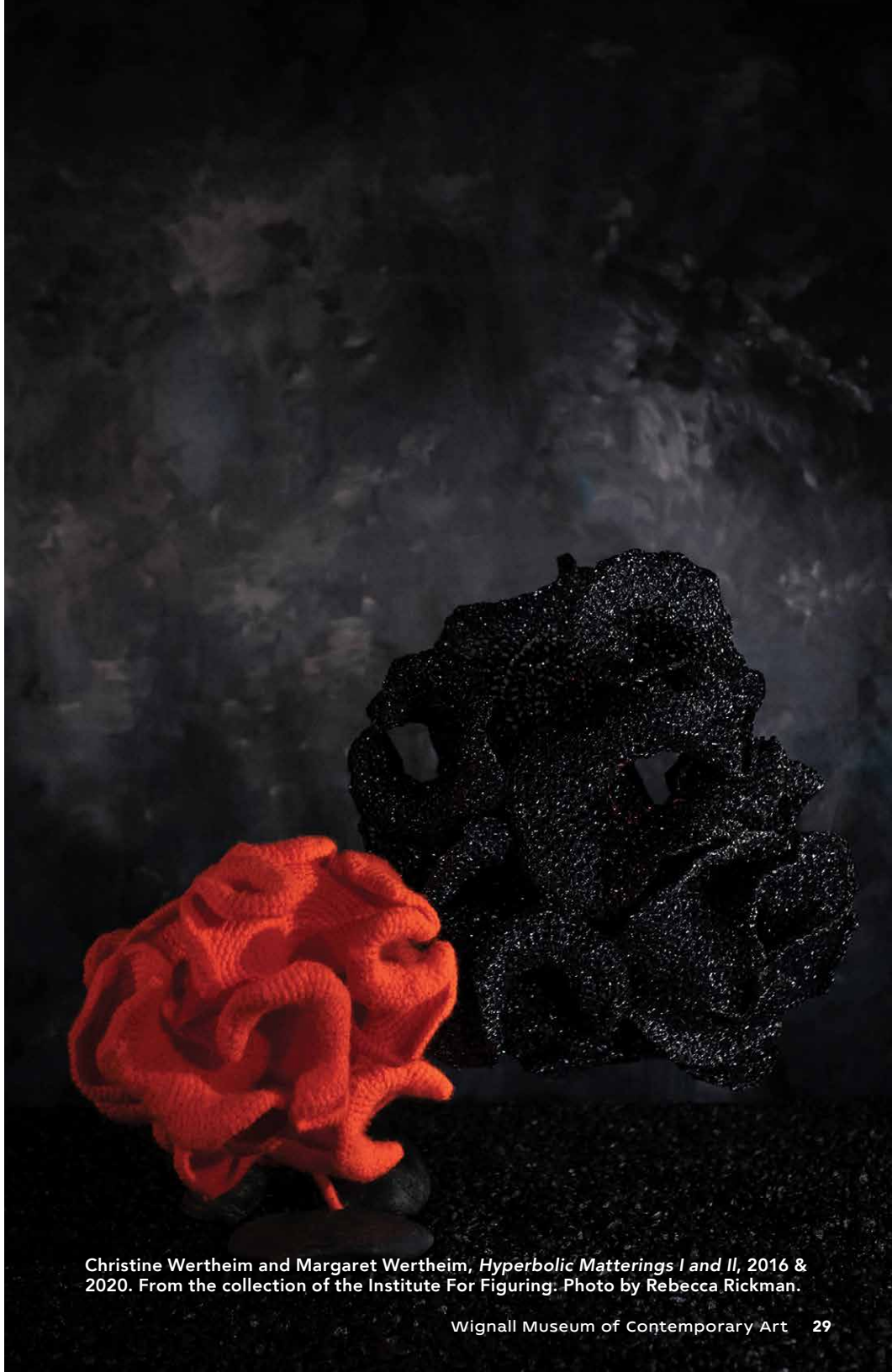
Nervous System, *Laplacian Growth 1*, 2011. Nylon (3d-printed by selective laser sintering). 7.2 x 6.9 x 7.2 inches. Courtesy of the artists.

CHRISTINE WERTHEIM AND MARGARET WERTHEIM

These pieces are crocheted models of *hyperbolic* surfaces, a type of geometric structure described by an alternative to the *Euclidean* geometry we learn in school. Mathematicians spent hundreds of years trying to prove that such forms were impossible, yet me can make them with various handicraft practices. In 1993 Dr. Daina Taimina at Cornell discovered how to make hyperbolic models with crochet using a simple stitch algorithm – "crochet 'n' stitches, increase one stitch; repeat *ad infinitum*." After learning about her discovery, the Wertheim sisters became fascinated by how this algorithm could produce different material objects by varying such physical parameters as the gage of the yarn, the size of the hook, and the type of material – wool, silk, plastic, video tape, and so on. These objects are thus exploratory exercises in the materialization of a mathematical concept and reveal how formal ideas play out differently under different real-world conditions. Put simply: *matter* itself *matters*.

What does it mean for an artwork to simulate the processes by which natural things form, or to emulate methodologies used by scientists and mathematicians? These are questions at the heart of Margaret and Christine Wertheim's practice. Although we are used to thinking of science and mathematics as disciplines spelled out in equations and other symbolic languages, the Wertheims are interested in the ways abstract ideas can be realized and explored through material form. As well as working with crochet and other feminine coded-crafts, they have done projects using various paper-folding techniques. As curators, they have mounted exhibitions about the intersection of logic and drawing, and the geometrical foundations of the 19th century Kindergarten movement pioneered by German crystallographer Friedrich Froebel. The sisters are co-founders of the Los Angeles based Institute For Figuring, a practice devoted to the "poetic and aesthetic dimensions of science and mathematics." The IFF is a research-oriented project exploring new possibilities at the interface of science and art, and also a "play tank" which aims to illuminate STEM ideas through playful, embodied, hand-made processes. Their most well-known work is the *Crochet Coral Reef*, now the world's largest art+science endeavour, which has attracted nearly 25,000 participants in over 50 cities and countries.

https://theiff.org
https://crochetcoralreef.org



Christine Wertheim and Margaret Wertheim, *Hyperbolic Matterings I and II*, 2016 & 2020. From the collection of the Institute For Figuring. Photo by Rebecca Rickman.

CURATORS

MORGAN REA developed a love for Mathematics because of her fascination with identifying patterns, including those that overlap with art, music, and nature. She believes that the beauty of math can be found everywhere, from the spiral of a seashell to the rhythm of a song, and she encourages her students to see the world through a mathematical lens. Born and raised in Chino, Morgan graduated from Don Lugo High School and is now a Mathematics teacher at the Chaffey Chino campus. Morgan holds a B.S. in Mathematics from Cal Poly Pomona, where she also minored in Philosophy. She then ventured across the country to earn a M.S. in Mathematics, specializing in Number Theory at the University of South Carolina, before coming back to California. Morgan's passion for teaching began when she worked as a tutor in college. Morgan's enthusiasm for Mathematics is contagious and she strives to make her classes engaging and accessible to all students. Through her teaching, she hopes to instill in her students a love of learning that will stay with them for a lifetime. She is committed to helping them succeed not just academically, but also as confident, compassionate, and engaged members of their communities.

HANNAH SEIDLER-WRIGHT began to have fun doing mathematics during her high school calculus class and enjoyed drawing in her spare time. When she enrolled in Cal Poly Pomona, she found her calling in Mathematics, while still continuing to explore her artistic abilities. As she progressed toward earning a BS in Pure Mathematics from Cal Poly Pomona, and an MS in Pure Mathematics from UCR, she was able to explore the connection between Math and Art. As a teacher, she strives to inspire and engage students to discover these connections themselves, enabling them to appreciate the beauty of Mathematics. Hannah believes that Mathematics and Art are not as different as people perceive them to be. She believes that creativity and critical thinking are the key to success in both fields. Hannah's goal as a teacher is to inspire her students to think creatively, critically, and see the world in a different light.

ROMAN STOLLENWERK is Assistant Curator at the Wignall Museum of Contemporary Art at Chaffey College, Rancho Cucamonga, CA. Stollenwerk has curated exhibitions for the Wignall, including: *Fashion-Conscious* (2019), *ManUp! Masculinity in Question* (2017), *Unruly* (2014), *The New World* (2013), *Art/Object* (2011), *Haute* (2010), and *Infrastructure* (2008). He has also organized solo projects by artists Nathan Bennett, Brian Bress, Sky Burchard, Suzanne Erickson, Carole Frances Lung, Macha Suzuki, and Bari Ziperstein. In addition to his curatorial practice, Stollenwerk maintains his own studio practice in Altadena, CA. Stollenwerk received an MFA in Studio Art from Claremont Graduate University, Claremont, CA, and a BA in Studio Art from the University of Southern California, Los Angeles, CA.

OTHER CONTRIBUTORS

We want to give thanks to the following people who provided ideas, concepts, and other expertise to this exhibition in unique and imaginative ways:

Brody Albert
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Linda Lamp
Beth Marquez
Amy Nevarez
Roni Osifeso
Mark Padilla
Christine Phillips
Paul Rodriguez
Cyrus Sepahbodi
Steve Spencer
Michael Wangler
Grace Wong
Doug Yegge

ASK ART

USING THE MUSEUM TO MAKE CURRICULAR CONNECTIONS

QUESTIONS FOR VIEWING

- If you were the curator of this exhibition, what would you title the exhibition and why?
- Does the theme of *Seeing the Unseen* resonate through the art in the exhibition and your math course? If so, please explain how to use specific details from your course and museum experiences. If not, please explain!
- In what ways do the process of art and mathematics seem similar, and how do they differ? Please use specific examples from your museum and course experiences to explain.
- How do you see the works of art informing or enriching your view of the mathematical concepts that they are making visible in their artwork?
- What have we gained by compartmentalizing math away from art? What have we lost? What are the risks? Can we explore our knowledge, feelings, and experiences in a more integrated way? If so, how? If not, why not? Please use specific examples from your experience.
- Both mathematics and art require spatial reasoning skills and the ability to recognize patterns. What patterns stand out to you as you view the work in this exhibition?
- How can technology and computing be used in creating works of art? Do you see examples of this type of creative and technological marriage in the exhibition?
- Identify mathematical concepts such as topology (Klein bottles, tori, etc.), geometry (tessellations, hyperbolic planes, projections, perspective, etc.), algebra (sequences, series, fractals, golden ratio, etc.), number theory (prime numbers, etc.) in the works of art presented in the exhibition. Are there other topics you see the artists using in their artwork?
- Solving math problems is usually viewed as something you think about—not feel. For many people, viewing works of art results in an emotional response. Do you think it's possible to analyze a work of art from a mathematical point of view? Or, can you analyze a math problem from the point of view of an artist?
- What thoughts and emotions did you experience as you viewed the art in this exhibition? Note that feelings have a pattern, too.
- Select two of the artists from this exhibition and describe in detail the thoughts and emotions their work evokes in you. Consider which aspects of the work you are reacting to.
- The golden ratio in art creates a balanced relationship that the mind's eye loves. More precisely, it is about obtaining a precise ratio between the different parts of an artwork, and image, or an object. This irrational number has a value of approximately 1.61803398874989482045. Examine the work presented in the exhibition. Do any of them utilize the golden ratio in their compositions?
- The field of mathematics is broad. Identify concepts displayed in the exhibition from other STEM (Science, Technology, Engineering, Math) fields. Identify the connections made to mathematics in your everyday life.
- Find Richard Hammack's work in the exhibition. Handle the envelopes. What do you notice? How are the envelopes the same and how are they different? What other objects can you think of that are tori topology?
- View Bathsheba Grossman's work. Do these sculptures remind you of any objects you've seen before such as Temari balls, Celtic knots, or Chinese puzzle balls. What characteristics does Grossman's work share with any of those objects?
- View the work of Katy Ann Gilmore in the exhibition. Gilmore explores perspective in her painting and installation. Does Gilmore's work utilize 1- or 2-point perspective in her work?
- Susan Goldstine, 3-dimensional.space, and the Institute For Figuring all explore hyperbolic geometry in their works of art. View the work and then ask yourself what patterns and symmetries arise in the artworks.
- Origami is both a form of art and mathematics. Do any interesting mathematical questions arise from the process of folding paper? Is the mathematics behind origami useful for anything other than making pretty decorations? People who spend time folding paper often ask themselves questions that are ultimately mathematical. After viewing the work of Robert Lang, what questions can you think of? Or what problems can you see that Lang had to solve to make his work?

ESSAY PROMPTS

- Many of the works in this exhibition invite exploration into human sensory reception and processing and pattern formation. Students of such disciplines as biology, philosophy, and psychology (to name a few) may see some connections between coursework and the exhibition.
- After viewing the exhibition, compose an essay discussing connections you saw with the thoughts, ideas, and experiences you've had in the course thus far. Please use specific examples from your museum and course experiences.
- Write a well-developed essay in which you compare and contrast two artworks in the exhibition. Analyze key elements such as subject matter, composition, use of color, points of view, themes, mathematics fundamentals, etc. Utilize the artist's statements in your analysis.
- Write an essay comparing the processes of inquiry, exploration, and discovery of art and math as you see them playing out in the works of this exhibition. Please use specific examples from your museum and course experience.

ASK ART

USING THE MUSEUM TO MAKE CURRICULAR CONNECTIONS

- As you engage the artworks presented in the exhibition, what do you think the artist is exploring, inquiring about, visualizing, or illuminating? Organize your observations and thoughts into a social media post on your reaction to the exhibition, with an image from the exhibition. Please use the hashtags provided at the end of this list.
- Write a paper identifying mathematical concepts like topology, tessellations, hyperbolic geometry, Golden Ratio, Klein Bottle, and fractals reflected in the works of art presented in the exhibition. Are there other mathematical topics or ideas you see the artists using in their artwork?
- Create a representation of a mobius strip out of paper. All you need is a piece of paper, scissors, and tape. Take the strip of paper and bend the ends together. Twist one of the ends over 180 degrees, and stick the ends together. You have now created a Möbius strip. To prove it only has one side, take the pen/marker and draw a line along the middle, without lifting up the pen.

ACTIVITIES

- Origami project- learn a simple origami activity by googling how-to videos on YouTube. Share your techniques with a friend or family member. Share your finished product on socials, and with your instructor.
- In the early 1990s, artist Robert Lang proved that for any number of appendages, an origami base can produce the desired effect from a single square sheet of paper. Robert has created a computer program that can design a somewhat optimized base for any stick figure outline. This has enabled many folders to create origami animals that were considered impossible years ago. You can watch Lang's TED talk to hear him explain the math/art and it's applications in everything from medicine to astronomy here: https://ed.ted.com/lessons/robert-lang-folds-way-new-origami; his application is available for free at: https://langorigami.com/article/treemaker/.
- Watch Lang's talk and/or download and begin exploring his software. Construct an essay or a piece of origami sharing the insights you've gained from exploring Lang's work.
- Chaffey College holds an art collection. All of the works in the collection are displayed in public spaces on all three campuses. Visit the CAA Building, Rancho Campus to see a work of art that explores mathematical concepts. Locate the CAA Student Gallery and then, look up! See the hanging sculpture, *The Suspension of Ascension*, by artist Stephanie Bedwell. The artist utilizes vanishing points and perspective in the installation. What geometry concepts does the sculpture evoke? Create a 2-point perspective drawing from any angle of the sculpture.
- In honor of Pi Day, March 14, bake a pie! Read a bit out Pi Day. Share your pie with family and friends and together, contemplate the history and significance of Pi Day.

EXPLORATION IN OPEN-ENDED INQUIRY

- The following activity is a warm-up to guide folks out of their heads, and into sensory awareness and curiosity, it will be helpful to simply read items 1-3, and use items 4-5 as a guide – especially if you are new to exploring art!

1. Before entering the exhibition, spend 15 minutes or so just being outside. Focus as much as possible on nature, try to be aware of all of your senses. Write and/or draw what you see, hear, touch.
2. Your mind will try to reach beyond observing into interpreting, questioning—and daydreaming. When it does, gently bring it back to observing in the here and now. It is common to worry that what you're writing is silly or uninteresting. It's not. it can't be. So long as you are curious, you are totally on track! Keep going!
3. After about 10 minutes, reflectively evaluate your notes and drawings. Label observations (O); interpretations or attempts at exploration (I); questions (Q); and emotions (E). There is no right or wrong way to explore. It is important, though, to be aware of your thoughts and feelings. Because, while observations, questions, and some feelings (like joy, awe, and wonder) can open us to exploration, interpretation or worry can narrow our thinking.
4. Now that you've opened yourself to being curious, it's time to explore some art! Try using the same method of exploration you used with nature. Observe! Write or sketch your observations. Be curious! When questions arise, write them down! You might find it fun to imagine the artist was standing there and you could ask them a question about their work: What would you ask?
5. Finally, you will notice that information about the artists and their work is posted around the gallery and in the printed exhibition guide, available at the museum front desk. This information may be helpful as you explore the work.

SHARE

- **Create a music playlist** to accompany the exhibition. What would you include and why?
- **Tell a friend**, classmate, instructor, or family member about *Seeing the Unseen: Math and Art*. Invite them to view the exhibition with you, in person, or online at www.chaffey.edu/wignall.
- **Share your work** of art on socials:

  #seeingtheunseen

  #wignallMOCA

  #whatsupatthewig

  #mathandart

ACKNOWLEDGEMENTS

Institutional support for *Seeing the Unseen: Math and Art*, and the Wignall Museum of Contemporary Art is provided by Chaffey College; the Arts, Communication, and Design Academic and Career Community; the STEM Academic and Career Community; the President's Office; and the Chaffey College Foundation.

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STUDIO TECHNICIAN AND MUSEUM PREPARATOR VISUAL & PERFORMING ARTS
Andrew Hadle

PRINTING, GRAPHIC & WEB DESIGN
Strategic Communications Office

LAND ACKNOWLEDGMENT

It is our tradition that we acknowledge that Chaffey College is on the ancestral lands of The Kizh and Tongva (Gabrieleño) who remain in the area today. With respect and honor for the lands we gather on and the leaders before us, we would like to take a moment to acknowledge the Gabrieleño-Tongva (GABRIEL-EN-YO TONG–VAH) Peoples, the original stewards of these sacred and unceded homelands. The Tongva people's history, language(s), cultural traditions, and legacy continue to shape this region and we recognize their continuing presence in their homelands.

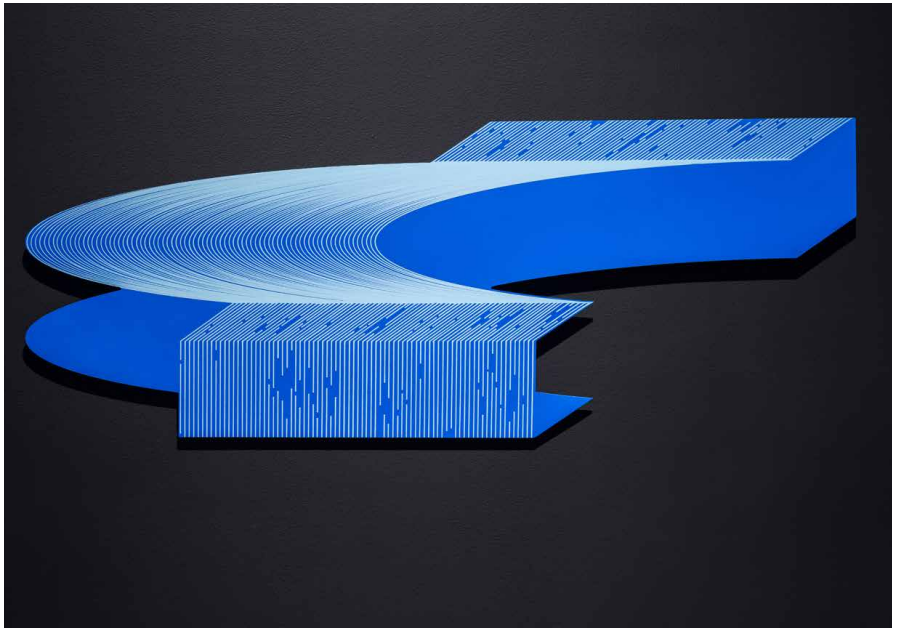
In the spirit of truth and equity, Chaffey College commits to uplifting the voices of indigenous peoples, and building an inclusive and equitable educational environment, and decolonizing the institution. We also encourage members of the Chaffey College community to learn about the land they reside on and the original caretakers and advocate for culturally responsive action.

MISSION STATEMENT

Chaffey College improves lives and our communities through education with a steadfast commitment to equity and innovation to empower our diverse students who learn and thrive through excellent career, transfer, and workforce education programs that advance economic and social mobility for all.

Installation Images

Katy Ann Gilmore, *Catenary Skew 6*, 2019. Acrylic and flashe on dibond.
18 x 46 inches.



Katy Ann Gilmore, *Catenary Skew 6*, 2019. Acrylic and flashe on dibond.
18 x 46 inches.

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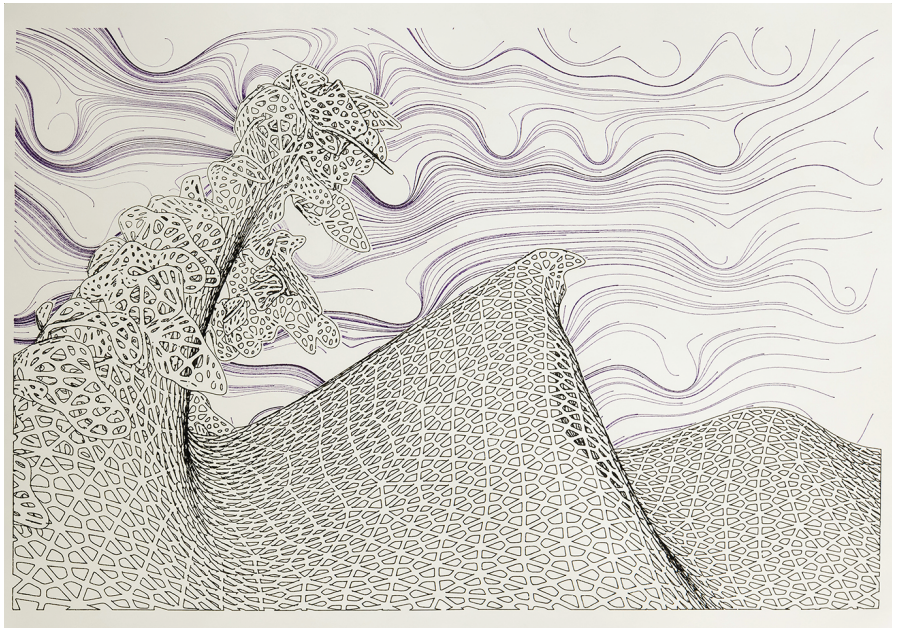
18 x 46 inches.

David Bachman, 2023. Pen plotter prints (ink on paper). 22 x 30 inches each.

Installation view of *Seeing the Unseen: Math and Art*, January 8 – March 9, 2024.
Wignall Museum of Contemporary Art, Chaffey College, Rancho Cucamonga, CA.



David Bachman, *Water*, 2023. Pen plotter print (ink on paper). 22 x 30 inches.

David Bachman, *Wind*, 2023. Pen plotter print (ink on paper). 22 x 30 inches.

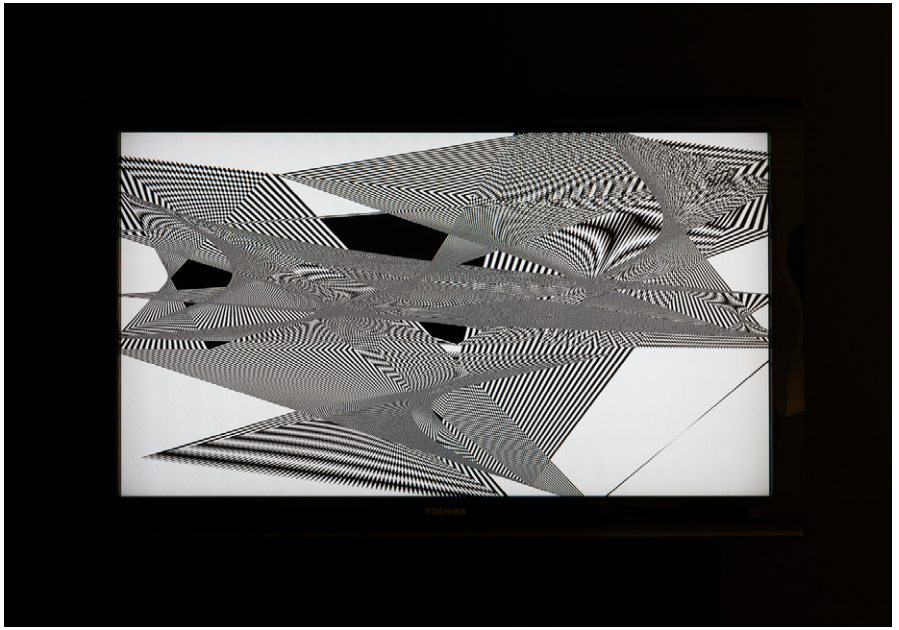
David Bachman, *Fire*, 2023. Pen plotter print (ink on paper). 22 x 30 inches.

Installation view of *Seeing the Unseen: Math and Art*, January 8 – March 9, 2024. Wignall Museum of Contemporary Art, Chaffey College, Rancho Cucamonga, CA.

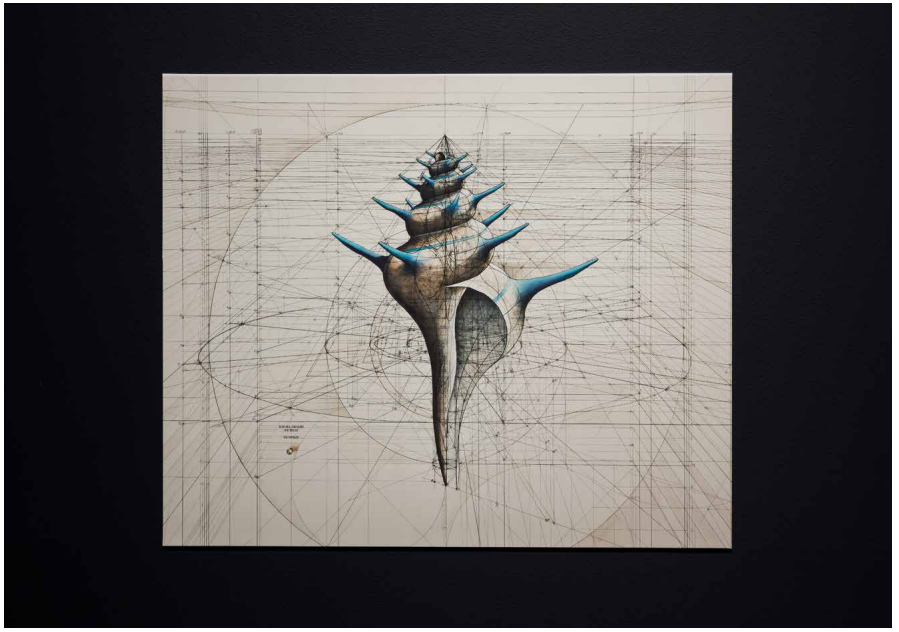
Susan Goldstine, *Fundamental Frieze Scroll II*, 2018. Merino/alpaca yarn, glass beads, wooden dowels. 17.5 x 9.5 inches.

Installation view of *Seeing the Unseen: Math and Art*, January 8 – March 9, 2024. Wignall Museum of Contemporary Art, Chaffey College, Rancho Cucamonga, CA.

David Harris, *Three Body Problem*, 2019.
Rafael Araujo, *Blue Spikes Shell*, 2015.



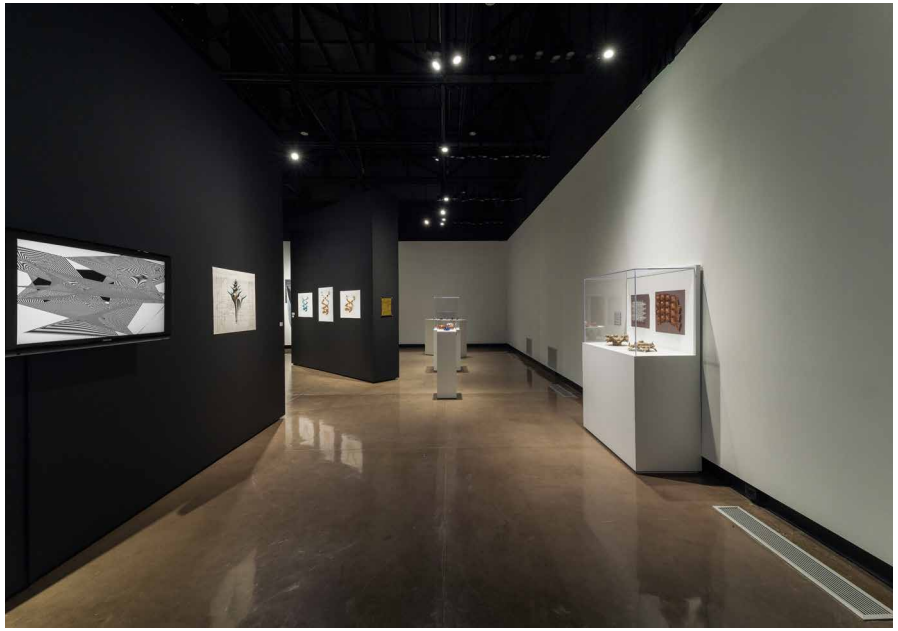
David Harris, *Three Body Problem*, 2019. Digital motion simulation written in Processing (1080p digital video), TRT: 05:10.



Rafael Araujo, *Blue Spikes Shell*, 2015. Archival pigment print. 62 x 75 centimeters.

David Harris, *Three Body Problem*, 2019.
Rafael Araujo, *Blue Spikes Shell*, 2015.

Robert J. Lang, featured in *Seeing the Unseen: Math and Art*, January 8 – March 9, 2024. Wignall Museum of Contemporary Art, Chaffey College, Rancho Cucamonga, CA.



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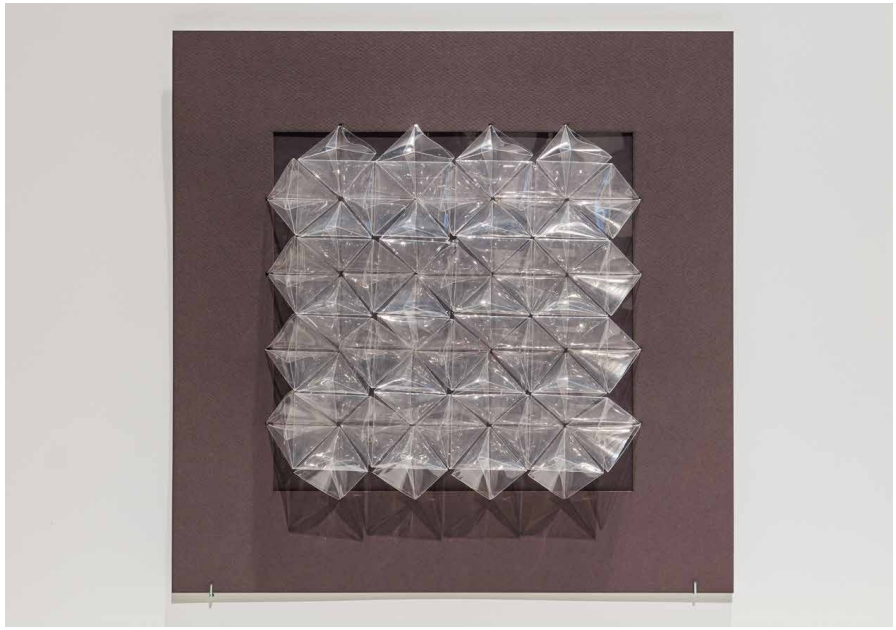
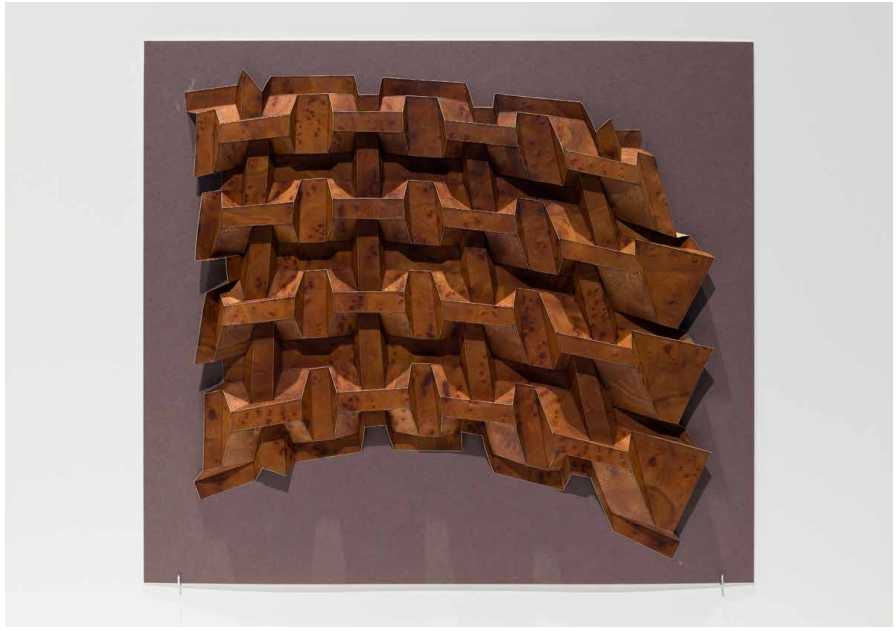


Robert J. Lang, *Octet Truss, Opus 652*, 2014. One uncut irregular polygon of Mylar (and matte board). 10 x 10 x 1.5 inches.

Robert J. Lang, *Single-Sheet Pentasia, Opus 645*, 2013. One uncut irregular polygon of elephant hide paper. 9 x 9 x 6 inches.



Robert J. Lang, *DFF-RFQM-6*, 2017. One uncut irregular polygon of camphor wood veneer laminate. 15 x 13 x 1 inches.

Robert J. Lang, *Pentasia*, 2012. 265 uncut squares of elephant hide paper. 12 x 12 x 6 inches.

(projection) Rèmi Coulon, Sabetta Matsumoto, Henry Segerman, and Steve Trettel, *Thurstonís Geometries*, 2023. Digital video (1080p), TRT: 12:02.

Susan Goldstine, *Hyperbolic Constellation*, 2014. Glass beads, crochet cotton thread. 2 x 4.5 x 4 inches

Susan Goldstine, *Makeri Mosaic*, 2019. Merino/cotton yarn, wooden dowels. 10.75 x 8.75 inches.

Susan Goldstine, *Float Free, Bumblebee*, 2018. Merino/alpaca yarn, wooden dowels. 18.5 x 11 inches

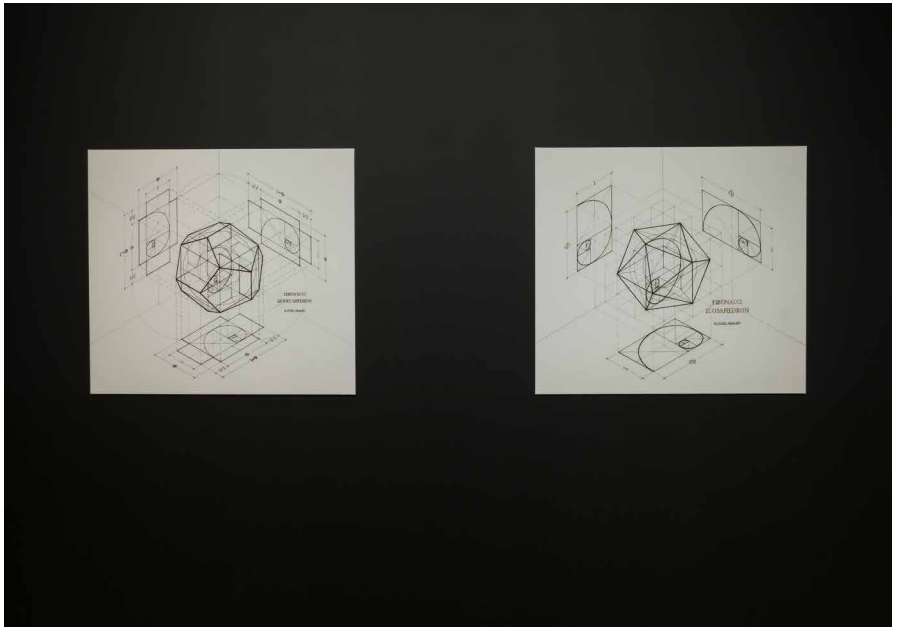
Installation view of *Seeing the Unseen: Math and Art*, January 8 – March 9, 2024. Wignall Museum of Contemporary Art, Chaffey College, Rancho Cucamonga, CA.

Robert J. Lang, *Bandpot A10*, 2012. One uncut decagon of Canson Mi-Teintes paper. 8 x 8 x 5 inches.

Robert J. Lang, *Camphorpot8, Opus 679* 2015. One uncut sheet of camphor wood laminate, 8 x 8 x 4 inches.

Robert J. Lang, *Seedpot24*, 2012. One uncut 24-gon of elephant hide paper. 4 x 4 x 3 inches.

Installation view of *Seeing the Unseen: Math and Art*, January 8 – March 9, 2024. Wignall Museum of Contemporary Art, Chaffey College, Rancho Cucamonga, CA.



Rafael Araujo, *Dodecahedron*, 2015. Rafael Araujo, *Icosahedron*, 2015. Archival pigment prints, 75 centimeters wide.

Bathsheba Grossman. Binder jetted steel, approximately 4 inches each.

Bathsheba Grossman, *Rygo*, 2010. Stereolithography. 6 x 6 x 8 inches.

Installation view of *Seeing the Unseen: Math and Art*, January 8 – March 9, 2024. Wignall Museum of Contemporary Art, Chaffey College, Rancho Cucamonga, CA.

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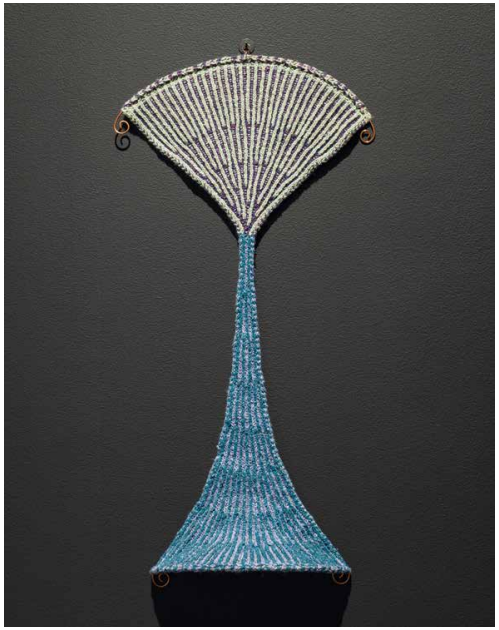
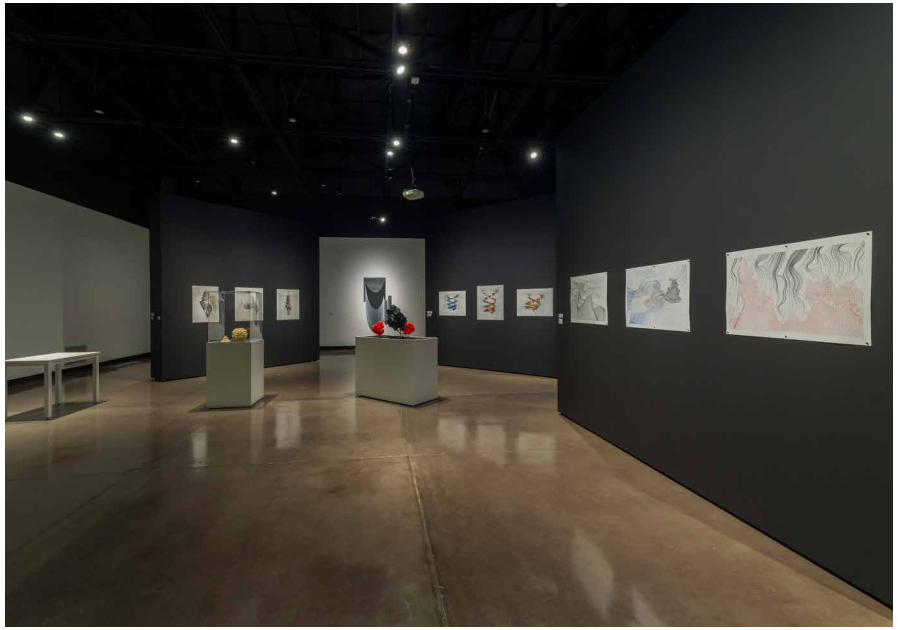


Susan Goldstine, *Redistribution*, 2023. Berroco Remix Light yarn, copper wire. 26 x 13 x 5 inches

Installation view of *Seeing the Unseen: Math and Art*, January 8 – March 9, 2024. Wignall Museum of Contemporary Art, Chaffey College, Rancho Cucamonga, CA.



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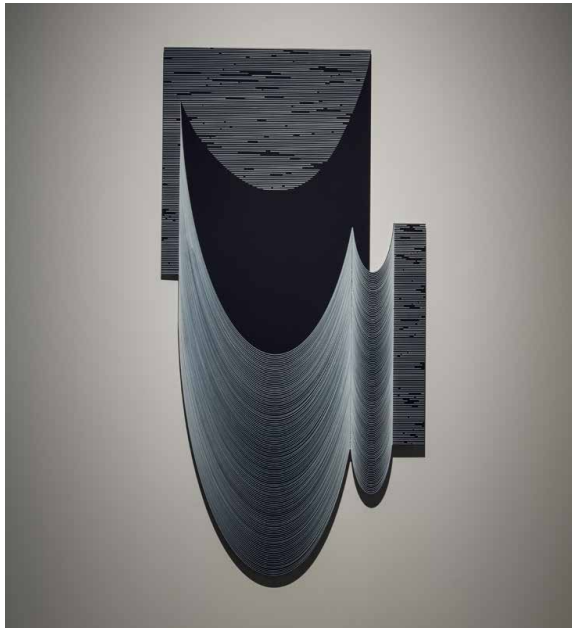

Katy Ann Gilmore, *Catenary Drip 7*, 2019. Acrylic on dibond. 73.75 x 37 inches.

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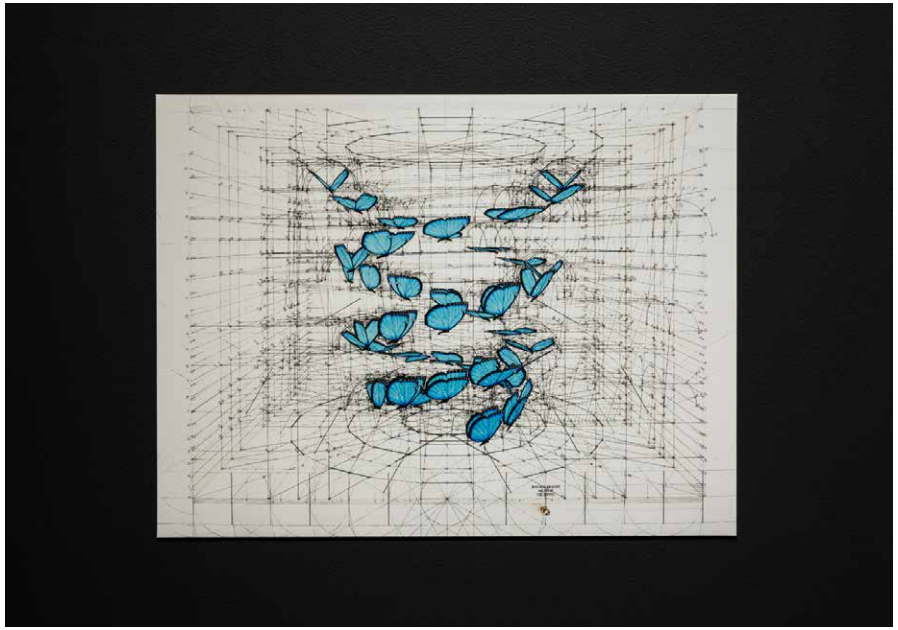
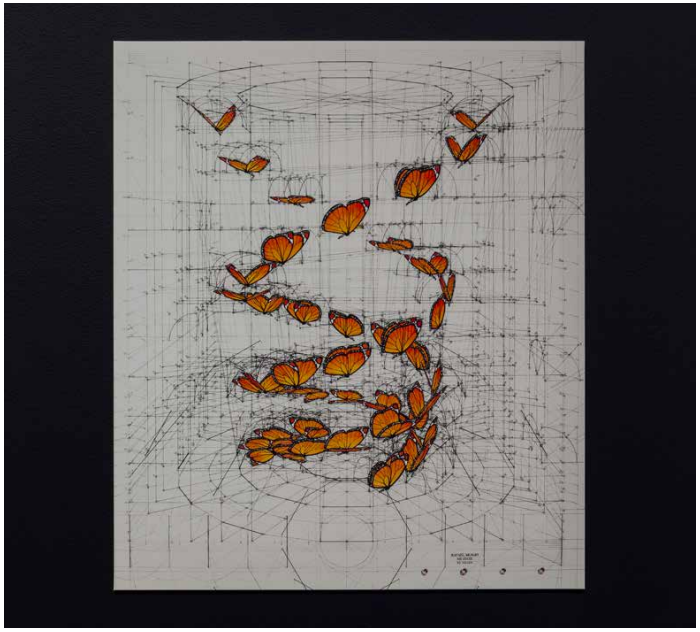
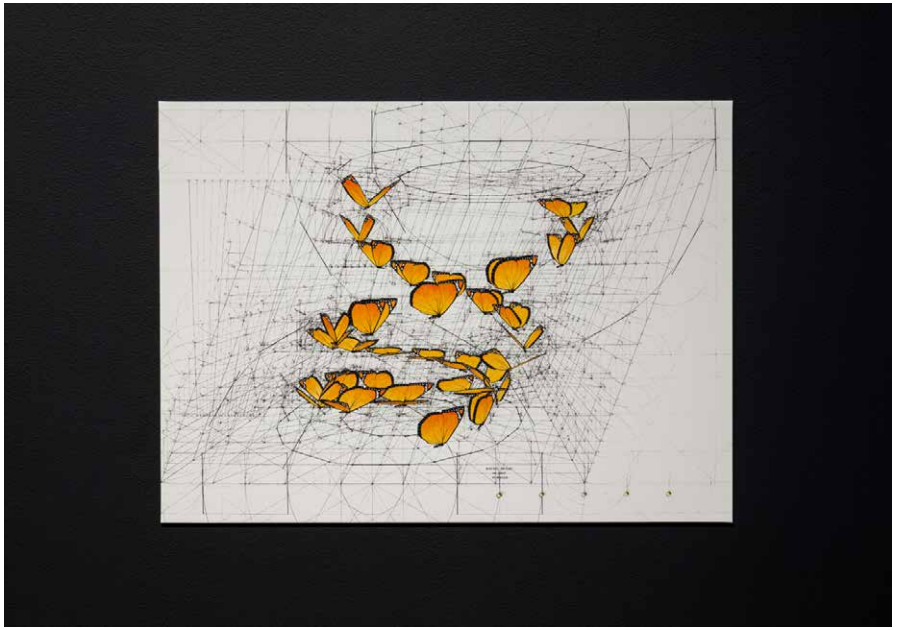
Rafael Araujo, archival pigment prints, 75 centimeters wide.



Rafael Araujo, *Morpho Double Helix*, 2016. Archival pigment print.
57 x 75 centimeters.



Rafael Araujo, *Slim Cone Double Helix*, 2016. Archival pigment print.
75 x 64 centimeters.



Rafael Araujo, *Monarch 3*, 2023. Archival pigment print. 55 x 75 centimeters.

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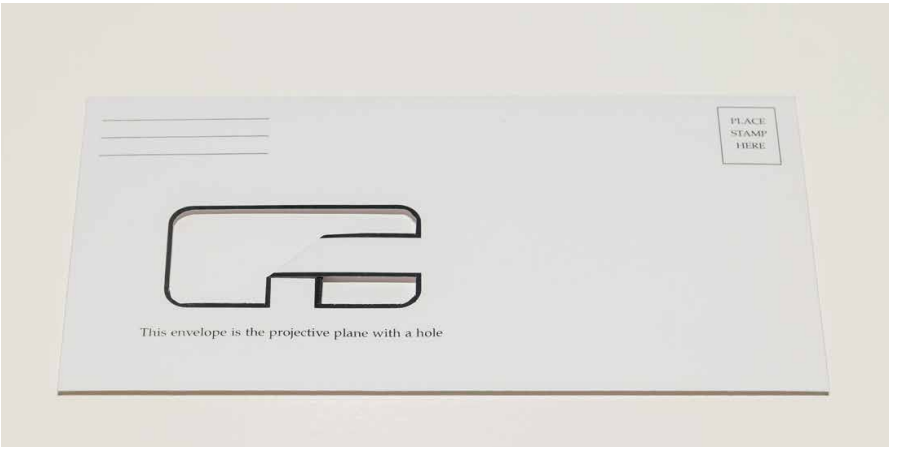
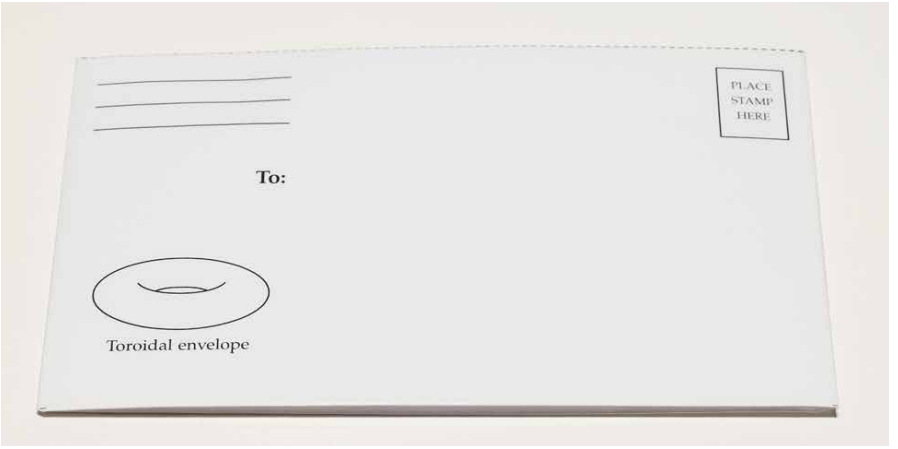
Richard Hammack, *Topological Envelopes*, 2023. PDF-LaTeX, laser-printed paper, cardstock, and glue. Approximately 4 x 9.5 inches each.





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Robert J. Lang†and Kevin Box, *One in a Billion (White)*, 2018.
Robert J. Lang†and Kevin Box, *Unicorn Unfolded, One in a Billion, Opus 736*, 2018.

Robert J. Lang†and Kevin Box, *One in a Billion (White)*, 2018.
Robert J. Lang†and Kevin Box, *Unicorn Unfolded, One in a Billion, Opus 736*, 2018.

Robert J. Lang and Kevin Box, *One in a Billion (White)*, 2018. Painted cast bronze (ED/50, AP/6). 12.5 x 9 x 4 inches. Courtesy of the artists.

Robert J. Lang and Kevin Box, *One in a Billion (White)*, 2018. Painted cast bronze (ED/50, AP/6). 12.5 x 9 x 4 inches. Courtesy of the artists.

Robert J. Lang and Kevin Box, *Unicorn Unfolded, One in a Billion, Opus 736*, 2018. Painted cast aluminum (Ed/24, AP/5). 33 x 33 x 2 inches. Courtesy of the artists.

Robert J. Lang and Kevin Box, *One in a Billion (White)*, 2018.
Robert J. Lang and Kevin Box, *Unicorn Unfolded, One in a Billion, Opus 736*, 2018.

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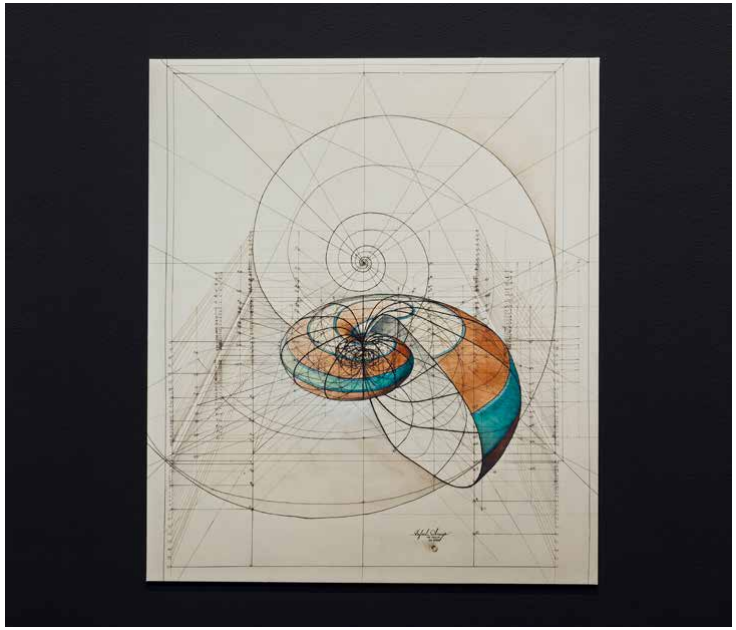
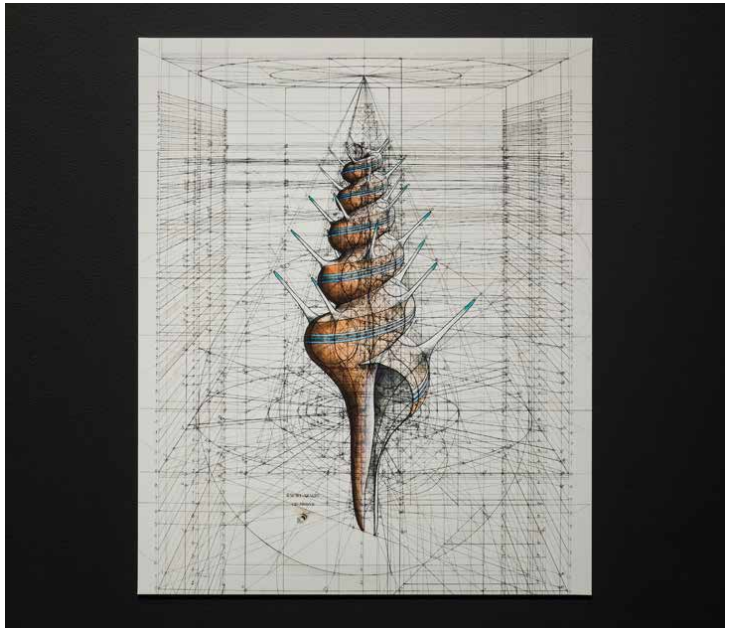
Rafael Araujo. Archival pigment prints. 75 centimeters tall.

Rafael Araujo, *Murex*, 2002. Archival pigment print. 75 x 52 centimeters.



Rafael Araujo, *Nautilus*, 2012. Archival pigment print. 75 x 65 centimeters.

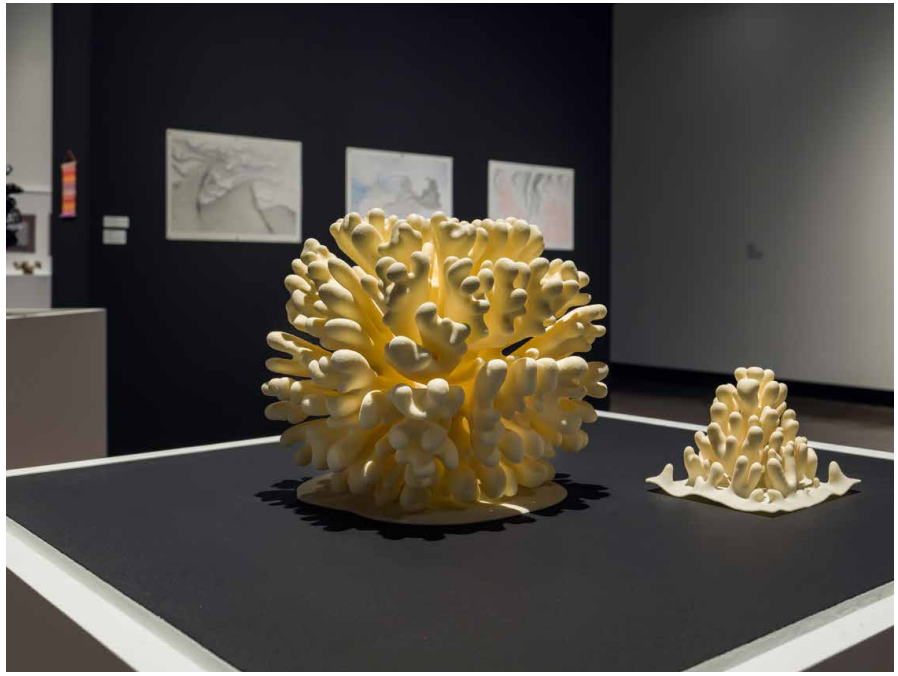


Rafael Araujo, *Blue Stripes Shell*, 2017. Archival pigment print. 75 x 61 centimeters.

Christine Wertheim and Margaret Wertheim, *Hyperbolic Matterings I and II*, 2016 & 2020. Videotape, wire, yarn, and lava rocks. Approximately 22 inches tall. From the collection of the Institute For Figuring.

Christine Wertheim and Margaret Wertheim, *Hyperbolic Matterings I and II*, 2016 & 2020. Videotape, wire, yarn, and lava rocks. Approximately 22 inches tall. From the collection of the Institute For Figuring.

Nervous System, *Laplacian Growth 1 & 2*, 2011. Nylon 3d-printed by selective laser sintering. 7.2 x 6.9 x 7.2 inches & 4 x 4 x 3.3 inches. Courtesy of the artists.



Nervous System, *Laplacian Growth 1 & 2*, 2011. Nylon 3d-printed by selective laser sintering. 7.2 x 6.9 x 7.2 inches & 4 x 4 x 3.3 inches. Courtesy of the artists.

(projection) Rèmi Coulon, Sabetta Matsumoto, Henry Segerman, and Steve Trettel, *Thurstonís Geometries*, 2023. Digital video (1080p), TRT: 12:02.

Katy Ann Gilmore, *Fold 25*, 2019. Acrylic on dibond. 49 x 26 inches.

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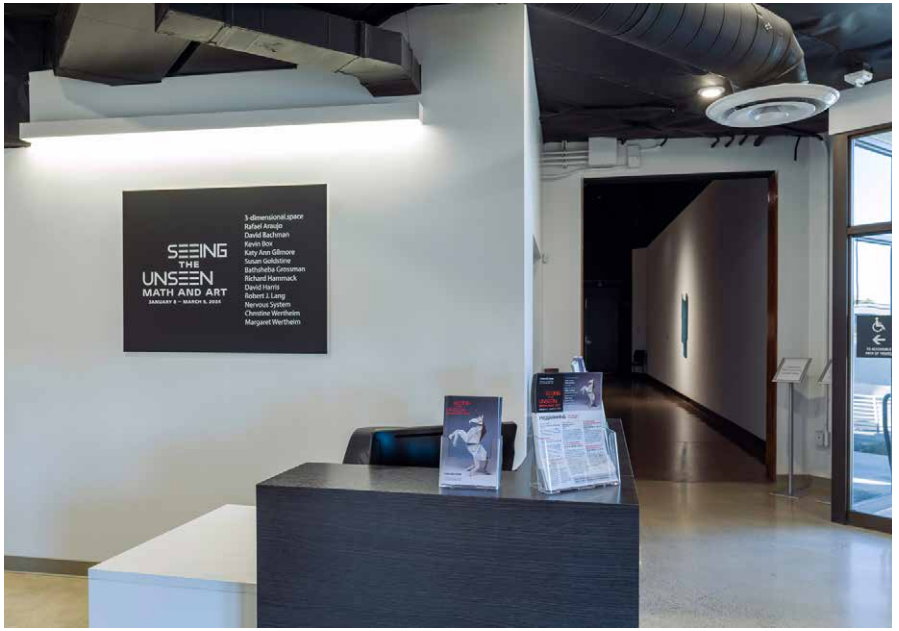

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SEEING THE UNSEEN
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