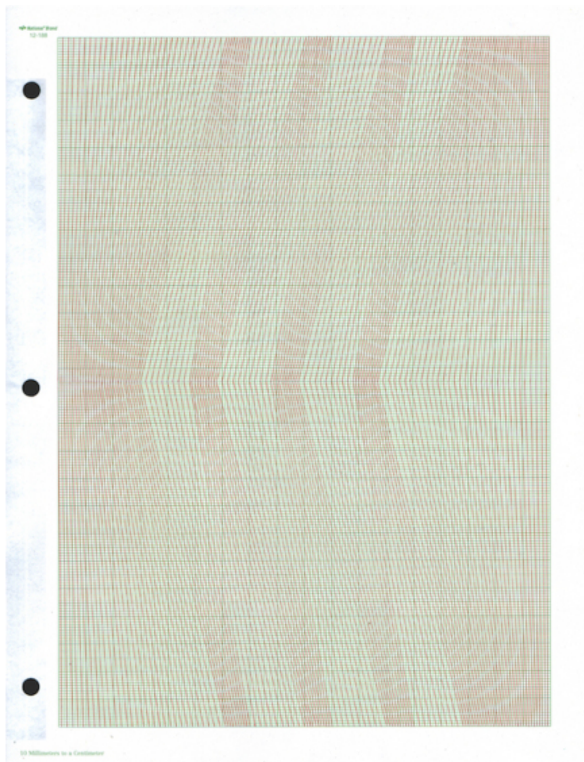
ARTFULLY LEARNING

ARTFUL EQUATIONS

By Adam Zucker l December 12, 2019



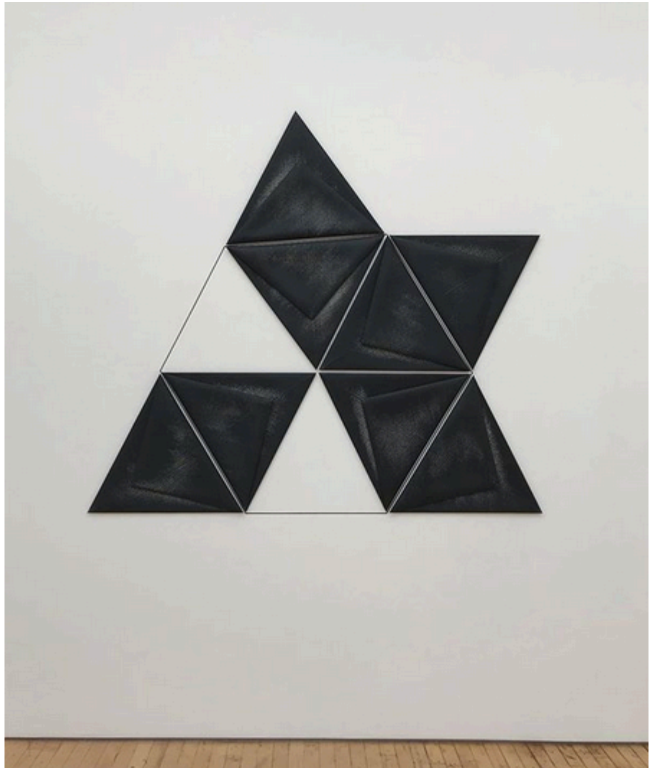
Joshua Caleb Weibley, *Excerpts from* Engineering *Forms*, 2011, ink on paper. Courtesy of the artist.

In High School, I loathed math. I was obviously very interested and invested in art and music, and didn't realize how artistic discovery relates to principles of mathematics (and vice versa). If I had been introduced to mathematical concepts via visual art, performance and music, perhaps it would have made a significant difference in my enthusiasm and effort in my math classes. I might have ended up challenging myself with numerical equations and problems, if artists like Jennifer Bartlett, Agnes Denes, Piero della Francesca (whose day job was as a mathematician) and Sandro Botticelli were discussed in relation to the content we were learning in math class.

The confluence of art and math should have been a forgone conclusion, because the mathematics we know today has its foundations in art. The practice of synthetic geometry, which was discovered by the Greek mathematician Euclid, in the 4th Century (BCE), is still taught in schools and utilized by graphic artists and architects. Euclidean geometry uses tools like compasses, rulers and protractors to visualize optical dimensions in a physical and tangible manner. In the 15th Century, Filippo Brunelleschi's concept of linear perspective (inspired by Euclid's optics) changed both the disciplines of math and art in a monumental fashion. Linear perspective directed the way artists, such as dell Francesca, realized and depicted three-dimensional space within a flat picture plane. The resulting aesthetic explorations with linear perspective led to enormous breakthroughs in the fields of architecture, science and engineering. STEAM learning was a huge component of the Renaissance and its lasting influence, which is why it is so shocking that the arts have largely been left out of the equation in educational curricula until recently (Gunn, 2017).

The cultural impact of linear perspective and other aesthetic mathematical revelations is the subject of Lynn Gamwell's book, *Mathematics + Art: A Cultural History*. Gamwell lays out the formulas and shows her work, in order to make the case that art and math are intrinsically linked and have progressed nicely together through time. Gamwell doesn't solely focus on Western culture; she traces the topic of mathematics within human development back to prehistoric times and our early explorations with counting systems and pattern design. During the modern and contemporary eras, both mathematicians and artists have been concerned with more abstract ways of defining what space is and can be. Non-euclidean geometry gave way to theories regarding the relationship between space and time, which artists of the 19th and 20th centuries sought to visualize in their artwork.
When you look at Jackson Pollock's drip paintings, it is not a stretch to think about fractal geometry. There is mathematical theory testing to prove the correlation between Pollock's chaotic splashes of paint and complex fractal patterns which are self-similar over different dimensions. As Jennifer Ouellette (2001) recounts, "the physicist Richard Taylor was on sabbatical in England six years ago when he realized that the same analysis could be applied to Pollock's work. In the course of pursuing a master's degree in art history, Taylor visited galleries and pored over books of paintings. At one point in his research, he began to notice that the drips and splotches on Pollock's canvases seemed to create repeating patterns at different size scales—just like fractals." In fact, Taylor did the math and revealed that Pollock's painting *Number 14* (1948) has a fractal dimension of 1.45, which is very similar to the fractal dimension of many natural coastlines (Taylor, Micolich and Jonas, 1999). In November 1945, Pollock and Lee Krasner moved to the town of East Hampton on Long Island, so he was definitely attuned to the natural seascapes nearby his home and studio.

The integration of math and aesthetics can also be deciphered within the work of artists such Dorothea Rockburne, Jennifer Bartlett, Agnes Denes, Joshua Caleb Weibley and Nick Naber.



Dorothea Rockburne, *Egyptian Painting: Basalt*, 1981, oil, glue, pencil on gessoed linen. Photograph by Nick Naber.

Dorothea Rockburne fulfills her academic interest and passion for math via her creative practice as a studio artist. While studying at the renowned Black Mountain College in the 1950s, she was influenced by a professor named Max Dehn, who was a leading practitioner and scholar in the mathematics of geometry, topology and geometric group theory. She is also intrigued by the scientific and astronomical explorations of Leonardo da Vinci and Piero della Francesca, who she references in her painting *Piero's Sky* (1991-92). The painting alludes to the 'natural' starry night skies that della Francesca depicts in paintings like *The Dream of Constantine* (1464), which reinforces his expertise as both an artist and astronomer (see: Valerio, 2011). The sublime and serene character of Renaissance humanism and the elongated forms Mannerism, are evident in many of Rockburne's contemporary abstract paintings. She connects 15th and 16th century painting to topology, by creating geometric forms that retain their essence under material deformations that include bending, stretching and twisting. This mathematical treatment of her imagery also makes them feel as if they are in motion, akin to the avant-garde choreography of her friends from the Judson Dance Theater. Rockburne personally describes her painterly process, which results in very fluid and accurate geometric compositions, as "visually solving equations" (Hoban, 2015). In a 2013 article Rockburne wrote for the Brooklyn Rail, she elaborates on her studio process and its connection to math:

> *"During the '60s and '70s I struggled to find a new geometry, something beyond the grid and Euclid. Excited by topology and set theory I began to look at transitive geometry, always envisioning concepts in different, possible materials that could be made into art, but which were outside of art materials. Carbon paper seemed a perfect choice. My intuition demanded that previously unseen, invisible structures and proportions be made visible through a transitive process." – Dorothea Rockburne (Sept. 2013)*

Jennifer Bartlett, *House: Dots, Hatches*, 1998, enamel on 81 baked enamel plates. Photograph by Adam Zucker.

Jennifer Bartlett makes paintings that are inspired by systems based processes, sets, proportions and ratios. She presents these self-imposed mathematical elements via a highly expressive painterly style that comments on painting's narrative history and its roots in geometry (see: Artful Arithmetic for further analysis of Bartlett's math infused art practice).

Agnes Denes is also drawn to mathematical systems, ratios and proportions. Her oft-environmentally themed artworks employ geometric structures such as pyramids and sets of flora planted to form patterns inspired by natural rhythmic and evolutionary phenomena (see: Differentiation and Multiple Intelligences for more about Denes' work).

Joshua Caleb Weibley utilizes synthetic geometry to create very intricately hand rendered drawings that discerningly provide insights into the evolution of technology, game theory and programming language. Many of his drawings parallel the ideological process of Minimalist art, the language of play and the optical mechanics of Op art. Weibley's critical analysis of technology, presents it within the framework of time and space. His major focus is the coordinated obsolescence of technology, a process which is consistently stimulated by new technological advances and machine based learning. By replicating digital ephemera using an analog technique, Weibley's art melds the fields of fine art, industrial engineering and computer science.

Nick Naber, *Facility 23, 2019*, marker and graphite on watercolor paper. Courtesy of the artist.

Nick Naber's technically stunning paintings and drawings adopt a personalized mathematical process that highlights line, geometry, and repetitive gesture to make commentary on architecture's affect on the human psyche. Naber's geometric structures, which largely resemble archetypal modern and post-modern buildings, impose upon one another to form implied three-dimensional compositions. These structures are drawn to scale and often based on odd numbers, often sets of three. They are like a contemporary version of Giovanni Battista Piranesi's *Carceri d'invenzione* or 'Imaginary Prisons,' because they similarly form fantastical architectural labyrinths, which are Kafkaesque in nature. Through Euclidean geometry, Naber's works envelop the viewer with the illusion of feeling trapped, alienated and/or imprisoned within the confines of overarching forms.

The aforementioned artists represent a few examples of how mathematical processes and aesthetic concepts inform one another. With mathematical knowledge and tactile skills, artists continue to probe, explain and expound upon the phenomena of our lived experiences. For the people like myself who struggle with didactic math (i.e. studying baseline formulas), analyzing works of art that combine math, science and technology, can open inquiring minds into developing a better understanding and application of these fields.

References, Notes, Suggested Reading:

Hoban, Pheobe. "Works in Progress," *T Magazine*, 15 May, 2015. https://www.nytimes.com/interactive/2015/05/15/t-magazine/17older-female-artists-agnes-dene-herrera-rockbourne-farmanfarmaian.html

Gamwell, Lynn. Mathematics *+ Art: A Cultural Hist*ory, New Jersey: Princeton, 2016.

Garner, Mary L. 'The Merging of Art and Mathematics in *Surface Substitution on 36 Plates*', in Kirsten Swenson (ed.), *In Focus: Surface Substitution on 36 Plates 1972 by Jennifer Bartlett*, Tate Research Publication, 2017, https://www.tate.org.uk/research/publications/in-focus/surface-substitution/art-and-maths, accessed 17 March 2019.
Gunn, Jennifer. "What is STEAM Education?" *Room 241*, *A Blog by Concordia University*, 8 Nov. 2017. https://education.cu-portland.edu/blog/leaders-link/importance-of-arts-in-steam-education/
Ouellette, Jennifer. "Pollock's Fractals," *Discover Magazine,* 31 Oct. 2001. https://www.discovermagazine.com/the-sciences/pollocks-fractals
Rockburne, Dorothea. "Points of Change; A Painter's Journey," *Brooklyn Rail*, 4 Sept. 2013. https://brooklynrail.org/2013/09/criticspage/points-of-change-a-painters-journey
Taylor, Richard, Micolich, Adam and Jonas, David. "Fractal analysis of Pollock's drip paintings," *Nature* 399, 422, 03 June 1999.

Valerio, Vladimiro. "Piero della Francesca's Sky in The Dream of Constantine," *The Inspiration of Astronomical Phenomena VI. ASP Conference Series*, Vol. 441. San Francisco: Astronomical Society of the Pacific, 2011, p.161, http://adsabs.harvard.edu/full/2011ASPC..441..161V, accessed 11 Dec. 2019.