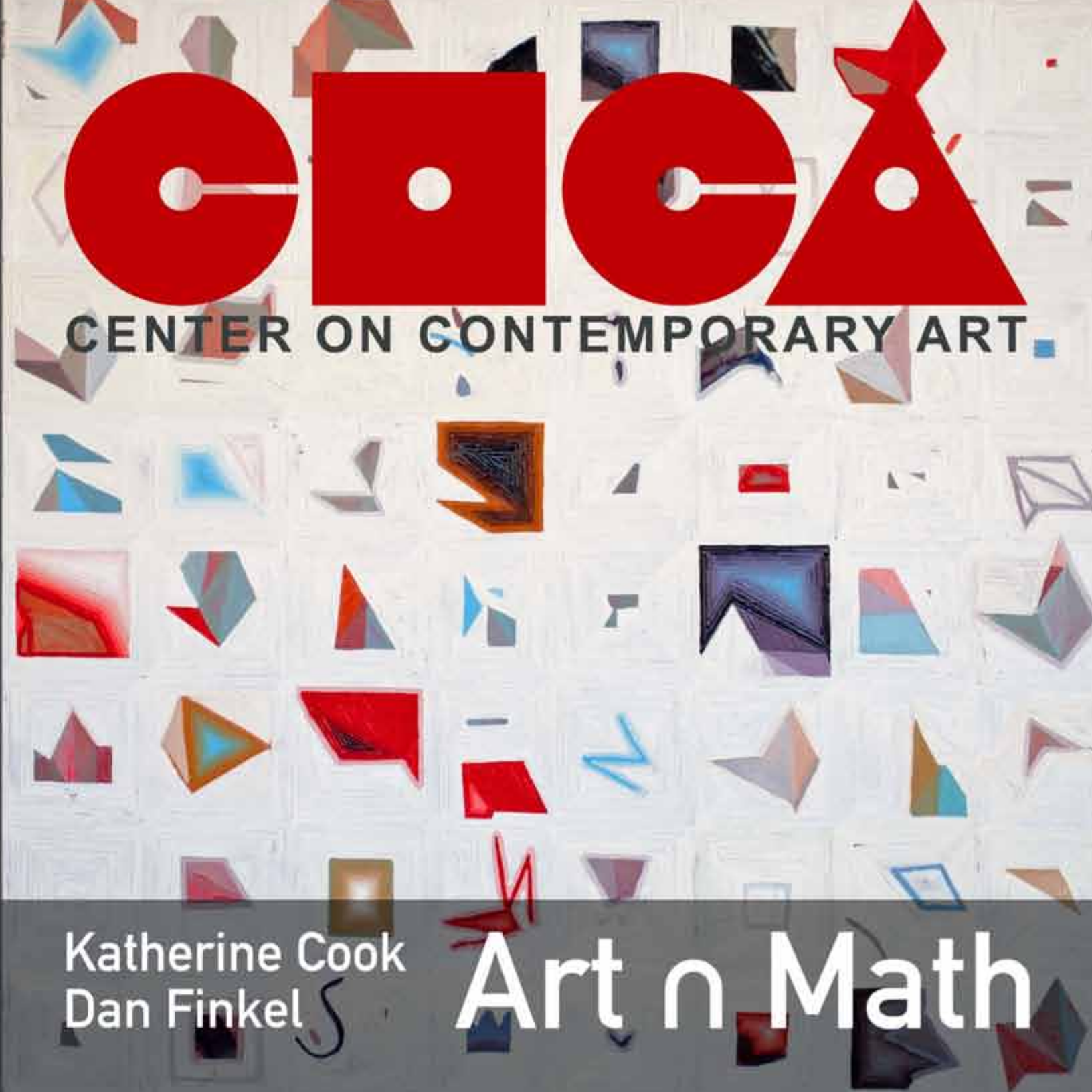
CCA
CENTER ON CONTEMPORARY ART
Katherine Cook
Dan Finkel
Art ∩ Math

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Sponsors

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Mission Statement:

CoCA Serves the Pacific Northwest as a Catalyst and Forum for the Advancement, Development, and Understanding of Contemporary Art.

Art ∩ Math

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photo by Erik Demaine and Martin Demaine

Something from Nothing from Nothing III
Erik Demaine and Martin Demaine, Elephant Hide Paper, 11 x 11 x 14", 2014

Art ∩ Math

"The first thing to understand is that mathematics is an art."
—Paul Lockhart, *A Mathematician's Lament,* 2009

This exhibit is a celebration of the artistry of mathematicians and the mathematics that inspires artists. The overlap between art and mathematics is large and full of astonishments. If anyone ever doubted that the questions and processes of mathematics were inherently linked to aesthetic experience, let the artworks in this show be evidence to the contrary.

Our producer, Kate Vrijmoet, came to us in the summer of 2017 with the idea to create an exhibit exploring the connections between art and mathematics. The seed of those early discussions grew into a dream: that an impression of the big picture of mathematics, with all the beauty and awe it entails, would become accessible in the artwork and writing of the show.

We believe mathematics is an art, and art is mathematical, and embracing the overlap reveals the true nature of both.

Welcome to a view of the intersection of art and mathematics.

Katherine Cook
Dan Finkel

Curators

What Is Math?

"Mathematics is for human flourishing"
—Francis Su, 2017

Here is the paradox of mathematics in our culture: math is promoted as beautiful, profound, indispensable. It is called the language of the universe, the poetry of reason, the most powerful creation of the human spirit. At same time, math confounds. A radio story concerning math comes on and the announcer begs their audience not to flee. Every equation added to a book halves its readership. Many people have an uneasy relationship with math at best, and it is common to hear expressions of distrust, distaste, confusion, anger, sadness, shame. If math is so beautiful, why are so many tormented by it?

What is math, really?

Mathematics is not, to be clear, simply a collection of procedures for solving arithmetic problems. Perhaps you imagine a mathematician at work in a chalky office, slowly and deliberately multiplying large numbers together by hand. Applying bland procedures to solve complicated arithmetic problems is of no interest in mathematics; when we need to do complicated arithmetic we use computers. Most of us don't need to do this kind of tedious work at all.

Mathematics is the study of pattern, structure, and reason. It is part art and part science. Science here does not refer to the natural sciences, though math has contributions to make there too. Rather, science means a systematically organized inquiry producing a body of knowledge built around a particular subject. In other words, the sciences use pattern, structure, and reason to make sense of a specific subject. Biology does this for life, physics for natural law, psychology for human behavior. So what is the subject of mathematics? While many sciences are pointed outward and make use of patterns and reason to systematically organize external knowledge, math is unusual in that it is pointed inward. Math also makes use of patterns and reason to systematically organize knowledge, but the subject it inquires into is the fundamental nature of patterns and reasoning themselves. One of the beautiful and strange features of mathematics is that by directing this capacity to order, sort, classify, and organize at *itself*, mathematical ideas and objects seem to materialize almost out of thin air. It is self-creating. It makes its own wind. It seems like magic.

Sometimes mathematicians make forward progress in organizing and sorting and ordering the knowledge of their discipline by figuring out how to create new objects or fields of study. This often happens by relating previously isolated ideas. Before Descartes, equations and geometric shapes lived in separate mathematical domains. He developed *graphing*, and suddenly two distinct worlds, algebra and geometry, could be understood as facets of a single, greater truth. This inspiration to connect, to see the same underlying behavior governing apparently dissimilar objects, is one of the great pleasures in mathematics.

Seeking relationships between things is an intuitive and creative act, not dissimilar from the way an artist begins exploring a new idea. Mathematics shares more in common with art than many people realize. The process of developing new material in mathematics is seeded by a creative, intuitive, and often aesthetic

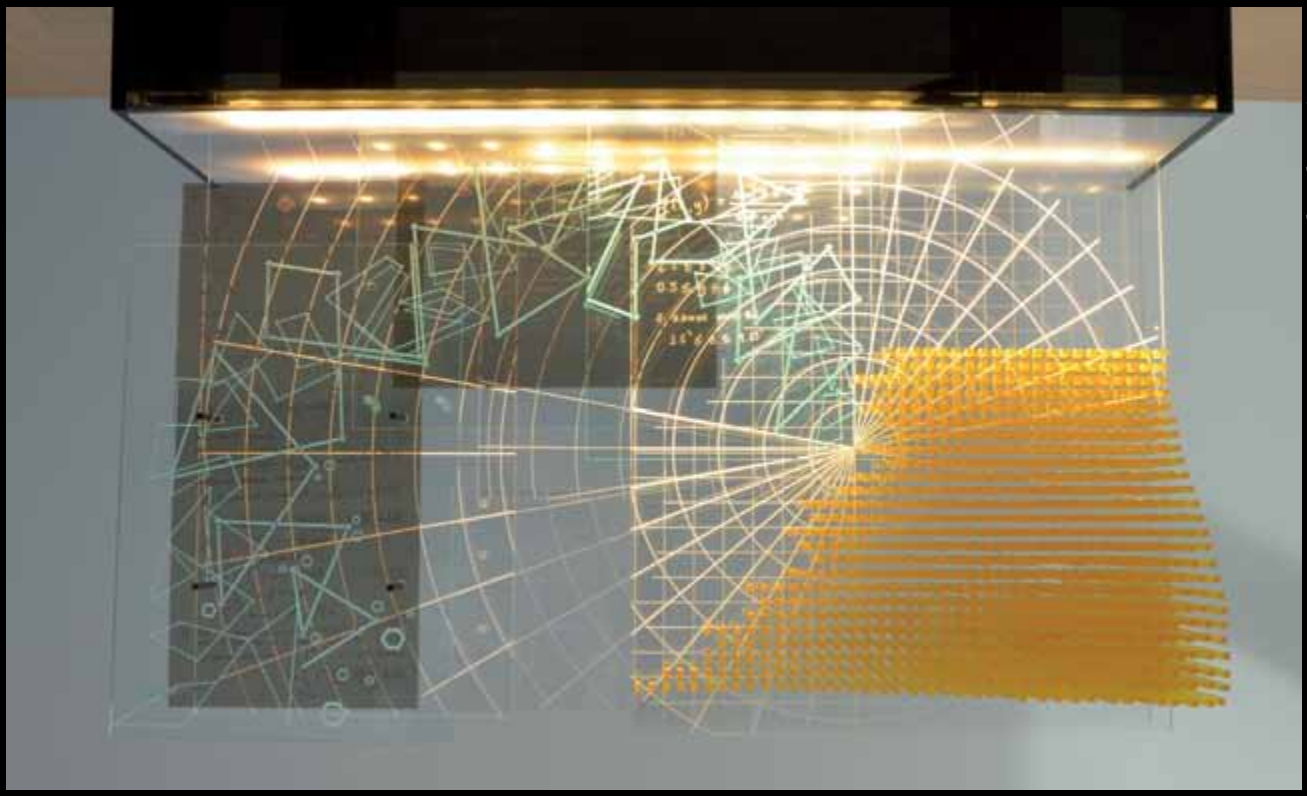

photo by Savina Mason

Sine Surface, Savina Mason, Acrylic and LED lights, 19 x 14 x 5.25", 2018

Savina Mason

There are several natural choices in how to organize your travel through the so-called Cartesian plane. The classic rectilinear coordinates connect to the xs and ys of high school algebra equations, and show us one picture. What if we change our squares for circles and look to so-called polar coordinates instead?

Sine Surface by Savina Mason shows the tension between these two choices. It presents the grid and the emanating concentric circles in an uneasy overlap, each perfectly designed to tell their own stories and perfectly inept at describing each other's.

And yet, with the advent of imaginary and complex numbers, a deeper underlying framework between the two formats, circle and square, could be understood, even though the details of the translation process from one to the other remained infinitely intricate.

photo by Suchitra Mattai

The Straight and Narrow, Suchitra Mattai, Thread on Vintage Needlepoint, 20 x 42", 2016

Suchitra Mattai

Straight and Narrow by Suchitra Mattai suggests the overlay of mathematics on the world, and how simplifying to the fundamentals reveals the true, raw laws of the universe. We see a forest, lit up with dusky fall colors; it may be sunset, and the sun is gentle, lighting the scene and reflecting it in the water. But pare away the details for a moment and a different tableau emerges: beams of light, perhaps, emerging mostly from the spot where the sun hides behind the clouds, form a prism shape above the water. In the water, and extending from it, a dual prism shape, skew-symmetric to the first, is reflected. The colors of the reflected shape suggest the effect of prisms on light, which separate white light into its component colored wavelengths. Here is the story of science told in a scene. We change our frame, alter our lens, and by selectively ignoring and enhancing, a drama of the fundamental nature of light and physics emerges in a scene we thought we already knew. Mathematics gives us the language and the tools to see these stories; art gives us a perspective to experience just how extraordinary they are.

photo by Wes Magyar, WM Services

Deep Within, Suchitra Mattai, Thread on Vintage Needlepoint, 20 x 42", 2016

impulse. The rules one follows toward the fruition of an idea may be different—following patterns and reason and logic in math, and following a heady mix of aesthetic, intuition, convention, etc. in art—but in some ways the arc is similar, beginning with a problem or direction, and proceeding into the unknown, expecting to be surprised. Like art, mathematics requires an aesthetic, and mathematicians use words like *beauty, elegance,* and *ugly* to describe their work, as in G. H. Hardy's remark from *A Mathematician's Apology, 1940:* "Beauty is the first test: there is no permanent place in the world for ugly mathematics."[1]

If an internal aesthetic guides mathematics, why is it useful at all? People have struggled to explain the unreasonable effectiveness of mathematics in the natural sciences. Nobody knows why math is the language the universe speaks, or why we as humans seem born with the capacity to understand it. Perhaps the universe speaks in several languages and math is the only one we can access. Perhaps we understand it because we are part of the universe too, another facet of the multiplicity of reality. We should be happy about it, in any case. The fact that mathematics is useful as well as beautiful provides us the means to understand our world; the art of the abstract is also the engine of the scientific process.

[1] Beauty is a complicated and subjective idea. We don't mean to suggest art or mathematics need to conform to any particular standard of beauty; only to say that there is an aesthetic sensibility that arises in mathematics as in art and lends a guiding hand to practitioners.

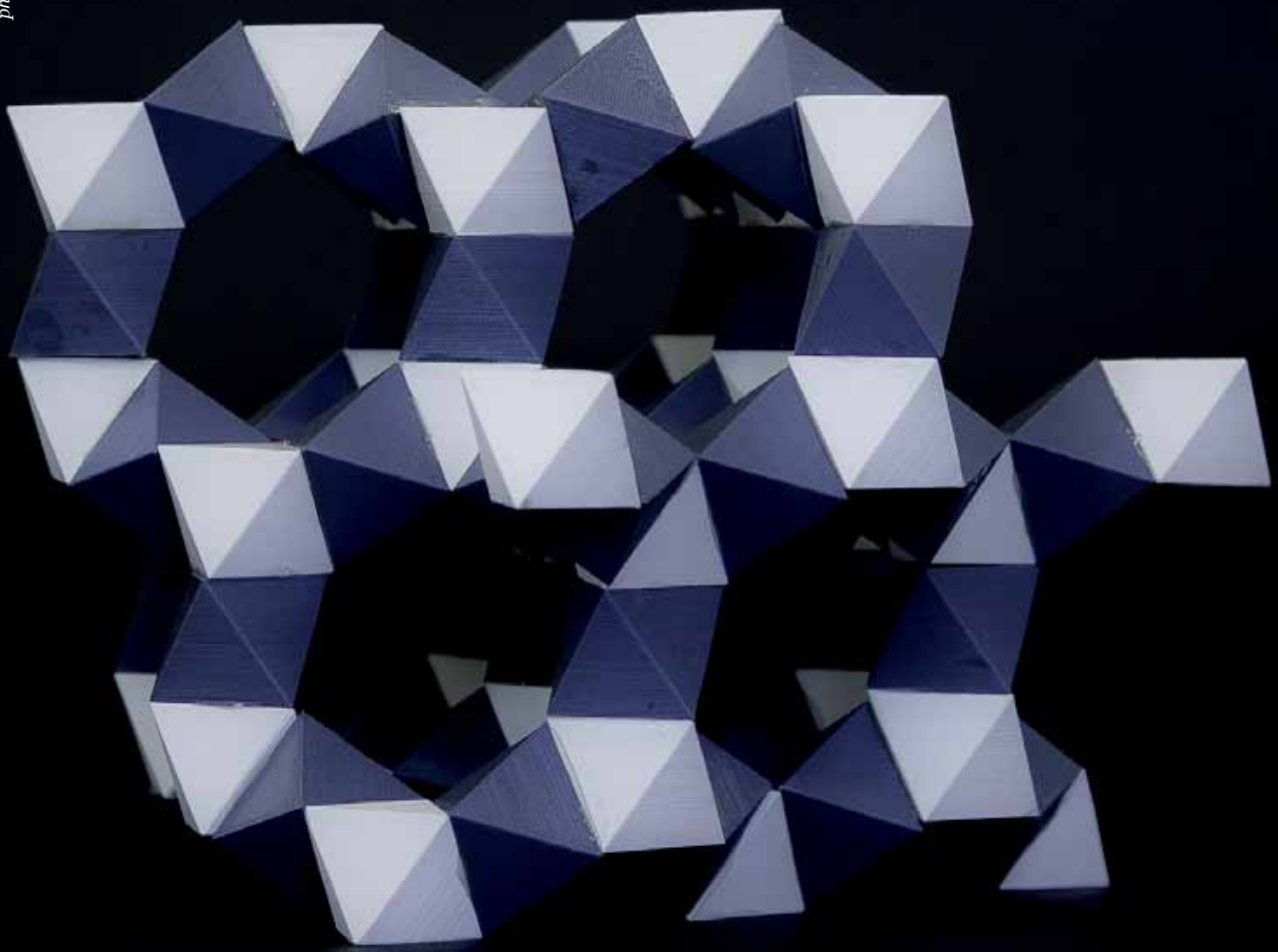

photo by Dan Paz

Example/Exception: Fermation, Jayadev Athreya, PLA, Glue, 10 x 10 x 10”, 2017

Equivalence

"Mathematics is the art of giving the same name to different things."
—Henri Poincaré, 1908

"It depends upon what the meaning of the word *is* is."
—Bill Clinton, 1998

When are things the same? What do we mean by 'the same'?

Sameness is the primary driver for the fundamental activity of sorting. Small children begin sorting early, and much of their play is based on the impulse to sort. Out of this behavior comes an early understanding of number, because number is one of several attributes that we use to say *this* is like *that*: this group of three squirrels is like that group of three trees. Not because of their shape or their color or their design, but because both have the quality of *threeness*. The group of squirrels and the group of trees are, with respect to number, the same. When we say things are similar or equivalent to one another with respect to a certain quality, we are saying that we are ignoring all the rest of the information except the quality we care about. Making this kind of mental abstraction is a move of great power, allowing us to simplify an exceedingly complex world down to manageable parts.

Sameness is the way in which things are classified as belonging together. Similarity is another word for this, as is equivalence, as is equality. Sameness can be determined with respect to many different qualities, not just number. Indeed, this process of deciding when and how things are the same is an important part of systematically organizing knowledge. We look at the world around us and classify what we see by domain, kingdom, phylum, class, order, family, genus, and species; by matter or energy; by baryon, lepton, fermion, photon; by the periodic table; by the DSM-5; by genre; by era; by age, shape, color, size; by anything and everything. We are sorting machines. We take in the mess of the world and turn out order and clarity.

This act of sorting or classifying is one of the great aims of mathematics: to understand, with respect to some meaning of *equivalent to*, when mathematical objects are the same or distinct. Mathematicians choose how to define equivalence, and then explore how that choice orders the universe of mathematical objects. Different choices of equivalence give different contexts, and alter our orderings profoundly. There is no mathematical truth so fundamental that it does not depend on context.

In fact, defining equivalence is often what defines a field of mathematics. In the field of knot theory, two loops are equivalent if one can be moved to form the other without any cutting or gluing. If you can disentangle a Gordian catastrophe and reduce it to a simple loop, we say the two are the same. Even more mind-blowing is the notion of equivalence applied to infinite sets. With respect to size alone, sets that appear different are actually