

Reflections on a year
at the
Museum of Mathematics

Steven Strogatz

National Museum of Mathematics (MoMath)



MoMath

- Opened in 2012
- Glen Whitney, George Hart, Cindy Lawrence
- 11 E 26th St (between Madison and Fifth Ave)
- Two floors
- 40 interactive exhibits

Square-wheeled tricycle



Hyperboloid as a ruled surface





Hyper Hyperboloid

Enter the cylindrical chamber and spin in the chair, creating a curved surface made entirely out of straight lines.



Solids of constant width

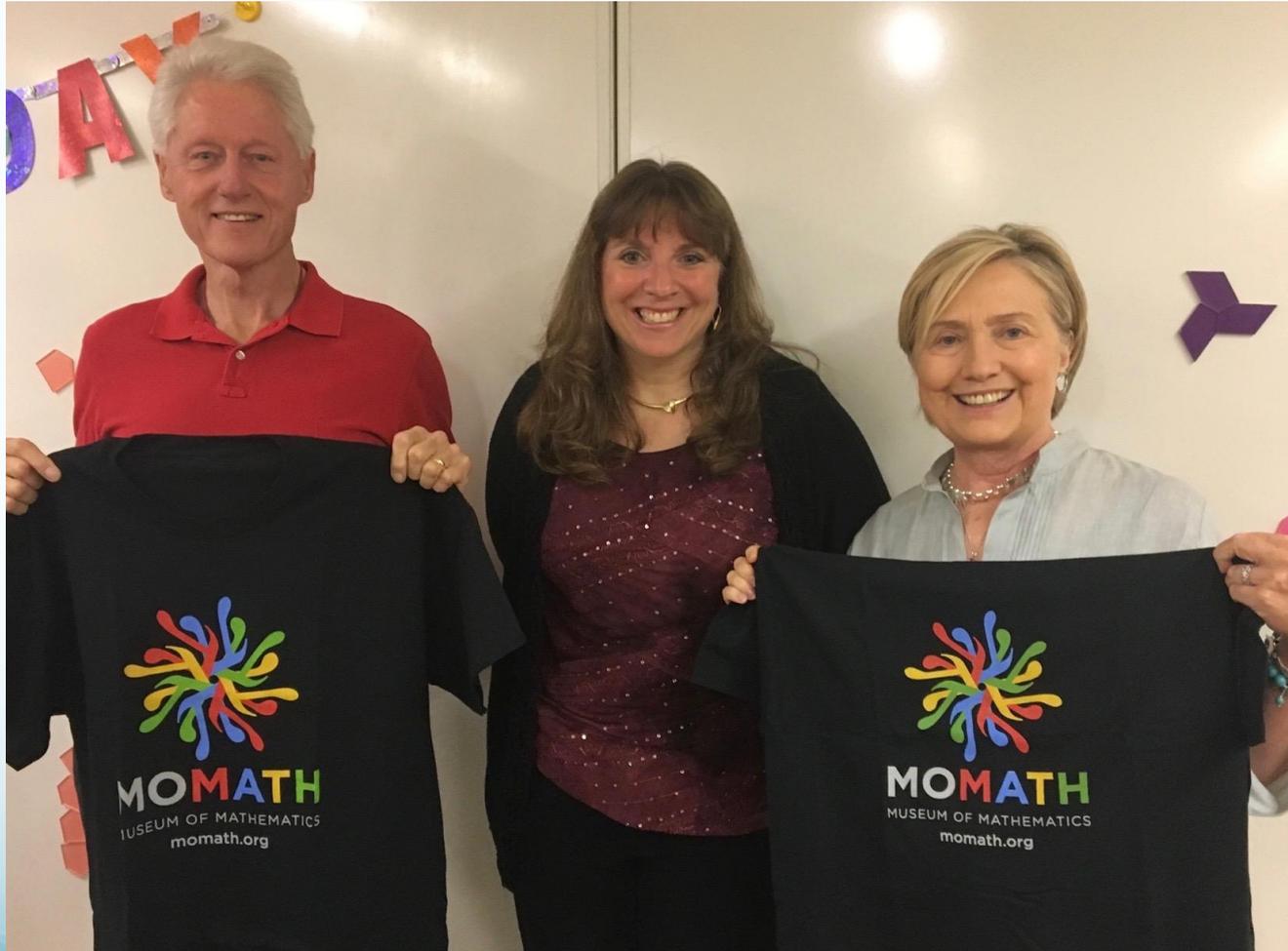


“Coaster rollers”





Cindy Lawrence and friends



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Distinguished Visiting Professor for the Public Dissemination of Mathematics

- Manjul Bhargava (2018-19)
- Peter Winkler (2019-20)
- Alex Kontorovich (2020-21)
- Steven Strogatz (2021-22)
- Tim Chartier (2022-23)
- Ingrid Daubechies (2023-24)

Minicourses

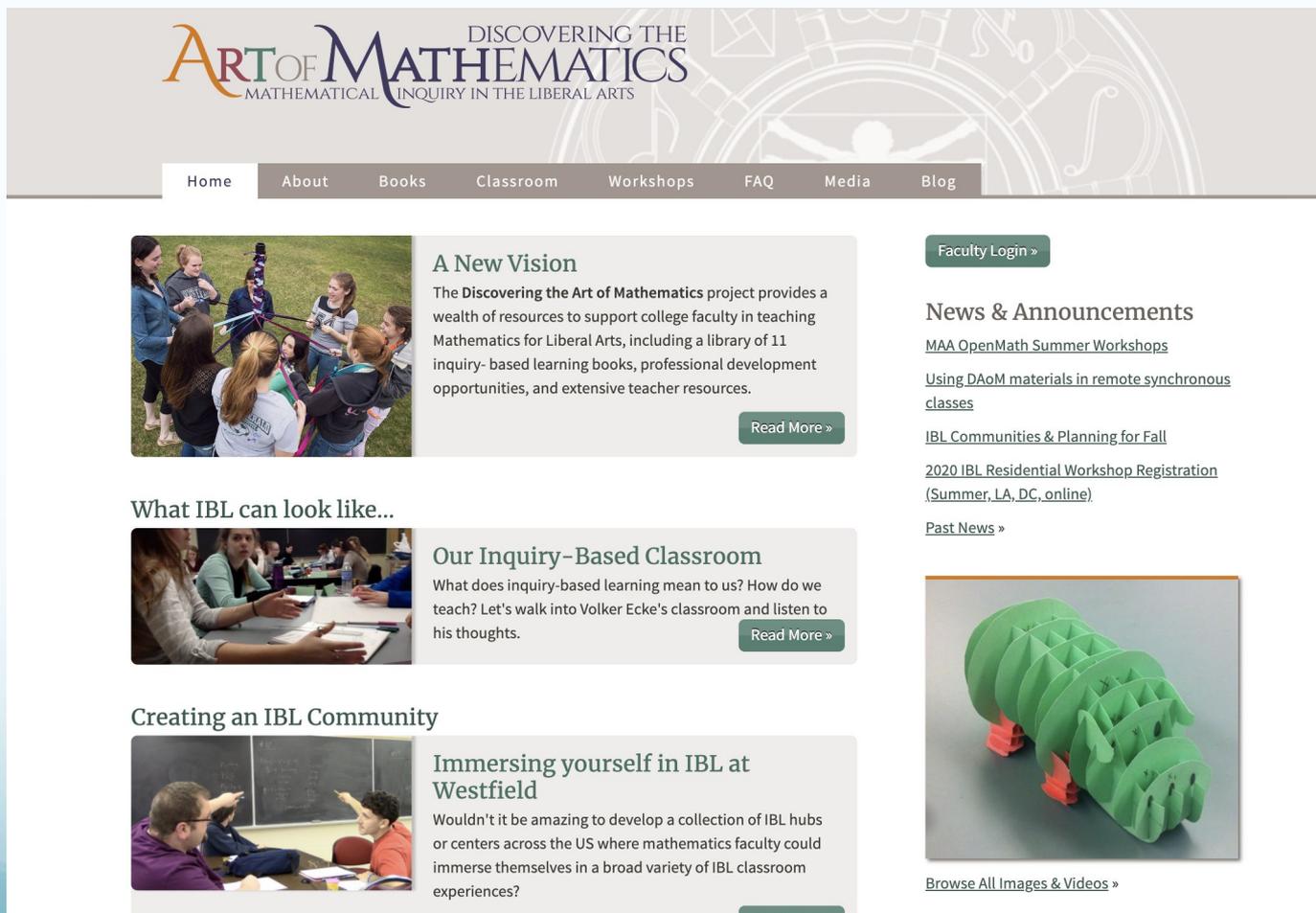
- ~ 5-10 people in person, 20-30 people on Zoom
- Fall: *Math Explorations*
- Spring: *Math Gems*
- Summer: *Ideas of Calculus in Islam and India*

Math Explorations

- eight-week minicourse
- participants worked individually or in small groups
- Learn about problem-solving, creativity, proofs, and mathematical resourcefulness.
- Open-ended topics outside the usual fare, e.g.,
 - straight-cut origami
 - taxicab geometry
 - billiards on rectangles
 - symmetries of frieze patterns
 - ...

Math Explorations

- Activities from “Discovering the Art of Mathematics”



The screenshot shows the homepage of the 'Discovering the Art of Mathematics' website. The header features the logo 'ART OF MATHEMATICS' with the tagline 'DISCOVERING THE MATHEMATICAL INQUIRY IN THE LIBERAL ARTS'. A navigation menu includes links for Home, About, Books, Classroom, Workshops, FAQ, Media, and Blog. The main content area is divided into several sections:

- A New Vision:** A section with a photo of a group of people outdoors. The text describes the project's resources for college faculty. A 'Read More »' button is present.
- What IBL can look like...:** A section with a photo of students in a classroom. The text discusses inquiry-based learning. A 'Read More »' button is present.
- Our Inquiry-Based Classroom:** A section with a photo of a student and a teacher. The text asks about inquiry-based learning. A 'Read More »' button is present.
- Creating an IBL Community:** A section with a photo of two students in a classroom. The text discusses developing IBL hubs. A 'Read More »' button is present.
- Immersion in IBL at Westfield:** A section with a photo of two students. The text discusses developing IBL hubs. A 'Read More »' button is present.
- Faculty Login:** A button labeled 'Faculty Login »'.
- News & Announcements:** A section with several links: 'MAA OpenMath Summer Workshops', 'Using DAoM materials in remote synchronous classes', 'IBL Communities & Planning for Fall', '2020 IBL Residential Workshop Registration (Summer, LA, DC, online)', and 'Past News »'.
- Images & Videos:** A 3D model of a green caterpillar-like object with red legs. A 'Browse All Images & Videos »' link is below it.

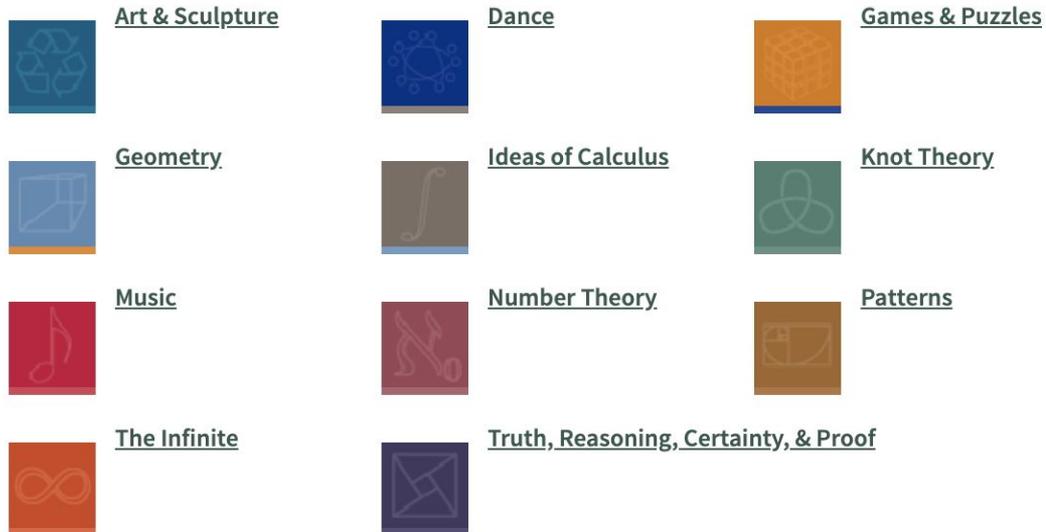
Free books from “Discovering the Art of Mathematics”

Books: Inquiry-Based Learning Guides

The DAoM library includes **11 inquiry-based books freely available for classroom use**. These texts can be used as semester-long content for themed courses (e.g. geometry, music and dance, the infinite, games and puzzles), or individual chapters can be used as modules to experiment with inquiry-based learning and to help supplement typical topics with classroom tested, inquiry based approaches (e.g. rules for exponents, large numbers, proof). The [topic index](#) provides an overview of all our book chapters by topic.

For a list of other inquiry-based learning materials (Calculus, Pre-Calculus, Algebra, K-12, etc.) take a look at a list of IBL materials we're aware of, we collected under [Resources](#).

Book Titles



Billiards on rectangles

DRAFT ©2018 Julian Fleron, Philip Hotchkiss, Volker Ecke, Christine von Renesse

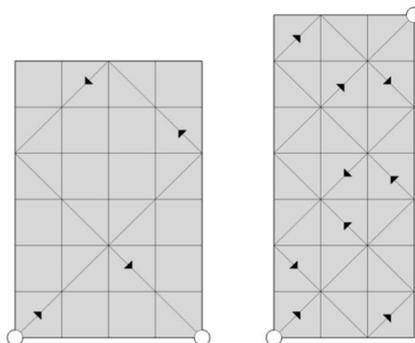


Figure 1.5: Orbits of balls on rectangular, 4-pocket pool tables with balls shot from the lower-left corner. A 4×6 table on the left and a 3×7 table on the right.

8. On a *global scale* of the whole path of the ball, what do you notice about the geometry of the individual paths?
9. Will this pattern, or some related pattern, continue when a single ball is shot on a real pool table? Explain.
10. Are there two, or more, tables where the orbit is (mathematically) **similar** (i.e. has the same shape that has been scaled to a different size)? If so, what do you notice about the dimensions of these tables? If not, make two tables on which the orbits are similar.
11. Create several more tables on which orbits are similar.
12. Formulate a statement which describes a pattern that characterizes *all* tables on which the balls' orbits are similar.
13. Are you certain that your statement will hold for all tables of this type? Explain.

In the table in the right of Figure 1.5 the ball crossed through the center of every square while on the table on the left the ball did not pass through the center of every square.

14. Find several tables on which the orbit fails to pass through every square on the table.
15. Find a pattern in the dimensions of these tables and then formulate a precise pattern which characterizes *all* such tables on which the ball fails to pass through every square.
16. Find several tables on which the orbit passes through every square on the table.

Mathematical Gems

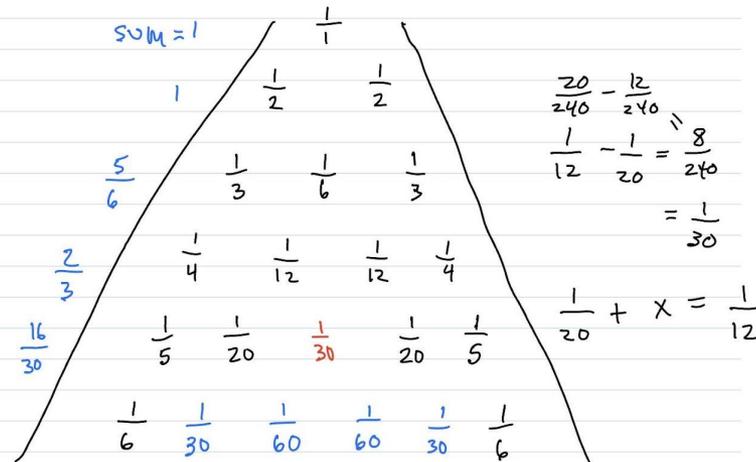
- Stories of great proofs, calculations, ideas, and other gems of mathematics from around the world.
- Topics included Leibniz and the harmonic triangle, Euler and the Basel Problem, Poincaré and visualizing solutions to differential equations, and many more.

Leibniz's harmonic triangle

9:44 AM Tue Dec 6

100%

Find the pattern -
What's the next row?



$\frac{1}{n}$, symmetry, Fran's n-1 rule for 2^{th} diagonal.

all numerators = 1



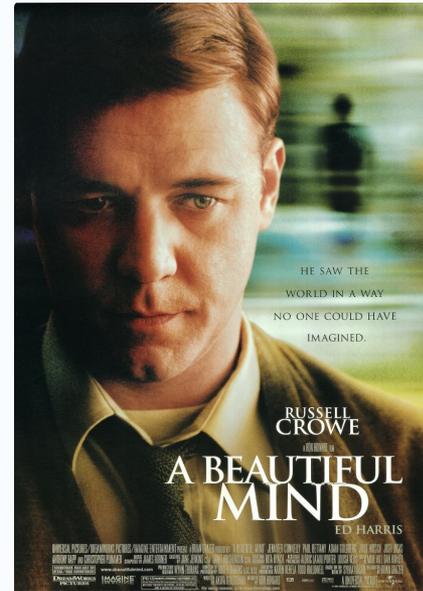
Ideas of Calculus in Islam and India

- Based on Victor Katz's article
- Examined two precursors to calculus that were developed long before Newton and Leibniz.
- Two sessions on Ibn al-Haytham's work on sums of integer powers (in tenth-century Egypt)
- Two sessions on Madhava's work on power series for sine and cosine (in fourteenth-century India).

Starring Math!

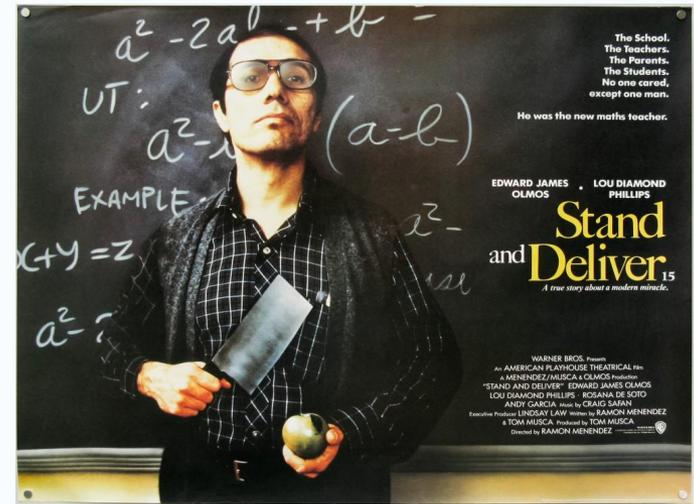
- A monthly movie discussion series
- Biopic or a documentary about a notable mathematician.
- The Zoom audience screened the movie ahead of time (on Netflix, Amazon Prime, Hulu, etc.).
- The event consisted of a discussion between me and a panel of experts – who could be the filmmakers themselves, or mathematicians who knew the mathematician featured in the film, or historians of the field in which the mathematician worked, or friends or family of the real-life mathematician portrayed in the film.
- The goal was to give the audience deeper insight into the mathematics behind the film, and to separate fact from fiction about the mathematician's life and work, while still appreciating the power of Hollywood movies to introduce wide audiences to important stories, people, and ideas.

A Beautiful Mind



- Guests:
- Prof. Silvain Cappell (NYU), who knew John Nash as a young man;
- Prof. Dave Bayer (Columbia), the math consultant for the film, as well as Russell Crowe's hand double for the mathematical scenes in the movie;
- Prof. Alex Kontorovich, who worked with Nash near the end of his life, at a time when Kontorovich was an undergraduate at Princeton.

Stand and Deliver



- The story of Mr. Jaime Escalante, an inspiring high school teacher in a poor neighborhood in East Los Angeles.
- He taught his students calculus, though many of his colleagues thought they were not capable of learning algebra.
- Guests: Writer/producer Tom Musca, and Professor Erika Tatiana Camacho and Thomas Valdez, two of Mr. Escalante's most successful former students
- Camacho is now a math professor at Arizona State
- Valdez is a Senior Member of the Engineering Staff for NASA's Jet Propulsion Laboratory, where he leads the Fuel Cell Group.

Movies and guests

- *Adventures of a Mathematician* (Thor Klein, George Dyson)
- *A Beautiful Mind* (Sylvain Cappell, Dave Bayer, Alex Kontorovich)
- *Stand and Deliver* (Tom Musca, Erika camacho, Thomas Valdez)
- *The Man Who Knew Infinity* (Matthew Brown, Ken Ono, Manjul Bhargava)
- *The Imitation Game* (Graham Moore, Janna Levin)
- *Hidden Figures* (Aprille Ericsson, Talitha Washington)
- *The Theory of Everything* (Brian Greene, Lisa Randall)
- *Moneyball* (Stan Chervin, Lee Mendelowitz)
- *Secrets of the Surface* (George Csicsery, Amie Wilkinson, Erica Klarreich)
- *The Proof* (Simon Singh and Kenneth Ribet)
- *Beautiful Young Minds* (Saul Glasman, Po-Shen Loh, and Geoff Smith)

Volumes

- [*Adventures of a Mathematician*](#) by S.M. Ulam (with Rebecca Ulam Weiner, George Dyson, Stephen Wolfram)
- [*The Joy of X*](#) by Steven Strogatz
- [*The Weil Conjectures*](#) by Karen Olsson
- [*The Calculus of Friendship*](#) by Steven Strogatz
- [*The Man from the Future*](#) by Ananyo Bhattacharya
- [*The Puzzler*](#) by A.J. Jacobs
- [*The Calculus of Happiness*](#) by Oscar E. Fernandez
- [*Journey to the Edge of Reason*](#) by Stephen Budiansky
- [*The Jazz of Physics*](#) by Stephon Alexander
- [*How to Free Your Inner Mathematician*](#) by Susan D'Agostino
- [*A Divine Language: Learning Algebra, Geometry, and Calculus at the Edge of Old Age*](#) by Alec Wilkinson

Meet a Mathematician

- Zoom interviews with mathematicians
- Grant Sanderson, creator of 3Blue1Brown, an exceptional popular and instructive YouTube math channel devoted to visualization and geometric insight.
- William Dunham, author of outstanding books on history of mathematics, including *Journey through Genius*, *Euler: The Master of Us All*, and *The Calculus Gallery*.
- Emily Riehl, category theorist and topologist, Johns Hopkins University.

Meet a Mathematician (continued)

- Tatiana Toro
- Benson Farb
- Mel Currie, NSA
- Francis Su
- Mariel Vazquez
- Talithia Williams
- Angela Tabiri
- Nalini Joshi

Ask a Mathematician - Anything!

- a monthly online discussion with the MoMath audience about any topic they were curious about

QED: Pitfalls for Parents

- A monthly online session with parents about their questions in mathematics education, or about the homework that their children were being assigned.
- I'd usually invite an award-winning K-12 teacher, often from Math for America, to join us for the discussion (to bring in an expert with firsthand knowledge).