Math in nature and art

Spring 2025

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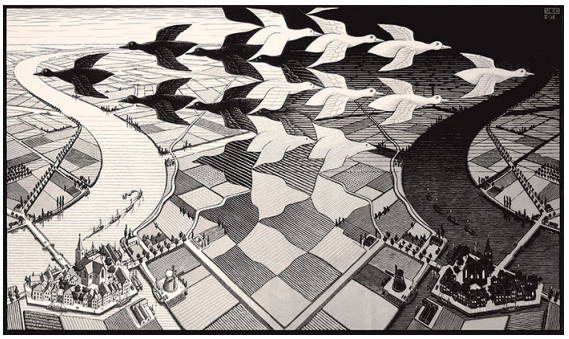
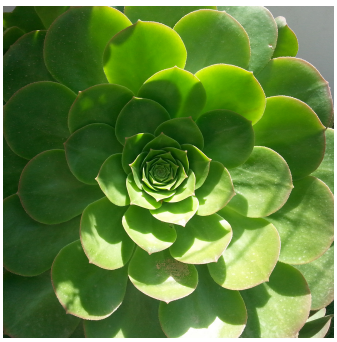
Time:	Tentatively Mondays 3-4 or 5-6pm	**Place:**	MSB: Room TBD

Description: Math is deeply woven into both nature and art, often appearing in places we might not even expect. Many people think that you have to be an expert in math to appreciate its beauty and complexity, but that's not the case! In this seminar, we will explore the mathematical patterns and relationships that shape the world around us. The major topics we will cover include symmetry, the golden ratio, Fibonacci spirals, fractals, and the numerical patterns that appear in both nature and human creativity.

Prerequisites: Must have thought at least one math concept was beautiful.

Sources: Math and Art: An Introduction to Visual Mathematics by Sasho Kalajdzievski. Various Math Circle activities.

Meeting Format and Expectations: We will meet once a week for 60 minutes during a time the works best for people. A typical meeting will look like 15-20 minutes of lecture from the mentors, then group discussions and/or activities for the rest of the time. There will potentially be some readings and problems outside of class but it will be kept to a minimum to not interfere with your coursework.

Tentative Seminar Outline:

- Meeting 1: Introductions
- Meeting 2: Fibonacci Sequence and spirals
  - The definition of the sequence and how it forms a spiral, golden ratio.
  - Flower petals, snail shells, pine cones and galaxies will be among the examples.
- Meeting 3: Symmetries
  - Groups of symmetries of planar objects, frieze patterns.
  - Some examples we will discuss include snowflakes, flowers, shells, plants, crystals, waves.
- Meeting 4: Tilings in art
  - Tilings of the plane. Discuss work from M.C. Escher.
- Meeting 5: Projections, reflection, and non-euclidean geometries.

  - Projections, reflections, how to make 2-d art 3-d using the concept of the point at infinity.

- Meeting 6: Fractals
  - Basic examples constructive, Koch snowflake, the Serpinski trizangy, some original hand coded ones like Indra's pearls.
  - Show examples of fractal like structure in nature, tree branches, romanesco.

- Meeting 7: Cellular Automata
  - Examine how complex systems can emerge from simple rules, fractal behavior, and applications to biological phenomena.
  - Conway's Game of Life, Rule 30.

- Meeting 8: Complexity of Shipping food
  - Talk about how difficult optimally shipping food is from a graph theoretic perspective.
  - Compute some small examples, talk about naive solutions for the distribution problem, encourage students to see how advancing math can help us solve clear tangible problems.

- Meeting 9: Student Presentations
  - Short 5-10 minute presentations on something interesting you learned about during the quarter!