Previous Topics Class Examples

The topics classes at Camp Sierpiński are a core part of the program. Each week, campers choose from a small set of advanced, curiosity-driven courses taught by mathematicians who emphasize deep, creative, and rigorous thinking.

Topics change from year to year (and session to session!) based on faculty interests, and we intentionally vary our offerings to ensure fresh and engaging options for returning students. These samples reflect the style, depth, and spirit of our topics classes: exploratory, rigorous, collaborative, and joyful.

For Summer 2026, we plan to offer three topics class options each week. **Please note that we do not announce the specific topics in advance.** On the first morning of each camp week, campers learn about the available options through short faculty presentations and submit a course preference form; their class then has its first meeting that afternoon. This approach encourages campers to choose based on what most sparks their curiosity and preserves the joy of discovering new ideas.

Tangled Tales: The Wonderful World of Knot Theory

Description: Did you know the same math that explains your tangled earbuds can help scientists understand statistical mechanics, quantum computation, pharmaceutical design, and even our own DNA? In this course, we will explore the mathematical concept of knots. In order to create a mathematical knot, take a piece of string or rope, tie a knot in it, and then glue the ends together. Our main task? Creating a comprehensive list of all possible knots - similar to how biologists catalog animal species in the natural world. But here is the challenge! How do we know that we have found a truly new knot versus just a disguised and tangled up version of one we already have listed? In order to distinguish knots, mathematicians invented the concept of knot invariants. In this course, we will discover some basic knot invariants and learn how to calculate them. Along the way, we will encounter problems that even professional mathematicians have not solved yet!

The Mathematics of SET

Description: SET is an extremely popular family game that is both easy to learn and fun and challenging for young and old alike. The mathematics behind the game is both deep and varied. The cards form what is called a finite affine geometry and many natural questions that arise in playing the game can be answered with tools from combinatorics, probability, modular arithmetic, and geometry.

In thinking about the game and some natural generalizations students will explore a more abstract notion of parallel lines and planes. We will see how modular arithmetic can help us figure out whether (and which!) card is missing from our deck The capstone of the course will appropriately be an exploration of the cap set problem which was solved for the standard game of SET in 1970 (4 years before the game was invented!) and remains an area of active research in more general cases even today.

Mathematical Games and How to Win Them

Description: "Believe it or not, there is a whole branch of mathematics that is all about games! But as mathematicians, we don't just play games -- we solve them. Solving a game means figuring out a strategy and proving that it always works. We will also see how games are a lot like numbers -- for example, you can add and subtract them!

The games that we'll be studying in this class are simpler than games you are familiar with, like chess or checkers, but they're still fun to play. And once you solve them, you can use them to impress your friends: you will win every time, and they will have no idea how you're doing it!

A Colorful Introduction to the World of Graphs

Description: This course is a friendly introduction to graph theory, a fascinating area of mathematics that's largely missing from standard school curricula. It's an engaging and accessible way for young students to explore advanced mathematical ideas. With just a basic understanding of algebra and a bit of curiosity, students can quickly progress to exploring intriguing and elegant results.

This course will introduce fundamental concepts, encouraging students to develop intuition through problem-solving and discovery. For the first several days, students will identify pairs of isomorphic graphs, discover the Handshake Lemma, and explore the basics of connectivity and degree sequences. During the second half of the course, the focus will shift to planar graphs, where students will work toward proving the Six-Color and Five-Color Theorems. Along the way, students will encounter key proof techniques, such as the concept of a minimal counterexample.

Through this course, students will experience the beauty and excitement of graph theory, gaining skills that extend beyond this subject and into broader mathematical thinking.

Measuring Infinity

Description: Not all infinities were created equally, and mathematicians have found various ways to measure the size of infinite sets, producing plenty of surprising results along the way. We will begin by studying infinite sets of natural numbers by analyzing the convergence or divergence of their reciprocal sums. We will then explore rational and irrational numbers, introducing Georg Cantor's famous idea of countable and uncountable sets. We will explore how mathematicians "measure" sets using outer measure, and we will use this to refine our understanding of countable and uncountable sets. Finally, we will study the size of the real numbers and discover how to construct even larger sets. In addition to gaining insight into the nature of infinity, in this course students will see mathematical ideas and results that will be useful throughout their math journey: prime numbers, geometric series, irrational numbers, countable and uncountable sets, and the Cantor set.

Modeling Hyperbolic Geometry

Description: Hyperbolic surfaces are complex, beautiful, and ubiquitous once you grow your math eyes and learn to spot them. From the ambitious Dorton Arena's roof in Raleigh to humble lettuce leaves, from Ariana Grande's skirt at the Oscars-2025 to the geometric basis of Einstein's theories of time and space, many things in nature and culture behave wildly differently from the Euclidean Flatland of the geometric plane.

Campers will create their own physical and computer models and art featuring hyperbolic surfaces and explore their properties. Triangles with angles that don't add up to 180 degrees, circumference-to-diameter ratio of 4, 5, or anything you wish, or many parallel lines through a given point? These are examples of subtle wonders that help us explore what it means to define, conjecture, and prove as we make a different kind of geometry from scratch.