



## Lyceum Seminars

### 1. Fun with Graphs

A graph is a simple mathematical structure that gives rise to some great games and puzzles. We'll start by introducing everybody in the seminar to each other using a graph (to find out how, you'll have to come to the seminar!). You'll learn about the famous Bridges of Königsberg problem discovered in the 18th century. In doing so, you'll explore graph tracing puzzles and learn some tricks that will help solve them. You'll finish the seminar by finding interesting patterns in graphs while playing some cooperative and competitive games.

### 2. Latin Squares, Art, Clocks, and Prime Numbers

The popular Sudoku puzzle is based on a mathematical object known as a Latin square. In this seminar you'll learn about Latin squares and how to solve Latin square and Sudoku puzzles. You'll create some pleasing artistic designs based on Latin squares. You'll also explore some alien worlds to find out how Latin squares are related to clocks! Even more amazing you'll discover how prime numbers are the link between Latin squares and clocks. And of course you'll get a Sudoku puzzle to solve.

### 3. Beyond Dominoes

Take away the spots from a domino and you'll have a rectangle made of two squares. We'll explore combining this domino shape in many ways and make an art project that shows how dominoes are related to seashells! You'll combine more than two squares to make tetrominoes (4 squares) and pentominoes (5 squares) and use these shapes to learn about area and parity and solve mathematical jigsaw puzzles. We'll have a contest to create unique shapes and areas and have prizes for the winners!

### 4. Magical Mathematical Squares and Circles

Numbers, squares, circles – you'll create some mystifying magic tricks to show your friends and family. You'll create a magic mystery number square that only you know the secret to. You'll learn a surprising fact about subtraction in the Magic Diamond Square. You'll discover some amazing properties of the number 9 in the Magic Circle trick. You will make your own versions of these tricks to take home and show your friends and family.

### 5. Hex-plorations

This seminar is a mixture of mathematics, art, magic, and games all based on the six-sided polygon known as a hexagon. You will solve a hexagon number puzzle that was unsolved for 47 years! You'll learn how to fold hexagons from paper strips to make magical color-changing hexagons. You'll explore hexagon symmetry, discover how circles and hexagons are related, and create artistic hexagon designs. We'll finish by playing some captivating games on hexagons with prizes for the winners!



## 6. Cubes Cubed

A cube is more than just a box-shaped object! In this seminar you'll explore all about cubes. You'll learn about the geometry of cubes and how to make cubes. You'll learn to draw cubes and combine cubes. You'll explore building with cubes and solve three-dimensional construction puzzles. You'll make a magical pop-up cube that builds itself and you get to take it home and surprise your friends with this one!

## 7. Fine Lines

A line is a very simple and plain geometric object. But combine lines in the right way and you get some very cool art! Or use lines to divide a house into rooms and discover the architecture of an alien world! Or search for train lines through a network of cities and you have a fun game! In this seminar you'll explore lines in new and interesting ways. In doing so you'll have fun doing art, solving puzzles, and playing games.

## 8. Curious Combinations and Puzzling Permutations

Explore the mathematics behind combinations and permutations through the art, anagrams, and shuffling playing cards. You'll discover mathematics of designing and slicing pizza that leads to a fun puzzle. You'll learn about anagrams and solve some word puzzles to explore permutations. Using permutations, you'll learn a magic trick with which you can amaze your friends and family.

## 9. Amazing Algorithms

An algorithm is a step-by-step procedure for solving a problem or attaining a goal. In this seminar you'll learn about algorithms by solving puzzles and playing games. You'll find your own algorithm to solve some real-world problems and also learn about some very difficult problems for which no good algorithms are available. You'll solve the famous Tower of Hanoi puzzle by finding an algorithm for its solution (don't try to execute the algorithm's procedure unless you have millions of years of time to complete it!).

## 10. More Fun With Graphs

Graphs are simple mathematical structures that give rise to some great puzzles and games. In this seminar you'll learn about graphs and play games on graphs. You'll learn about one of the most famous mathematical problems, the Four Color Problem, and solve some different coloring puzzles with maps, beads, and nets. You'll play games on graphs where you'll have to find the secret move to win.

Note: This material presented in this seminar does not overlap that of the "Fun With Graphs" seminar. It does not require "Fun with Graphs" as a prerequisite.

## 11. Numbers and Games

Do you like winning games? Then you'll definitely want to attend this seminar! We'll talk about different types of games and how some games can be added and subtracted just like numbers. Finding winning strategies in these games is simple arithmetic. In exploring these games, you'll rediscover familiar numbers like 0, 1, -1,  $\frac{1}{2}$ , ..., as well as a new number  $*$ . You'll learn how to make game calculators to find winning strategies. And we'll finish with a tournament to test your winning strategies with others in the seminar.



## **12. Cubes Cubed**

There's more to a cube than just 6 faces! In this seminar you'll explore all about cubes. You'll learn about the geometry of cubes, make some cubes in new ways, solve building puzzles based on cubes, and play games based on cubes. You'll never again look at a cube as just another boring shape made up of 6 faces, 12 edges, and 8 vertices!

## **13. Playing with Parity**

Don't know what parity is? Come and learn! It may surprise you but parity is used everywhere, from when you go shopping to when you watch TV. In this seminar, you'll explore how parity is used, solve extra-terrestrial puzzles, and learn some parity magic tricks.

## **14. Numbers and Patterns**

You've probably encountered number sequences like 2, 4, 6, 8, ... but do you know what the next number in the sequence 1, 5, 12, 22, 35, ... is? In this seminar you'll explore patterns of numbers and see how these patterns can be related to geometric shapes. You'll explore a variety of number puzzles, all of them involving squares full of numbers. You'll also learn some amazing magic tricks that you can show your family and friends.

