

CONTENTS

Introduction 7
How to Use This Book 8

1

Geometry: Learn About Shapes 11

Prisms and pyramids and Platonic solids, oh my!

- Lab 1: Prisms 12
- Lab 2: Pyramids 14
- Lab 3: Antiprisms 16
- Lab 4: Platonic Solids 18
- Lab 5: Perfect Circles 24
- Lab 6: Try a Triangle 26
- Lab 7: Exact Ellipses 28
- Lab 8: Draw Giant Circles and Ellipses 30

2

Topology: Mind-Bending Shapes 35

Learn about squeezable, squishable shapes and surfaces

- Lab 9: Compare and Classify Shapes 36
- Lab 10: Möbius Strips 38
- Lab 11: Möbius Surprise 42

3

Color Maps Like a Mathematician 45

Using the fewest number of colors possible, fill in a map so adjacent shapes are different

- Lab 12: Map Coloring Basics 46
- Lab 13: Efficient Map Coloring 50
- Lab 14: Squiggle Maps 54

4

Stitching Curves 57

Learn to create curves using only straight lines

- Lab 15: Drawing Parabolas 58
- Lab 16: Stitching Stars 62
- Lab 17: Creative Curves 64

5

Fantastic Fractals 67

A fractal is a shape that is similar to itself no matter how far you zoom in on one particular part

- Lab 18: Draw a Sierpinski Triangle 68
- Lab 19: Build a Sierpinski Triangle 70
- Lab 20: Draw a Koch Snowflake 74
- Lab 21: Draw a Square Fractal Snowflake 78
- Lab 22: Explore the Koch Snowflake's Perimeter 80



Terrific Tangrams 83

Solve ancient Chinese puzzles by making different shapes from the same seven pieces

Lab 23: Tangram Basics 84

Lab 24: Teaser Tangrams 86

Lab 25: Tougher Tangrams 88




Toothpick Puzzles 91

Create and solve brainteasers using patterns of toothpicks

Lab 26: Starter Toothpick Puzzles 92

Lab 27: Toothpick Puzzles: The Next Level 94

Lab 28: Challenging Toothpick Puzzles 96



The Game of Nim 99

Learn the game of Nim and develop a strategy to win every time

Lab 29: Learn to Play Nim 100

Lab 30: Win Nim: The Copycat Strategy 104

Lab 31: Copycat Nim as Player 1 106

Lab 32: Win Nim: $1 + 2 = 3$ Strategy 108



Graph Theory 111

Explore how points and edges are interconnected

Lab 33: Eulerian Circuits 112

Lab 34: Secrets of Eulerian Circuits Revealed 114

Lab 35: Bridges of Königsberg 116

Lab 36: The Euler Characteristic 118

Lab 37: A Proof About the Euler Characteristic 122

Pull-Outs 124

Hints and Solutions 131

Acknowledgments 142

About the Authors 142

Resources 142

Index 144