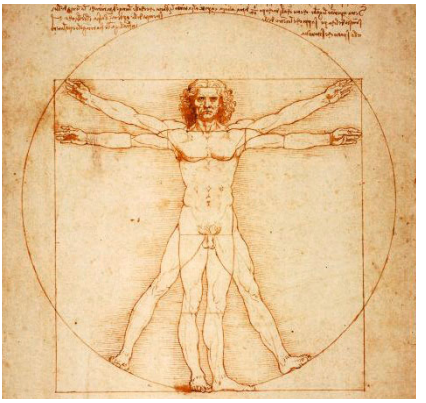
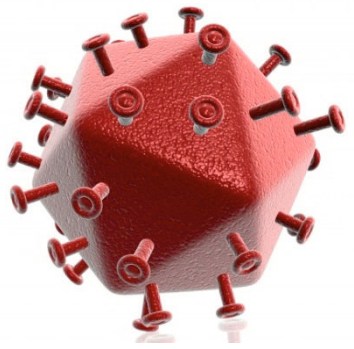
Preface



Vitruvian Man by Leonardo Da Vinci

Symmetry is a ubiquitous concept in mathematics and science. Certain shapes and images seem more symmetric than others, yet it is not immediately obvious how to best measure and understand an object's symmetry. In fact, the quest to more precisely understand symmetry has been a driving force in science and mathematics, and will form the central theme of this book. You will learn the ways in which mathematicians study the topic of symmetry.

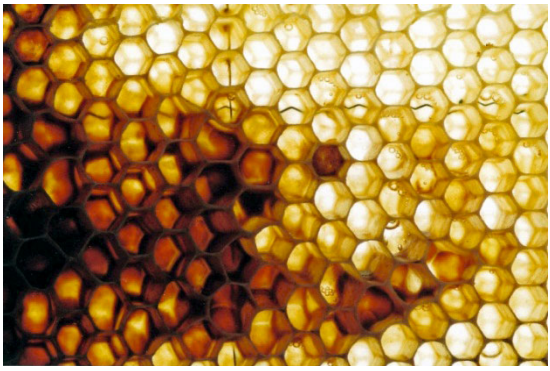


An icosahedral HIV virus

If you are curious about the mathematical patterns underlying the symmetry that you observe in the physical world, then this book is for you. Why are honeycombs hexagonal? Why are bubbles spherical? Why did the HIV virus evolve its icosahedral shape? What is the shape of the universe, and how might this shape be related to the shape of a virus? How can one understand the symmetry of molecules or crystal formations? How might the symmetry in a painting enhance its artistic appeal? Parts of these answers are found in other disciplines – biology, chemistry, physics, and art – but the common thread is mathematics. Mathematics provides the tools to understand and classify the possible types of symmetry that

objects may possess, which is a crucial prerequisite for addressing questions like those above.

No background beyond high school level algebra is required to read this book. The mathematical topics are drawn from diverse fields including graph theory, abstract algebra, linear algebra and topology, all of which are essential to rigorously study symmetry. Although some of these topics are advanced, the presentation in this book is intended to be precise and rigorous, yet accessible to a general audience. The only real prerequisite is that you discard any preconceived notions of what math is and is not, and begin this mathematical journey with an open mind and a willingness to begin actively doing what mathematicians do: discovering patterns, inventing precise language for discussing the mathematical principles underlying those patterns, forming conjectures, and eventually proving beautiful theorems.



Honeycomb photo by Ken Tapp

Intended Audience

This book is primarily intended as a textbook for a one-semester math course for math or non-math majors, including humanities majors, with the goal of encouraging effective analytical thinking and exposing students to elegant mathematical ideas. It includes some of the topics which are commonly found in sampler textbooks, such as Platonic solids, Euler's formula, irrational numbers, countable sets, permutations and a proof of the Pythagorean Theorem. All of these topics serve a single compelling goal: to understand the mathematical patterns underlying the symmetry that we observe in the physical world. I hope

that students from all majors will enjoy the many beautiful mathematical topics herein, and will come to better appreciate the powerful cumulative nature of mathematics as these topics are woven together into a single story about symmetry.

Instructor resources, including PowerPoint lectures and access to all images in the book, can be found at http://www.sju.edu/~ktapp/Symmetry

Acknowledgments

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