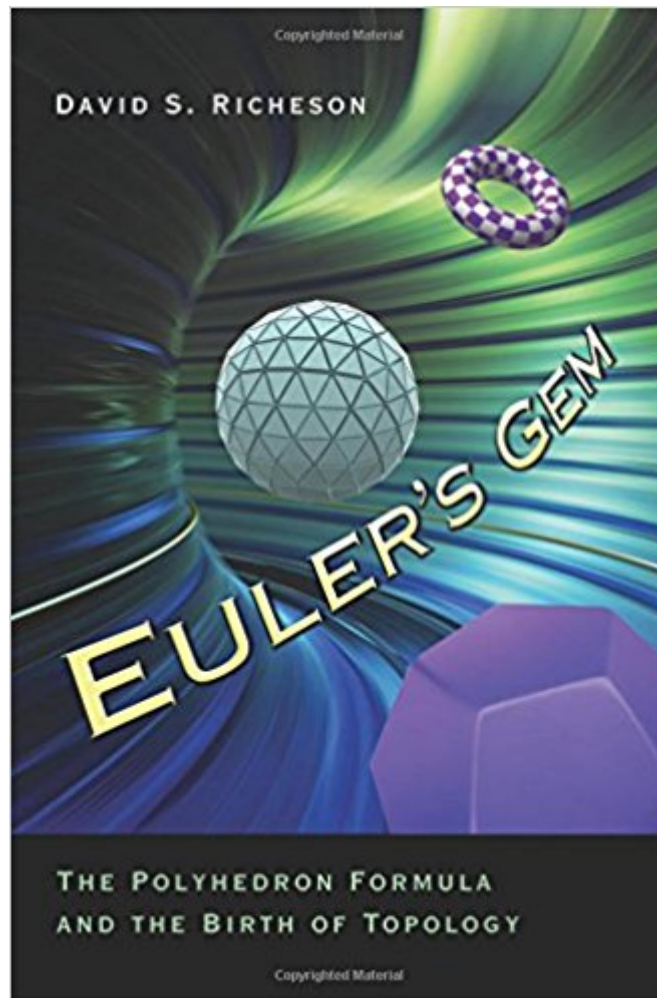




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# Euler's Gem: The Polyhedron Formula And The Birth Of Topology



## Synopsis

Leonhard Euler's polyhedron formula describes the structure of many objects--from soccer balls and gemstones to Buckminster Fuller's buildings and giant all-carbon molecules. Yet Euler's formula is so simple it can be explained to a child. Euler's Gem tells the illuminating story of this indispensable mathematical idea. From ancient Greek geometry to today's cutting-edge research, Euler's Gem celebrates the discovery of Euler's beloved polyhedron formula and its far-reaching impact on topology, the study of shapes. In 1750, Euler observed that any polyhedron composed of  $V$  vertices,  $E$  edges, and  $F$  faces satisfies the equation  $V-E+F=2$ . David Richeson tells how the Greeks missed the formula entirely; how Descartes almost discovered it but fell short; how nineteenth-century mathematicians widened the formula's scope in ways that Euler never envisioned by adapting it for use with doughnut shapes, smooth surfaces, and higher dimensional shapes; and how twentieth-century mathematicians discovered that every shape has its own Euler's formula. Using wonderful examples and numerous illustrations, Richeson presents the formula's many elegant and unexpected applications, such as showing why there is always some windless spot on earth, how to measure the acreage of a tree farm by counting trees, and how many crayons are needed to color any map. Filled with a who's who of brilliant mathematicians who questioned, refined, and contributed to a remarkable theorem's development, Euler's Gem will fascinate every mathematics enthusiast.

## Book Information

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## Customer Reviews

Winner of the 2010 Euler Book Prize, Mathematical Association of America One of Choice's Outstanding Academic Titles for 2009 "The author has achieved a remarkable feat, introducing a naïve reader to a rich history without compromising the insights and without leaving out a delicious detail. Furthermore, he describes the development of topology from a suggestion by Gottfried Leibniz to its algebraic formulation by Emmy Noether, relating all to Euler's formula. This book will be valuable to every library with patrons looking for an awe-inspiring experience."--Choice "This is an excellent book about a great man and a timeless formula."--Charles Ashbacher, *Journal of Recreational Mathematics* "I liked Richeson's style of writing. He is enthusiastic and humorous. It was a pleasure reading this book, and I recommend it to everyone who is not afraid of mathematical arguments and has ever wondered what this field of 'rubbersheet geometry' is about. You will not be disappointed."--Jeanine Daems, *Mathematical Intelligencer* "The book is a pleasure to read for professional mathematicians, students of mathematicians or anyone with a general interest in mathematics."--European Mathematical Society Newsletter "I found much more to like than to criticize in Euler's Gem. At its best, the book succeeds at showing the reader a lot of attractive mathematics with a well-chosen level of technical detail. I recommend it both to professional mathematicians and to their seatmates."--Jeremy L. Martin, *Notices of the AMS* "I highly recommend this book for teachers interested in geometry or topology, particularly for university faculty. The examples, proofs, and historical anecdotes are interesting, informative, and useful for encouraging classroom discussions. Advanced students will also glimpse the broad horizons of mathematics by reading (and working through) the book."--Dustin L. Jones, *Mathematics Teacher* "The book should interest non-mathematicians as well as mathematicians. It is written in a lively way, mathematical properties are explained well and several biographical details are included."--Krzysztof Ciesielski, *Mathematical Reviews*

"Euler's Gem is a thoroughly satisfying meditation on one of mathematics' loveliest formulas. The author begins with Euler's act of seeing what no one previously had, and returns repeatedly to the resulting formula with ever more careful emendations and ever-widening points of view. This highly nuanced narrative sweeps the reader into the cascade of interlocking ideas which undergird modern topology and lend it its power and beauty."--Donal O'Shea, author of *The Poincaré Conjecture: In Search of the Shape of the Universe* "Beginning with Euler's famous polyhedron formula, continuing to modern concepts of 'rubber geometry,' and advancing all the way to the proof of Poincaré's Conjecture, Richeson's well-written and well-illustrated book is a gentle tour de force of topology."--George G. Szpiro, author of *Poincaré's Prize: The Hundred-Year Quest to Solve*

One of Math's Greatest Puzzles" A fascinating and accessible excursion through two thousand years of mathematics. From Plato's Academy, via the bridges of Königsberg, to the world of knots, soccer balls, and geodesic domes, the author's enthusiasm shines through. This attractive introduction to the origins of topology deserves to be widely read."--Robin Wilson, author of *Four Colors Suffice: How the Map Problem Was Solved* "Appealing and accessible to a general audience, this well-organized, well-supported, and well-written book contains vast amounts of information not found elsewhere. Euler's Gem is a significant and timely contribution to the field."--Edward Sandifer, Western Connecticut State University "Euler's Gem is a very good book. It succeeds in explaining complicated concepts in engaging layman's terms. Richeson is keenly aware of where the difficult twists and turns are located, and he covers them to satisfaction. This book is engaging and a joy to read."--Alejandro López-Ortiz, University of Waterloo

Extremely well written book. And very well documented. It covers a very nice selection of material. My only reservation is that, while it may make the reader "wonder" and marvel, it doesn't have problems or puzzles to test and extend his/her understanding; i.e., the reader is encouraged to wonder, but not to think.

I often will flip through a new book reading short sections before starting from page 1. When I tried that with this book, I found I was so enthralled that I read each chapter through as I turned to it. Richeson makes this easy by keeping each chapter almost entirely self contained and independent of other chapters. I will be reading this one cover to cover. Never before have I had an entire branch of mathematics explained to me by a single book and at just the right depth of coverage to both give me a good grasp of each topic, and to make me want to dig deeper and learn more. I took topology in college, only to learn that it was elementary point-set topology. Nothing could be more dry and disappointing. Absent from the material presented was every topic I had heard of that fits under the umbrella of 'topology'. Well here in this one volume are the platonic and Kepler polyhedra, the bridges of Königsberg, graphy theory, knot theory, classification of surfaces, the 4 color theorem, the Poincare conjecture, Poincare-Hopf theorem, Brouwer fixed point theorem, and some algebraic topology. Amazingly, he ties it all together with the use of Euler's Formula. This is the book I should have had in college. Previously, I always looked for Paul Nahin's books. Now I will be looking for Richeson too.

This is a wonderful book. Even for a professional mathematician, there is much to learn from this

book. This book is an excellent example in how to write Mathematics. Even though I knew the Euler's formula and several proofs, the proof by Legendre took me completely by surprise - what a beauty! Richeson gently leads you to the final result through carefully chosen exploratory path so that at the final destination (pulling out Euler's formula from area calculation on a sphere) leaves you speechless! By the time you finish the book, you would have fallen madly in love with Topology.

I knew about Euler's formula from high school, but I'd never seen it connected with topology. This is such an easy way to approach topology and I wish my classes had started here, rather than with point sets and limits. It finally made it clear to me why people talk about rubber sheets when they talk about topology - it was completely not clear to me how this related to the stuff I'd learned about topology as a college student.

GREAT BOOK for college math majors. Students have been given this book as a gift for several years and I recently received an email from a student who still has it in her collection and loves to spend time re-reading.

I ran into this book because my ex professor recommended it (he didn't have a strong topology background). I already audited some courses in algebraic topology and graph theory before so this book to me is a page turner. But the book is so well written that even for layman, it should certainly be enjoyable, much more enjoyable than the notorious Love and Math...

I read this book after going through a series of books about mathematics aimed at the general public, including MacCormick's book about modern algorithms and a book about general mathematical logic and reasoning. This book gave an excellent overview of proofs and theorems in topology. The bridges of Königsberg and the Four Color problem being my favorites. Like any book about math, it can be a little dense sometimes, but I found it to be enjoyable more often than not.

Exceptionally well written and easy to follow. Makes a complicated topic understandable. One of my favorite books.

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