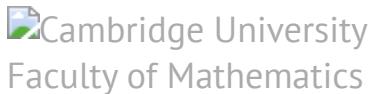


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NRich logo

Maths at Home  
Summer Challenges  
2024



# Recommended Books

Here is a list of books that we would recommend for young people who are interested in mathematics. They are grouped into three different categories:

- History of Mathematics
- Recreational
- Thinking Mathematically

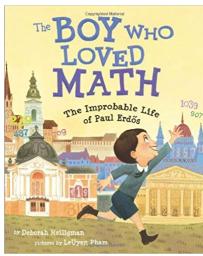
We have given each book a lower age band based on the content and language used in the book and have presented them in ascending order of age. This is merely a guideline and you are welcome to make your own judgements on whether or not a book is suitable.

If you'd like to see some book recommendations for younger learners, take a look at the [list of books compiled by our Primary team](#).

Students considering studying Maths or a related subject at university might be interested in the [Cambridge Mathematical Reading List](#), which contains a wide range of suggested books including historical, recreational and technical maths books.

There are lots of maths podcasts you can listen to. Why not try: BBC's [More or Less](#) podcast [Numberphile](#)'s videos and postcasts.

## History of Mathematics

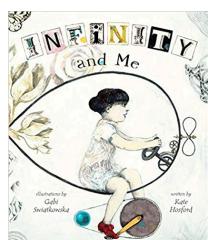
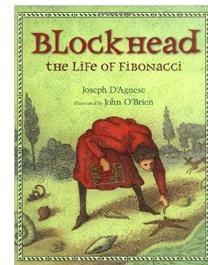


## The Boy Who Loved Math: The Improbable Life of Paul Erdős

**Age 7+** Most people think of mathematicians as solitary, working away in isolation. And, it's true, many of them do. But Paul Erdős never followed the usual path. At the age of four, he could ask you when you were born and then calculate the number of seconds you had been alive in his head. But he didn't learn to butter his own bread until he turned twenty. Instead, he traveled around the world, from one mathematician to the next, collaborating on an astonishing number of publications. With a simple, lyrical text and richly layered illustrations, this is a beautiful introduction to the world of math and a fascinating look at the unique character traits that made "Uncle Paul" a great man.

## Blockhead: The Life of Fibonacci

**Age 7+** As a young boy in medieval Italy, Leonardo Fibonacci thought about numbers day and night. He was such a daydreamer that people called him a blockhead. When Leonardo grew up and traveled the world, he was inspired by the numbers used in different countries. Then he realized that many things in nature, from the number of petals on a flower to the spiral of a nautilus shell, seem to follow a certain pattern. The boy who was once teased for being a blockhead had discovered what came to be known as the Fibonacci Sequence!



## Infinity and Me

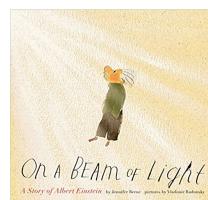
**Age 7+**

Uma can't help feeling small when she peers up at the night sky. She begins to wonder about infinity. Is infinity a number that grows forever? Is it an endless racetrack? Could infinity be in an ice cream cone? Uma soon finds that the ways to think about this big idea may just be ... infinite.

## On a Beam of Light: A Story of Albert Einstein

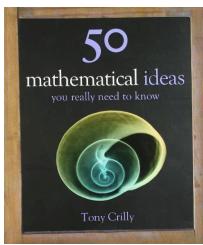
**Age 7+**

Travel along with Einstein on a journey full of curiosity, laughter, and scientific discovery. Parents and children alike will appreciate this moving story of the powerful difference imagination can make in any life.



## 50 Mathematical Ideas You Really Need to Know by Tony Crilly

**Age 11+**

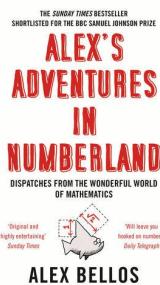
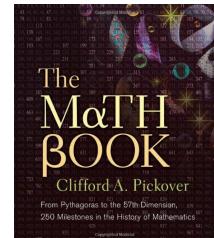


In this book, Professor Tony Crilly explains in 50 clear and concise essays the mathematical concepts - ancient and modern, theoretical and practical, everyday and esoteric - that allow us to understand and shape the world around us. Packed with diagrams, examples and anecdotes, this book is the perfect overview of this often daunting but always essential subject. For once, mathematics couldn't be simpler.

## The Math Book by Clifford A Pickover

Age 12+

Mathematic's infinite mysteries and beauty unfold in this book. Beginning millions of years ago with ancient ant odometers and moving through time to our modern-day quest for new dimensions, prolific polymath Clifford Pickover covers 250 milestones in mathematical history. Among the numerous concepts readers will encounter as they dip into this inviting anthology: cicada-generated prime numbers, magic squares, the discovery of pi and calculus, and the butterfly effect. Each topic is presented in a lavishly illustrated spread, including formulas, fascinating facts about scientists' lives and real-world applications of the theorems.



## Alex's Adventures in Numberland by Alex Bellos

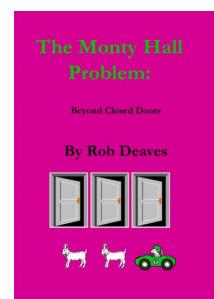
Age 13+

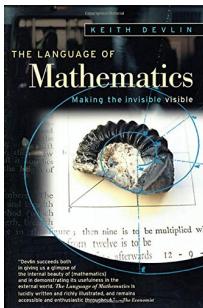
The world of maths can seem mind-boggling, irrelevant and, sometimes, boring. This groundbreaking book reclaims maths from the geeks. Mathematical ideas underpin just about everything in our lives: from the surprising geometry of the 50p piece to how probability can help you win in any casino. In search of weird and wonderful mathematical phenomena, Alex Bellos travels across the globe and meets the world's fastest mental calculators in Germany and a startlingly numerate chimpanzee in Japan. Packed with fascinating, eye-opening anecdotes, Alex's Adventures in Numberland is an exhilarating cocktail of history, reportage and mathematical proofs that will leave you awestruck.

## The Monty Hall Problem: Beyond Closed Doors by Rob Deaves

Age 14+

This short book explores the Monty Hall dilemma, a well known mathematical puzzle. The original problem, the controversy surrounding it and its solution are discussed. Further, the boundaries of the problem are expanded to consider prior knowledge and host intention. This book should be of interest to those who enjoy problem solving.





## The Language of Mathematics by Keith Devlin

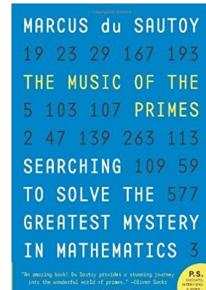
Age 14+

In *The Language of Mathematics*, award-winning author Keith Devlin reveals the vital role mathematics plays in our eternal quest to understand who we are and the world we live in. More than just the study of numbers, mathematics provides us with the eyes to recognize and describe the hidden patterns of life. Devlin shows us what keeps a jumbo jet in the air, explains how we can see and hear a football game on TV, allows us to predict the weather, the behavior of the stock market, and the outcome of elections. Far from a dry and esoteric subject, mathematics is a rich and living part of our culture. An exploration of an often woefully misunderstood subject, this book celebrates the simplicity, the precision, the purity, and the elegance of mathematics.

## The Music of the Primes by Marcus du Sautoy

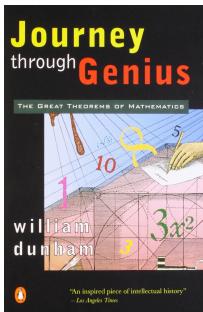
Age 14+

How can one predict when the next prime number will occur? Is there a formula which could generate primes? These apparently simple questions have confounded mathematicians ever since the Ancient Greeks. In 1859, the brilliant German mathematician Bernhard Riemann put forward a hypothesis which finally seemed to reveal a magical harmony at work in the numerical landscape. The promise that these eternal, unchanging numbers would finally reveal their secret thrilled mathematicians around the world. Yet Riemann never publicly provided a proof for his hypothesis and his housekeeper burned most of his personal papers on his death. Whoever cracks Riemann's hypothesis will go down in history, for it has implications far beyond mathematics. In business, it plays a central role in security and e-commerce. In science, it brings together vastly different areas, with critical ramifications in Quantum Mechanics, Chaos Theory and the future of computing. Pioneers in each of these fields are racing to crack the code and a prize of \$1 million has been offered to the winner. As yet, it remains unsolved.



## Journey Through Genius: The Great Theorems of Mathematics by William Dunham

Age 14+

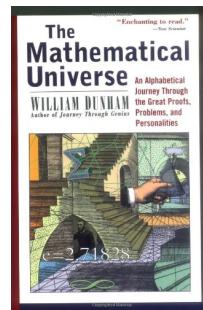


In this book Dunham treats mathematical theorems as creative works of art. He places each theorem within its historical context and explores the very human and often turbulent life of the creator. He studies such great mathematicians as Archimedes, Gerolamo Cardano and Georg Cantor. He also provides step-by-step

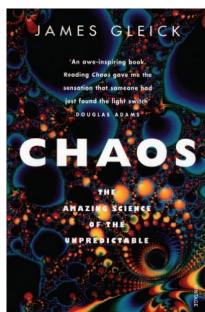
proofs for the theorems, each easily accessible to readers with no more than a knowledge of high school mathematics.

## The Mathematical Universe: Alphabetical Journey Through the Great Proofs, Problems & Personalities by William Dunham

Age 14+



In this book, Dunham takes us through a tantalizing selection of the great proofs, notorious disputes, and intriguing unsolved mysteries of the mathematical universe. Subjects range from the golden age of Greek geometry to the furthest frontier of infinite series. Dunham explores more than five thousand years of mathematical history, digging into the earliest records in Egypt, Babylon, India, and China, and turning up surprising tales and tidbits from modern times. All along the way, Dunham portrays the great masters of mathematics at their work. In colorful anecdotes, the brilliant - often eccentric - luminaries chart the course of mathematical progress. This book is accessible to any reader with a basic knowledge of algebra and geometry. You will come away from this exhilarating book with a keen sense of the power and splendor of the magical mathematical world.



## Chaos by James Gleick

Age 14+

Chaos is what happens when the behaviour of a system gets too complicated to predict; the most familiar example is the weather, which apparently cannot be forecast accurately more than five days ahead. This book tells the story so far in the study of this new field of Physics.

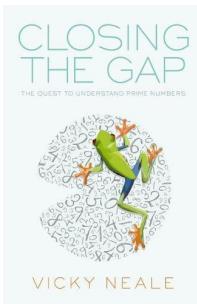
## Euclid's Window: The Story of Geometry from Parallel Lines to Hyperspace by Leonard Mlodinow

Age 14+



Anyone who thought geometry was boring or dry should prepare to be amazed. Despite its worthy cover this book is exactly what its title says - a story - and the plot of this story involves life, death and revolutions of understanding and belief. It stars some of the most famous names in history, from Euclid who laid the logical foundations, to Albert Einstein, who united space and time in a single non-Euclidean geometry. It offers an alternative history of mathematics, revealing how simple questions anyone might ask about space - in the living room or in some other galaxy - have been the hidden engines of the highest achievements in science and technology.

## Closing the Gap: The Quest to Understand Prime Numbers by Vicky Neale



Age 14+

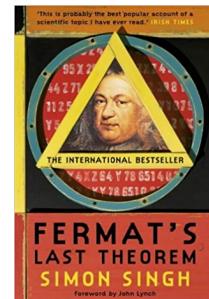
Prime numbers have intrigued, inspired and infuriated mathematicians for millennia. Every school student studies prime numbers and can appreciate their beauty, and yet mathematicians' difficulty with answering some seemingly simple questions about them reveals the depth and subtlety of prime numbers. In this book, Vicky Neale charts the recent

progress towards proving the famous Twin Primes Conjecture, and the very different ways in which the breakthroughs have been made: a solo mathematician working in isolation and obscurity, and a large collaboration that is more public than any previous collaborative effort in mathematics. Interleaved with this story are highlights from a significantly older tale, going back two thousand years and more, of mathematicians' efforts to comprehend the beauty and unlock the mysteries of the prime numbers.

### Fermat's Last Theorem by Simon Singh

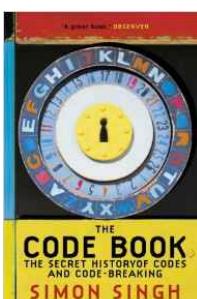
Age 14+

The story of the solving of a puzzle that has confounded mathematicians since the 17th century. In 1963, a schoolboy browsing in his local library stumbled across the world's greatest mathematical problem: Fermat's Last Theorem, a puzzle that every child can understand but which has baffled mathematicians for over 300 years. Aged just ten, Andrew Wiles dreamed that he would crack it. Wiles's lifelong obsession with a seemingly simple challenge set by a long-dead Frenchman is an emotional tale of sacrifice and extraordinary determination. In the end, Wiles was forced to work in secrecy and isolation for seven years, harnessing all the power of modern maths to achieve his childhood dream. Many before him had tried and failed, including a 18-century philanderer who was killed in a duel. An 18-century Frenchwoman made a major breakthrough in solving the riddle, but she had to attend maths lectures at the Ecole Polytechnique disguised as a man since women were forbidden entry to the school.



### The Code Book by Simon Singh

Age 14+



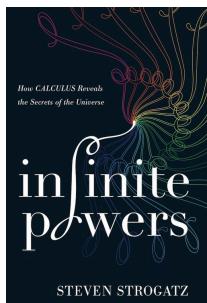
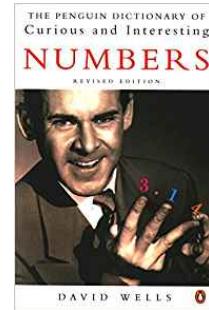
The Code Book is a history of man's urge to uncover the secrets of codes, from Egyptian puzzles to modern day computer encryptions. As in Fermat's Last Theorem, Simon Singh brings life to an astonishing story of puzzles, codes, languages and riddles that reveals man's continual pursuit to disguise and uncover, and to work out the secret languages of others. Codes have influenced events throughout history, both in the stories of those who make them and those who break them. The

betrayal of Mary Queen of Scots and the cracking of the enigma code that helped the Allies in World War II are major episodes in a continuing history of cryptography. In addition to stories of intrigue and warfare, Simon Singh also investigates other codes, the unravelling of genes and the rediscovery of ancient languages and most tantalisingly, the Beale ciphers, an unbroken code that could hold the key to a 20 million dollar treasure.

### **The Penguin Dictionary of Curious and Interesting Numbers by David Wells**

Age 14+

Look up 1729 to see why it is 'among the most famous of all numbers'. Look up 0.7404 ( $= \frac{\pi}{18}$ ) to discover that this is the density of closely packed identical spheres in what is believed by many mathematicians (though it was at that time an unproven hypothesis) and is known by all physicists and greengrocers to be the optimal packing. Look up Graham's number (the last one in the book), which is inconceivably big: even written as a tower of powers ( $9^{9^{\cdot\cdot\cdot}}$ ) it would take up far more ink than could be made from all the atoms in the universe. It is an upper bound for a quantity in Ramsey theory whose actual value is believed to be about 6. A book to be dipped into at leisure.



### **Infinite Powers by Steven Strogatz**

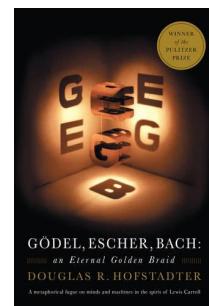
Age 14+

Calculus has a fierce reputation as complicated, abstract and difficult, but Steven Strogatz tells the true story of its beauty and simplicity. Starting with the Ancient Greeks, calculus has tantalised and fascinated humanity for millenia. Its applications grew from teaching us how to determine the area of a circle with only sand and a stick to safely launching rockets into space. Without it, we wouldn't have mobile phones, TV, GPS, or ultrasound. This book explains the history of our relationship with calculus, and its relationship with infinity.

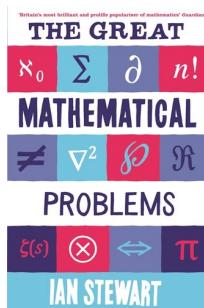
### **Gödel, Escher, Bach: An Eternal Golden Braid by Douglas Hofstadter**

Age 16+

Douglas Hofstadter's book is concerned directly with the nature of maps or links between formal systems. However, according to Hofstadter, the formal system that underlies all mental activity transcends the system that supports it. If life can grow out of the formal chemical substrate of the cell, if consciousness can emerge out of a formal system of firing neurons, then so too will computers attain human intelligence. Gödel, Escher, Bach



is a wonderful exploration of fascinating ideas at the heart of cognitive science: meaning, reduction, recursion, and much more.



### The Great Mathematical Problems by Ian Stewart

Age 17+

There are some mathematical problems whose significance goes beyond the ordinary - like Fermat's Last Theorem or Goldbach's Conjecture - they are the enigmas which define mathematics. This book explains why these problems exist, why

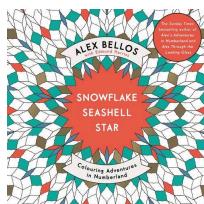
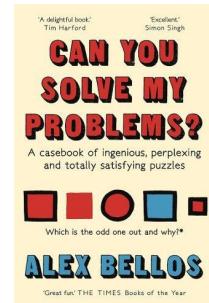
they matter, what drives mathematicians to incredible lengths to solve them and where they stand in the context of mathematics and science as a whole. It contains solved problems - like the Poincaré Conjecture, cracked by the eccentric genius Grigori Perelman, who refused academic honours and a million-dollar prize for his work, and problems which, like the Riemann Hypothesis, remain baffling after centuries. Stewart is the guide to this mysterious and exciting world, showing how modern mathematicians constantly rise to the challenges set by their predecessors, as the great mathematical problems of the past succumb to the new techniques and ideas of the present.

## Recreational

### Can you Solve my Problems? by Alex Bellos

Age 11+

This book contains 125 of the world's best brainteasers from the last two millennia, taking us from ancient China to medieval Europe, Victorian England to modern-day Japan, with stories of espionage, mathematical breakthroughs and puzzling rivalries along the way. Some solutions rely on a touch of cunning, others call for creativity, others need mercilessly logical thought. All are guaranteed to sharpen your mind!



### Snowflake Seashell Star by Alex Bellos and Edmund Harriss

Age 11+

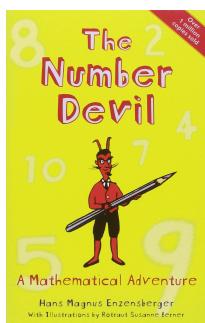
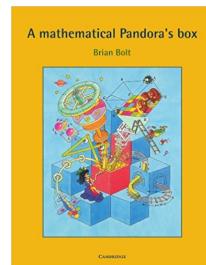
This book is the first in a series of mathematical colouring books by Alex Bellos and mathematical artist, Edmund Harriss. It is full of intricate and divinely beautiful illustrations, using patterns such as loops, waves and spirals. Stretch your artistic talents and embrace mathematics' aesthetic and conceptual exquisiteness. In 80 glorious images, Alex will teach you how to convey the wonder of mathematics through colour and design. Snowflake, Seashell,

Star is an incredible celebration of the overlaps between mathematics and art, learning and play, concentration and calm.

### A Mathematical Pandora's Box by Brian Bolt

Age 11+

Through his own experience, Brian Bolt has discovered a worldwide interest in mathematical puzzles. Bolt not only uses them to stimulate creative thinking, but also to open up new areas of mathematics to the reader. This book contains 142 activities: in addition to puzzles, there are games, tricks, models and explanation of various phenomena. They range from number manipulation, through happy and amicable numbers, coin puzzles, picnicking bears and pentominoes, to building shapes with cubes. There is a detailed commentary at the end of the book, giving solutions and explanations, together with the occasional follow-up problem.



### The Number Devil by Hans Magnus Enzensberger

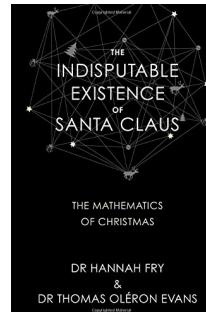
Age 11+

The quirky and unusual story of a young boy who hates maths at school, but who discovers a new side to the subject when he meets an unusual mathematician in a dream. This book takes you on an adventure through creative mathematical thinking, with great illustrations along the way.

### The Indisputable Existence of Santa Claus by Hannah Fry and Thomas Oléron Evans

Age 11+

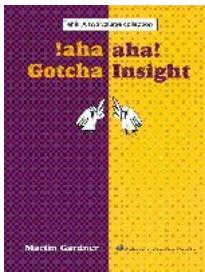
How do you apply game theory to select who should be on your Christmas shopping list? Can you predict Her Majesty's Christmas Message? Will calculations show Santa is getting steadily thinner - shimmying up and down chimneys for a whole night - or fatter - as he tucks into a mince pie and a glass of sherry in billions of houses across the world? Full of diagrams, sketches and graphs, beautiful equations, Markov chains and matrices, this book brightens up the bleak midwinter with stockingfuls of mathematical marvels. Mathematics has never been merrier.



### Aha! Insight & aha! Gotcha by Martin Gardner

Age 11+

Previously published separately, the two books *aha! Gotcha* and *aha! Insight* have been combined as a single volume. The *aha!* books, as they are referred to by fans of

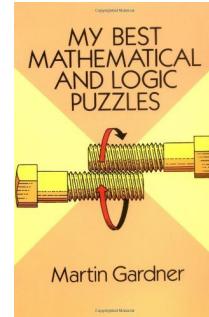


Martin Gardner, contain 144 wonderful puzzles from the reigning king of recreational mathematics. In this combined volume, you will find puzzles ranging over geometry, logic, probability, statistics, number, time, combinatorics, and word play. Gardner calls these puzzles aha! problems, that 'seem difficult, and indeed are difficult if you go about trying to solve them in traditional ways. But if you can free your mind from standard problem solving techniques, you may be receptive to an aha! reaction that leads immediately to a solution. Don't be discouraged if, at first, you have difficulty with these problems. After a while you will begin to catch the spirit of offbeat, nonlinear thinking, and you may be surprised to find your aha! ability improving.'

## My Best Mathematical and Logic Puzzles by Martin Gardner

Age 11+

Over a period of 25 years as author of the Mathematical Games column for Scientific American, Martin Gardner devoted a column every six months or so to short math problems or puzzles. This volume contains a rich selection of 70 of the best of these brain teasers, in some cases including references to new developments related to the puzzle. Now enthusiasts can challenge their solving skills and rattle their egos with such stimulating mind-benders as The Returning Explorer, The Mutilated Chessboard, Scrambled Box Tops, The Fork in the Road, Bronx vs. Brooklyn, Touching Cigarettes, and 64 other problems involving logic and basic math. Solutions are included.



## The Thrilling Adventures of Lovelace and Babbage by Sydney Padua

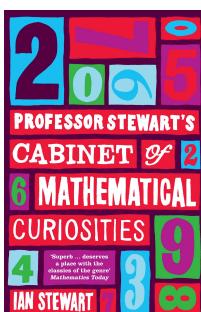
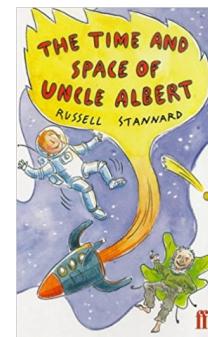
Age 11+

In this book Sydney Padua transforms one of the most compelling scientific collaborations into a hilarious set of adventures, starring Ada Lovelace and Charles Babbage. This book presents a delightful alternate reality in which Lovelace and Babbage build the Difference Engine and use it to create runaway economic models, battle the scourge of spelling errors, explore the wider realms of mathematics and, of course, fight crime - for the sake of both London and science. Extremely funny and utterly unusual, this book comes complete with historical curiosities, extensive footnotes and never-before-seen diagrams of Babbage's mechanical, steam-powered computer. And ray guns.

## The 'Uncle Albert' Series by Russell Stannard

Age 11+

A best selling science/adventure series, beginning with 'The Time and Space of Uncle Albert'. Uncle Albert and his intrepid niece, Gedanken, enter the dangerous and unknown world of a thought bubble. Their mission: to unlock the deep mysteries of Time and Space... Discover why you can't break the ultimate speed barrier, how to become older than your mother, how to put on weight without getting fat, and how to live forever without even knowing it. Other books in the series include: 'Black Holes and Uncle Albert' and 'Uncle Albert and the Quantum Quest'.



### **Professor Stewart's Cabinet of Mathematical Curiosities by Ian Stewart**

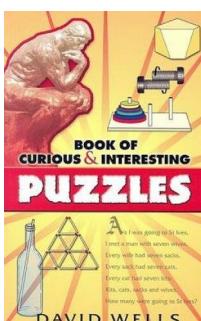
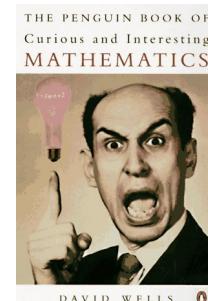
Age 11+

A selection of mathematical puzzles, stories, tricks and short articles - great to read all in one go, or to dip into. The content varies between simple logic puzzles to introductions to more advanced topics such as the Four Colour Theorem, which tells us that we can colour in any map using only four colours, so that no bordering countries have the same colour.

### **Book of Curious & Interesting Mathematics by David Wells**

Age 11+

A collection of strange mathematical facts and stories. This anthology covers a whole range of ages, maths and mathematicians, and includes probability paradoxes, jumbled Shakespearean sonnets, record-breaking monkeys and typewriters, and theories of big game hunting. Also featured are stories of people who looked for logical loopholes in the American Constitution or calmed their nerves with algebra.



### **Book of Curious & Interesting Puzzles by David Wells**

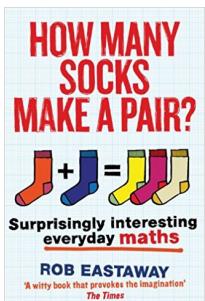
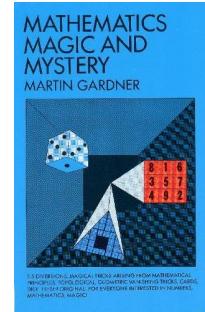
Age 11+

This collection by best-selling author David Wells, a Cambridge math scholar and teacher, includes more than 560 puzzles, from the "mind sharpeners" of a medieval monk to the eighteenth-century Ladies' Diary, the Hindu Bhakshali manuscript, and riddles and popular rhymes. None require any mathematics beyond the most elementary algebra and geometry - and few require even that. Complete answers appear at the end.

## **Mathematics, Magic and Mystery by Martin Gardner**

Age 12+

Famed puzzle expert Martin Gardner explains the mathematics behind a multitude of mystifying tricks: card tricks, stage "mind reading," coin and match tricks, counting out games, geometric dissections, etc. Each of these are actually demonstrations of probability, sets, number theory, topology and other branches of mathematics. No skill at sleight of hand is needed to perform the more than 500 tricks described in this book because mathematics guarantees their success.



## **How Many Socks Make a Pair? by Rob Eastaway**

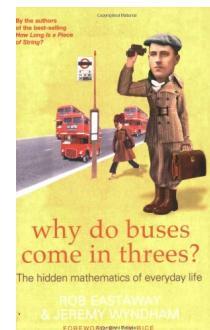
Age 13+

Can maths be creative? This book sets out to prove that it can, through a selection of short articles on surprising maths in everyday life. Through lots of intriguing problems, involving card tricks, polar bears and, of course, socks, Rob Eastaway shows how maths can demonstrate its secret beauties in even the most mundane of everyday objects.

## **Why do Buses Come in Threes? by Rob Eastaway and Jeremy Wyndham**

Age 13+

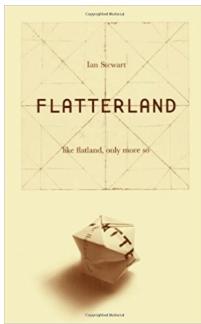
With a foreword by Tim Rice, this book will change the way you see the world. Why is it better to buy a lottery ticket on a Friday? Why are showers always too hot or too cold? And what's the connection between a rugby player taking a conversion and a tourist trying to get the best photograph of Nelson's Column? These and many other fascinating questions are answered in this entertaining and highly informative book, which is ideal for anyone wanting to remind themselves - or discover for the first time - that maths is relevant to almost everything we do. Dating, cooking, travelling by car, gambling and even life-saving techniques have links with intriguing mathematical problems, as you will find explained here. Whether you have a PhD in astrophysics or haven't touched a maths problem since your school days, this book will give you a fresh understanding of the world around you.



## **Flatterland by Ian Stewart**

Age 13+

In 1884, Edwin A. Abbott published "Flatland"; a brilliant novel about mathematics and philosophy that charmed and fascinated all of England. Now, Ian



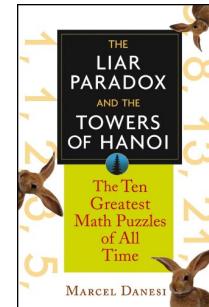
Stewart has written a fascinating, modern sequel to Abbott's book. Through larger-than-life characters and an inspired story line, "Flatterland" explores our present understanding of the shape and origins of the universe, the nature of space, time, and matter, as well as modern geometries and their applications.

### The Liar Paradox and the Towers of Hanoi: 10 Greatest Math Puzzles of All Time by

Marcel Danesi

Age 14+

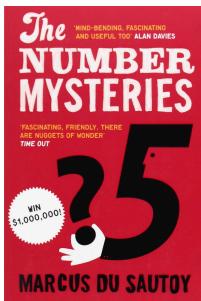
Ever since the Sphinx asked his legendary riddle of Oedipus, riddles, conundrums, and puzzles of all sizes have kept humankind perplexed and amused. The Liar Paradox and the Towers of Hanoi takes die-hard puzzle experts on a tour of the world's most enduringly intriguing braintwisters, from KÄfÄ¶nigsberg's Bridges and the Hanoi Towers to Fibonacci's Rabbits, the Four Color Problem, and the Magic Square. Each chapter introduces the basic puzzle, discusses the mathematics behind it, and includes exercises and answers plus additional puzzles similar to the one under discussion. Here is a veritable kaleidoscope of puzzling labyrinths, maps, bridges, and optical illusions that will keep aficionados entertained for hours.



### The Number Mysteries by Marcus du Sautoy

Age 14+

An exploration of surprising ways maths occurs in our everyday lives, centred around five famous unsolved problems in mathematics. Topics include how to detect an art forgery, winning strategies in Monopoly, and how to crack a code.

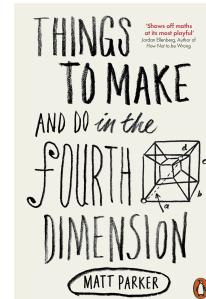


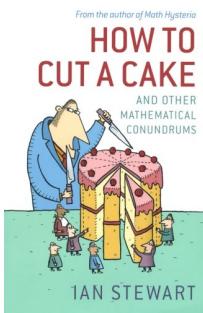
Sprinkled with games and links to interactive online content so you can try out some of the ideas for yourself!

### Things to Make and Do in the Fourth Dimension by Matt Parker

Age 14+

This is the complete guide to exploring the fascinating world of maths you were never told about at school. Stand-up comedian and mathematician Matt Parker uses bizarre Klein Bottles, unimaginably small pizza slices, knots no one can untie and computers built from dominoes to reveal some of the most exotic and fascinating ideas in mathematics. Starting with simple numbers and algebra, this book goes on to deal with inconceivably big numbers in more dimensions than you ever knew existed. And always with something for you to make or do along the way.





## How to Cut a Cake: and Other Mathematical Conundrums by Ian Stewart

Age 14+

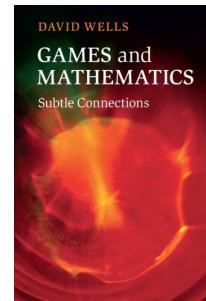
In this book are twenty more curious puzzles and fantastical mathematical stories from one of the world's most popular and accessible writers on mathematics. This is a strange world of never-ending chess games, empires on the moon, furious

fireflies, and, of course, disputes over how best to cut a cake. Each chapter - with titles such as, "How to Play Poker By Post" and "Repealing the Law of Averages" - presents a fascinating mathematical puzzle that is challenging, fun, and introduces the reader to a significant mathematical problem in an engaging and witty way. Illustrated with clever and quirky cartoons, each tale will delight those who love puzzles and mathematical conundrums.

## Games and Mathematics by David Wells

Age 14+

The appeal of games and puzzles is timeless and universal. In this book, David Wells explores the fascinating connections between games and mathematics, proving that mathematics is not just about tedious calculation but imagination, insight and intuition. The first part of the book introduces games, puzzles and mathematical recreations, including knight tours on a chessboard. The second part explains how thinking about playing games can mirror the thinking of a mathematician, using scientific investigation, tactics and strategy, and sharp observation. Finally the author considers game-like features found in a wide range of human behaviours, illuminating the role of mathematics and helping to explain why it exists at all. This thought-provoking book is perfect for anyone with a thirst for mathematics and its hidden beauty; a good high school grounding in mathematics is all the background that is required, and the puzzles and games will suit pupils from 14 years.

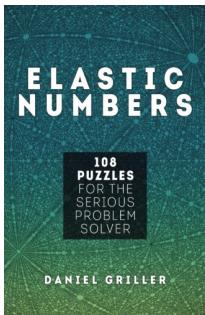


## Mathematical Puzzles: A Connoisseur's Collection by Peter Winkler

Age 16+

Collected over several years by Peter Winkler, dozens of elegant, intriguing challenges are presented in this book. The answers are easy to explain, but without this book, devilishly hard to find. Creative reasoning is the key to these puzzles. No involved computation or higher mathematics is necessary, but your ability to construct a mathematical proof will be severely tested - even if you are a professional mathematician. For the truly adventurous, there is even a chapter on unsolved puzzles.

# Thinking Mathematically



## Elastic Numbers by Daniel Griller

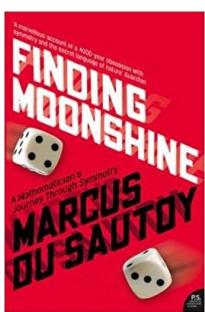
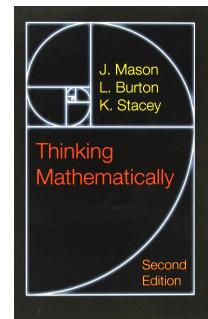
Age 11+

Beautifully crafted and immensely enjoyable, the problems in this book require minimal technical knowledge, being accessible to young secondary school pupils. However, there is an astonishing range in difficulty; while some of the problems are fairly straightforward, others are significantly tougher, with a great deal of ingenuity and clarity of thought needed to make progress. Whether you are a student preparing for a maths competition, an educational establishment seeking to supplement your problem solving resources, or an individual looking for a different sort of challenge, Elastic Numbers is a unique collection, and will push you to the very edge of your abilities.

## Thinking Mathematically by Mason, Burton & Stacey

Age 11+

Thinking Mathematically is perfect for anyone who wants to develop their powers to think mathematically, whether at school, at university or just out of interest. This book is invaluable for anyone who wishes to promote mathematical thinking in others or for anyone who has always wondered what lies at the core of mathematics. Thinking Mathematically reveals the processes at the heart of mathematics and demonstrates how to encourage and develop them. Extremely practical, it involves the reader in questions so that subsequent discussions speak to immediate experience.



## Finding Moonshine: A Mathematician's Journey Through Symmetry by Marcus Du Sautoy

Age 13+

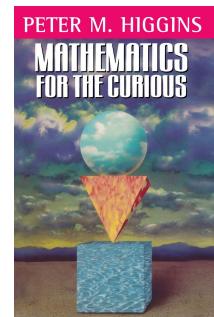
This book tells the story of one of the biggest adventures in mathematics: the search for symmetry. This is the story of how humankind has come to its understanding of the bizarre world of symmetry - a subject of fundamental significance to the way we interpret the world around us. Our eyes and minds are drawn to symmetrical objects, from the sphere to the swastika, from the pyramid to the pentagon. 'Symmetry' is all-pervasive: in chemistry the concept of symmetry explains the structure of crystals; in evolutionary biology, the natural world exploits symmetry in the fight for survival; symmetry and the breaking of symmetry are central to ideas in art, architecture and music; the mathematics of symmetry is even exploited in industry, for example to

find efficient ways to store more music on a CD or to keep your mobile phone conversation from cracking up through interference.

### **Mathematics for the Curious by Peter Higgins**

Age 13+

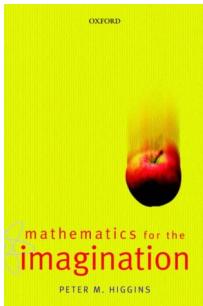
When do the hands of a clock coincide? How likely is it that two children in the same class will share a birthday? How do we calculate the volume of a doughnut? Mathematics for the Curious provides anyone interested in mathematics with a simple and entertaining account of what it can do. Author Peter Higgins gives clear explanations of the more mysterious features of childhood mathematics as well as novelties and connections that prove that mathematics can be enjoyable and full of surprises. Topics include: the truth about fractions, ten questions and their answers, and the golden ratio. Higgins poses entertaining puzzles and questions tempting the reader to ponder math problems with imagination instead of dread. Mathematics for the Curious is an accessible introduction to basic mathematics for beginning students and a lively refresher for adults.



### **Mathematics for the Imagination by Peter Higgins**

Age 13+

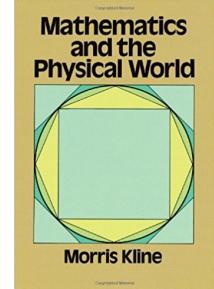
Mathematics for the Imagination provides an accessible and entertaining investigation into mathematical problems in the world around us. From world navigation, family trees, and calendars to patterns, tessellations, and number tricks, this informative and fun book helps you to understand the maths behind real-life questions and rediscover your arithmetical mind. This is a highly involving book which encourages the reader to enter into the spirit of mathematical exploration.



### **Mathematics and the Physical World by Morris Kline**

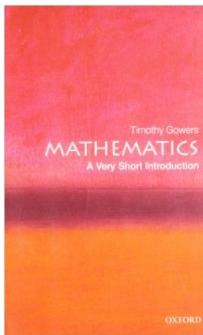
Age 13+

A stimulating account of development of basic mathematics from arithmetic, algebra, geometry and trigonometry, to calculus, differential equations and non-Euclidean geometries. Also describes how maths is used in optics, astronomy, motion under the law of gravitation, acoustics, electromagnetism, and other aspects of physics.



### **Mathematics: A Very Short Introduction by Timothy Gowers**

Age 14+

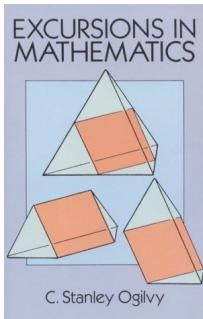
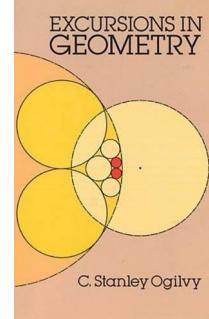


Tim Gowers is a Fields Medalist (the Fields medal is the mathematical equivalent of the Nobel prize), so it is not at all surprising that what he writes is worth reading. What is surprising is the ease and charm of his writing. He touches lightly many areas of mathematics, some that will be familiar (Pythagoras) and some that may not be (manifolds) and has something illuminating to say about all of them.

### **Excursions in Geometry by C. Stanley Ogilvy**

Age 14+

In this book, Professor Ogilvy demonstrates the mathematical challenge and satisfaction to be had from geometry, the only requirement being two simple implements (straight-edge and compass) and a little thought. Topics including harmonic division and Apollonian circles, inversive geometry, the hexlet, conic sections, projective geometry, the Golden Section and angle trisection are addressed in a way that brings out the true intellectual excitement inherent in each. Also included are some unsolved problems of modern geometry.



### **Excursions in Mathematics by C. Stanley Ogilvy**

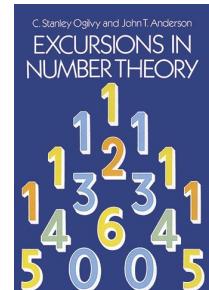
Age 14+

This book offers a fascinating glimpse into the world of mathematics and mathematicians. It is designed for the reader who has no advanced mathematical background or special aptitude, but who wants to acquaint him or herself with the intellectually stimulating and aesthetically satisfying aspects of the subject. After illuminating the role of the mathematician and dispelling several popular misconceptions about the nature of mathematics, Professor Ogilvy takes you on a lively tour of the four basic branches of the subject: number theory, algebra, geometry and analysis. Focusing on the interesting, and even amusing, aspects of mathematics, he points out the interconnections between the branches and presents mathematics as a vital subject whose frontiers are continually expanding. Many illustrations and examples illuminate classic aspects of the subject as well as recent advances.

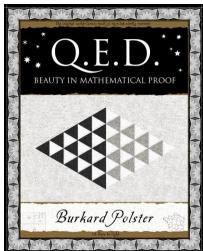
### **Excursions in Number Theory by C. Stanley Ogilvy and John T. Anderson**

Age 14+

This delightful volume, by two well-known mathematicians, invites readers to join a challenging expedition into the mystery and magic of number theory. No special training is needed - just



high school mathematics, a fondness for figures and an inquisitive mind. Beginning with familiar notions, the authors skillfully transport the reader to higher realms of mathematics, developing the necessary concepts along the way. Included are thorough discussions of prime numbers, number patterns, irrationals and iterations and calculating prodigies, among other topics.



### **Q.E.D. - Beauty in Mathematical Proof by Burkard Polster**

Age 14+

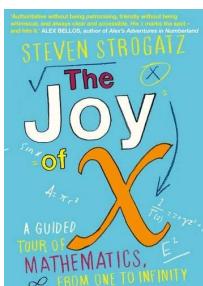
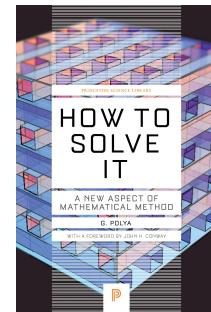
Which famous proof did Archimedes inscribe on his tombstone? How and why do knots make perfect pentagons? Have you ever seen a proof so completely that it is just obvious? In this

delicious little book, top down-under mathemagician Dr. Polster presents many of the most visually intuitive and exciting proofs from the dusty annals of mathematical history. You can test your ability to follow the logic, leap into mathemagnosis and experience eureka-moment after eureka-moment.

### **How to Solve It by George Polya**

Age 14+

A perennial bestseller by eminent mathematician G. Polya, How to Solve It will show anyone in any field how to think straight. In lucid and appealing prose, Polya reveals how the mathematical method of demonstrating a proof or finding an unknown can be of help in attacking any problem that can be "reasoned" out - from building a bridge to winning a game of anagrams. Generations of readers have relished Polya's deft - indeed, brilliant - instructions on stripping away irrelevancies and going straight to the heart of the problem.



### **The Joy of X: A Guided Tour of Mathematics from One to Infinity by Steven Strogatz**

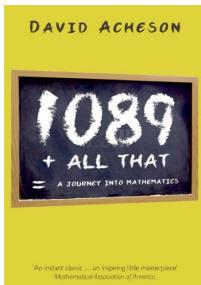
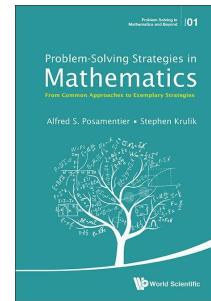
Age 14+

Maths is everywhere, often where we don't even realise. Award-winning professor Steven Strogatz acts as our guide as he takes us on a tour of numbers that - unbeknownst to the uninitiated - connect pop culture, literature, art, philosophy, current affairs, business and even every day life. In The Joy of X, Strogatz explains the great ideas of maths - from negative numbers to calculus, fat tails to infinity - with clarity, wit and insight. He is the maths teacher you never had and this book is perfect for the smart and curious, the expert and the beginner.

### **Problem-Solving Strategies In Mathematics: From Common Approaches To Exemplary Strategies by Alfred S Posamentier and Stephen Krulik**

Age 15+

This book introduces ten problem-solving strategies by first presenting the strategy and then applying it to problems in elementary mathematics. In so doing, the common less efficient approach is first mentioned and then the effective strategy is shown. Elementary mathematics is used so that the reader can focus on the strategy and not be distracted by some more sophisticated mathematics.



### **1089 and All That: A Journey into Mathematics by David Acheson**

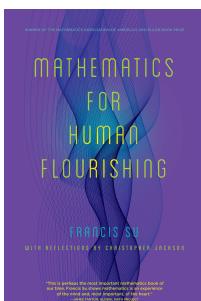
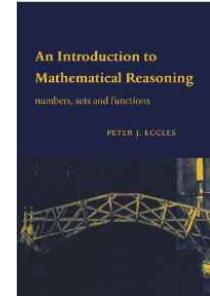
Age 15+

David Acheson's extraordinary little book makes mathematics accessible to everyone. From very simple beginnings he takes us on a thrilling journey to some deep mathematical ideas. On the way, via Kepler and Newton, he explains what calculus really means, gives a brief history of pi, and even takes us to chaos theory and imaginary numbers. Every short chapter is carefully crafted to ensure that no one will get lost on the journey. Packed with puzzles and illustrated by world famous cartoonists, this is one of the most readable and imaginative books on mathematics ever written.

### **An Introduction to Mathematical Reasoning by Peter Eccles**

Age 15+

The purpose of this book is to introduce the basic ideas of mathematical proof to students. The emphasis is on helping the reader in understanding and constructing proofs and writing clear mathematics. This is achieved by exploring set theory, combinatorics and number theory, topics which include many fundamental ideas which are part of the tool kit of any mathematician. This material illustrates how familiar ideas can be formulated rigorously, provides examples demonstrating a wide range of basic methods of proof, and includes some of the classic proofs.



### **Mathematics for Human Flourishing by Francis Su**

Age 16+

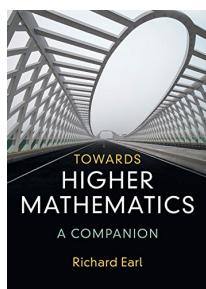
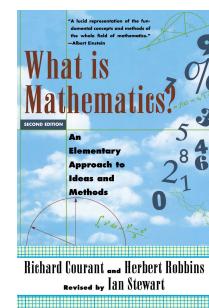
Can the study of mathematics enrich the heart as well as the mind? Francis Su explains how humans crave logic, beauty, truth and play, and that searching for these in mathematics is not only rewarding, but builds virtues in us that help us be better individuals and members of society. The book includes puzzles to draw everyone in

to the enjoyment of mathematics, as part of his vision that mathematics should be shared by everyone.

### **What is Mathematics? by Richard Courant, Herbert Robbins and Ian Stewart**

Age 16+

Written for beginners and scholars, for students and teachers, for philosophers and engineers, this book is a sparkling collection of mathematical gems that offers an entertaining and accessible portrait of the mathematical world. Covering everything from natural numbers and the number system to geometrical constructions and projective geometry, this fascinating survey allows readers to delve into mathematics as an organic whole rather than an empty drill in problem solving. With chapters largely independent of one another and sections that lead upward from basic to more advanced discussions, readers can easily pick and choose areas of particular interest without impairing their understanding of subsequent parts.



### **Towards Higher Mathematics: A Companion by Richard Earl**

Age 16+

Containing a large and varied set of problems, this rich resource will allow students to stretch their mathematical abilities beyond the school syllabus, and bridge the gap to university-level mathematics. Many proofs are provided to better equip students for the transition to university. The author covers substantial extension material using the language of sixth-form mathematics, thus enabling students to understand the more complex material. There are over 1500 carefully graded exercises, with hints included in the text, and solutions available online. Historical and contextual asides highlight each area of mathematics and show how it has developed over time.

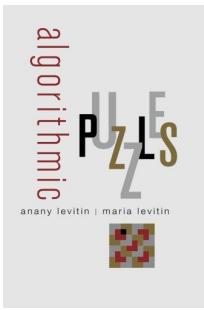
### **The Art of the Infinite by Robert and Ellen Kaplan**

Age 16+

This book unlocks the secrets of maths - revealing it to be our lost, native language, as much a part of us as the words we use every day. Number and form are the essence of our world: from the patterns of the stars to the pulses of the market, from the beats of our hearts to catching a ball or tying our shoelaces. Drawing on science, literature, history and philosophy, this book makes the rich patterns of maths brilliantly clear.



### **Algorithmic Puzzles by Anany & Maria Levitin**



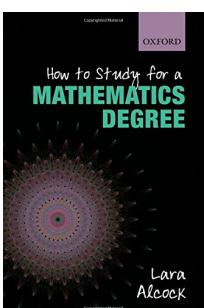
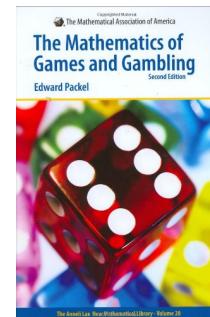
Age 16+

In this book, Anany and Maria Levitin use many classic brainteasers as well as newer examples from job interviews with major corporations to show readers how to apply analytical thinking to solve puzzles requiring well-defined procedures. The book's unique collection of puzzles is supplemented with carefully developed tutorials on algorithm design strategies and analysis techniques intended to walk the reader step-by-step through the various approaches to algorithmic problem solving. Mastery of these strategies - exhaustive search, backtracking, and divide-and-conquer, among others - will aid the reader in solving not only the puzzles contained in this book, but also others encountered in interviews, puzzle collections, and throughout everyday life. Each of the 150 puzzles contains hints and solutions, along with commentary on the puzzle's origins and solution methods. Readers with only middle school mathematics will develop their algorithmic problem-solving skills through puzzles at the elementary level, while seasoned puzzle solvers will enjoy the challenge of thinking through more difficult puzzles.

## The Mathematics of Games and Gambling by Edward Packel

Age 16+

This book introduces and develops some of the important and beautiful elementary mathematics needed for rational analysis of various gambling and game activities. Most of the standard casino games (roulette, craps, blackjack, keno), some social games (backgammon, poker, bridge) and various other activities (state lotteries, horse racing) are treated in ways that bring out their mathematical aspects. The mathematics developed ranges from the predictable concepts of probability, expectation, and binomial coefficients to some less well-known ideas of elementary game theory. Game-related exercises are included and solutions to some appear at the end of the book.



## How to Study for a Mathematics Degree by Lara Alcock

Age 17+

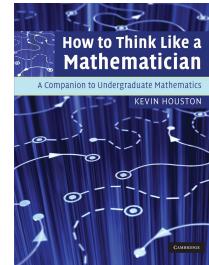
Every year, thousands of students go to university to study mathematics. Many of these students are extremely intelligent and hardworking, but even the best will, at some point, struggle with the demands of making the transition to advanced mathematics. The mathematics shifts in focus from calculation to proof, so students are expected to interact with it in different ways. These changes need not be mysterious - mathematics education research has revealed many insights into the adjustments that are necessary - but they are not obvious and they do need

explaining. This book translates these research-based insights into practical advice for a student audience. It covers every aspect of studying for a mathematics degree, from the most abstract intellectual challenges to the everyday business of interacting with lecturers and making good use of study time.

## How to Think Like a Mathematician by Kevin Houston

Age 17+

Looking for a head start in your undergraduate degree in mathematics? This friendly companion will ease your transition to real mathematical thinking. Working through the book you will develop an arsenal of techniques to help you unlock the meaning of definitions, theorems and proofs, solve problems, and write mathematics effectively. All the major methods of proof - direct method, cases, induction, contradiction and contrapositive - are featured. Concrete examples are used throughout, and you'll get plenty of practice on topics common to many courses such as divisors, Euclidean algorithms, modular arithmetic, equivalence relations, and injectivity and surjectivity of functions. With over 300 exercises to help you test your progress, you'll soon learn how to think like a mathematician.



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The NRICH Project aims to enrich the mathematical experiences of all learners. To support this aim, members of the NRICH team work in a wide range of capacities, including providing professional development for teachers wishing to embed rich mathematical tasks into everyday classroom practice.

NRICH is part of the family of activities in the Millennium Mathematics Project.

