The Big Questions Mathematics

Your guide to grow and learn as a math teacher! Let's face it, teaching elementary math can be hard. So much about how we teach math today may look and feel different from how we learned it. Today, we recognize placing the student at the center of their learning increases engagement, motivation, and academic achievement soars. Teaching math in a student-centered way changes the role of the teacher from one who traditionally "delivers knowledge" to one who fosters thinking. Most importantly, we must ensure our practice gives each and every student the opportunity to learn, grow, and achieve at high levels, while providing opportunities to develop their agency and authority in the classroom which results in a positive math identity. Whether you are a brand new teacher or a veteran, if you find teaching math to be quite the challenge, this is the guide you want by your side. Designed for just-in-time learning and support, this practical resource gives you brief, actionable answers to your most pressing questions about teaching elementary math. Written by four experienced math educators representing diverse experiences, these authors offer the practical advice they wish they received years ago, from lessons they?ve learned over decades of practice, research, coaching, and through collaborating with teams, teachers and colleagues—especially new teachers—every day. Questions and answers are organized into five areas of effort that will help you most thrive in your elementary math classroom: 1. How do I build a positive math community? 2. How do I structure, organize, and manage my math class? 3. How do I engage my students in math? 4. How do I help my students talk about math? 5. How do I know what my students know and move them forward? Woven throughout, you?ll find helpful sidebar notes on fostering identity and agency; access and equity; teaching in different settings; and invaluable resources for deeper learning. The final question—Where do I go from here?— offers guidance for growing your practice over time. Strive to become the best math educator you can be; your students are counting on it! What will be your first step on the journey?

Easy, enlightening and mind-stretching, here are answers to the 20 biggest questions of religion and its attempts to give meaning to our world. The Big Questions series is designed to let renowned experts address the 20 most fundamental and frequently asked questions of a major branch of science or philosophy. Each 3000-word essay simply and concisely examines a question that has eternally perplexed enquiring minds, and provides answers based on the latest research. This ambitious project is a unique distillation of humanity's best ideas. In The Big Questions: God, Mark Vernon answers the 20 key questions:Can reason prove the existence of God? Will science bring the end of religion? Why do people still have religious beliefs? Is religion a mistake of evolution? Can drugs induce religious experiences? Can you be spiritual without being religious? Have you seen a miracle? What is the literal meaning of Scripture? If you're not religious, is nothing sacred? Can an agnostic pray? Is religion inherently violent? What is it like to be a fundamentalist? What is Buddhist enlightenment? Is Confucianism a religion? Is nature divine? Is there a perennial philosophy? Does human suffering rule out God? Can we be good without God? Are we living in the end times? Is there life after death?

An irreverent and accessible explanation of challenging puzzles within the world of mathematics considers such topics as the link between a pineapple's spirals and the famous Fibonacci numbers, the shape of the universe as reflected by a twisted strip of paper, and the parallels between the Lincoln and Kennedy assassinations. 50,000 first printing.

Just the mention of mathematics is enough to strike fear into the hearts of many, yet without it, the human race couldn't be where it is today. By exploring the subject through its 50 key insights--from the simple (the number one) and the subtle (the invention of zero) to the sophisticated (proving Fermat's last theorem)--this book shows how mathematics has changed the way we look at the world around us.

If you think numbers are boring, think again! Imagine the world without measurements: What time is it? Are we nearly there yet? How big do you want it? Why Pi? takes readers through a mesmerizing, historical number journey, from the ancient civilizations that used numbers as simple measurement, through the Renaissance period with the conquering of the seas and mapping of the world, the Industrial Revolution, and all the way on to Einstein's theory of relativity and discovering space. Numbers are eternal and have been a crucial element in human history. From sailing the seven seas to journeying deep below the waves and up through the atmosphere, it's all about numbers. Discover how simple modern-day things are all about measurement and see how the future will be shaped by numbers as we travel farther into space. Numbers aren't just about sums and calculations, and there is no one better at illustrating this than the ingenious Johnny Ball as he demonstrates just how essential math is to our everyday world. Why Pi? examines how numbers have allowed explorers, engineers, and scientists to explore, build, and discover. Reviews: "[An] extensive look at the history of measurement." - Booklist Awards: Teachers' Choice Award Winner

Stephen Hawking was recognized as one of the greatest minds of our time and a figure of inspiration after defying his ALS diagnosis at age twenty-one. He is known for both his breakthroughs in theoretical physics as well as his ability to make complex concepts accessible for all, and was beloved for his mischievous sense of humor. At the time of his death, Hawking was working on a final project: a book compiling his answers to the "big" questions that he was so often posed--questions that ranged beyond his academic field. Within these pages, he provides his personal views on our biggest challenges as a human race, and where we, as a planet, are heading next. Each section will be introduced by a leading thinker offering his or her own insight into Professor Hawking's contribution to our understanding. The book will also feature a foreword from Academy Award winning actor Eddie Redmayne, who portrayed Hawking in the film The Theory of Everything, and an afterword by Hawking's daughter, Lucy Hawking, as well as personal photographs and additional archival material.

Engage students in mathematics using growth mindset techniques The most challenging parts of teaching mathematics are engaging students and helping them understand the connections between mathematics concepts. In this volume, you'll find a collection of low floor, high ceiling tasks that will help you do just that, by looking at the big ideas at the first-grade level through visualization, play, and investigation. During their work with tens of thousands of teachers, authors Jo Boaler, Jen Munson, and Cathy Williams heard the same message—that they want to incorporate more brain science into their math instruction, but they need guidance in the techniques that work best to get across the concepts they needed to teach. So the authors designed Mindset Mathematics around the principle of active student engagement, with tasks that reflect the latest brain science on learning. Open, creative, and visual math tasks have been shown to improve student test scores, and more importantly change their relationship with mathematics and start believing in their own potential. The tasks in Mindset Mathematics reflect the lessons from brain science that: There is no such thing as a math person - anyone can learn mathematics to high levels. Mistakes, struggle and

challenge are the most important times for brain growth. Speed is unimportant in mathematics. Mathematics is a visual and beautiful subject, and our brains want to think visually about mathematics. With engaging questions, open-ended tasks, and four-color visuals that will help kids get excited about mathematics, Mindset Mathematics is organized around nine big ideas which emphasize the connections within the Common Core State Standards (CCSS) and can be used with any current curriculum.

With his long-running 'Everyday Economics' column in Slate and his popular book, The Armchair Economist, Steven Landsburg has been leading the pack of economists who are transforming their science from a drab meditation on graphs and charts into a fascinating window on human nature. Now he's back and more provocative than ever with surprises on virtually every page. In More Sex is Safer Sex, Professor Landsburg offers readers a series of stimulating discussions that all flow from one unsettling fact. Combining the rational decisions of each of us often produces an irrational result for all of us. Avoiding casual sex can actually encourage the spread of diseases. To solve population pressures, we need more people. In his tantalizing, entertaining narrative, Landsburg guides us through these shocking notions by the light of compelling logic and evidence and makes suggestions along the way: Why not charge juries if a convicted felon is exonerated? Why not let firemen keep the property they rescue? As entertaining as it is inflammatory, More Sex is Safer Sexwill make readers think about their decisions in unforgettable ways -- and spark debate over much that we all take for granted.

What are "essential questions," and how do they differ from other kinds of questions? What's so great about them? Why should you design and use essential questions in your classroom? Essential questions (EQs) help target standards as you organize curriculum content into coherent units that yield focused and thoughtful learning. In the classroom, EQs are used to stimulate students' discussions and promote a deeper understanding of the content. Whether you are an Understanding by Design (UbD) devotee or are searching for ways to address standards—local or Common Core State Standards—in an engaging way, Jay McTighe and Grant Wiggins provide practical guidance on how to design, initiate, and embed inquiry-based teaching and learning in your classroom. Offering dozens of examples, the authors explore the usefulness of EQs in all K-12 content areas, including skill-based areas such as math, PE, language instruction, and arts education. As an important element of their backward design approach to designing curriculum, instruction, and assessment, the authors *Give a comprehensive explanation of why EQs are so important; *Explore seven defining characteristics of EQs; *Distinguish between topical and overarching questions and their uses; *Outline the rationale for using EQs as the focal point in creating units of study; and *Show how to create effective EQs, working from sources including standards, desired understandings, and student misconceptions. Using essential questions can be challenging—for both teachers and students—and this book provides guidance through practical and proven processes, as well as suggested "response strategies" to encourage student engagement. Finally, you will learn how to create a culture of inquiry so that all members of the educational community—students, teachers, and administrators—benefit from the increased rigor and deepened understanding that emerge when essential questions become a guiding force for learners of all ages.

This book covers 250 milestones in mathematical history, beginning millions of years ago with ancient "ant odometers" and moving through time to our modern-day quest for new dimensions.

In What Do We Really Know? Simon Blackburn addresses the twenty most-asked philosophical questions, including 'Can machines think?', 'What is the meaning of life?', 'Is death to be feared?', 'Why be good?', 'What am I?' and 'What do we really know?' Each 3000-word essay examines a question that has eternally perplexed enquiring minds, and provides answers from history's great thinkers.

Weave high-level questions into your teaching practices.

Like masterpieces of art, music, and literature, great mathematical theorems are creative milestones, works of genius destined to last forever. Now William Dunham gives them the attention they deserve. Dunham places each theorem within its historical context and explores the very human and often turbulent life of the creator -- from Archimedes, the absentminded theoretician whose absorption in his work often precluded eating or bathing, to Gerolamo Cardano, the sixteenth-century mathematician whose accomplishments flourished despite a bizarre array of misadventures, to the paranoid genius of modern times, 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. A rare combination of the historical, biographical, and mathematical, Journey Through Genius is a fascinating introduction to a neglected field of human creativity. "It is mathematics presented as a series of works of art; a fascinating lingering over individual examples of ingenuity and insight. It is mathematics by lightning flash." --Isaac Asimov

The Big Questions series enables renowned experts to tackle the 20 most fundamental and frequently asked questions of a major branch of science or philosophy. Each 3000-word essay simply and concisely examines a question that has eternally perplexed enquiring minds, providing answers from history's great thinkers. This ambitious project is a unique distillation of humanity's best ideas. In Big Questions: The Universe, Dr. Stuart Clark tackles the 20 key questions of astronomy and cosmology: What is the universe? How big is the universe? How old is the universe? What are stars made from? How did the universe form? Why do planets stay in orbit? Was Einstein right? What are black holes? How did the Earth form? What were the first celestial objects? What is dark matter? What is dark energy? Are we really made from stardust? Is there life on Mars? Are there other intelligent beings? Can we travel through time and space? Can the laws of physics change? Are there alternative universes? What will be the fate of the universe? Is there cosmological evidence for God?

In Big Questions: Mathematics, Tony Crilly answers the 20 key questions: What is math for? Where do numbers come from? Why are primes the atoms of maths? Which are the strangest numbers? Are imaginary numbers real? How big is infinity? Where do parallel lines meet? What is the math of the universe? Are statistics lies? Can math guarantee riches? Is there a formula for everything? Why are three dimensions not enough? Can a butterfly's wings really cause a hurricane? Can we create an unbreakable code? Is math beauty? Can math predict the future? What shape is the

universe? What is symmetry? Is math true? Is there anything left to solve?

Air bags cause accidents, because well-protected drivers take more risks. This well-documented truth comes as a surprise to most people, but not to economists, who have learned to take seriously the proposition that people respond to incentives. In The Armchair Economist, Steven E. Landsburg shows how the laws of economics reveal themselves in everyday experience and illuminate the entire range of human behavior. Why does popcorn cost so much at the cinema? The 'obvious' answer is that the owner has a monopoly, but if that were the whole story, there would also be a monopoly price to use the toilet. When a sudden frost destroys much of the Florida orange crop and prices skyrocket, journalists point to the 'obvious' exercise of monopoly power. Economists see just the opposite: If growers had monopoly power, they'd have raised prices before the frost. Why don't concert promoters raise ticket prices even when they are sure they will sell out months in advance? Why are some goods sold at auction and others at pre-announced prices? Why do boxes at the football sell out before the standard seats do? Why are bank buildings fancier than supermarkets? Why do corporations confer huge pensions on failed executives? Why don't firms require workers to buy their jobs? Landsburg explains why the obvious answers are wrong, reveals better answers, and illuminates the fundamental laws of human behavior along the way. This is a book of surprises: a guided tour of the familiar, filtered through a decidedly unfamiliar lens. This is economics for the sheer intellectual joy of it.

What's wrong with stealing? What's the best way to blood test a pot-bellied pig? Should we tolerate intolerance? In the wake of his enormously popular books, The Armchair Economistand More Sex is Safer Sex, Steven Landsburg uses concepts from maths, economics and physics to address the big questions in philosophy: Where does knowledge come from? What's the difference between right and wrong? Do our beliefs matter? Is it possible to know everything? Provocative, utterly entertaining and always surprising, The Big Questions challenges readers to re-evaluate their most fundamental beliefs and reveals the relationship between the loftiest philosophical quests and our everyday lives.

Max Tegmark leads us on an astonishing journey through past, present and future, and through the physics, astronomy and mathematics that are the foundation of his work, most particularly his hypothesis that our physical reality is a mathematical structure and his theory of the ultimate multiverse. In a dazzling combination of both popular and groundbreaking science, he not only helps us grasp his often mind-boggling theories, but he also shares with us some of the often surprising triumphs and disappointments that have shaped his life as a scientist. Fascinating from first to last—this is a book that has already prompted the attention and admiration of some of the most prominent scientists and mathematicians.

Why do polished stones look wet? How does the Twin Paradox work? What if Jupiter were a star? How can we be sure that pi never repeats? How does a quantum computer break encryption? Discover the answers to these, and other profound physics questions! This fascinating book presents a collection of articles based on conversations and correspondences between the author and complete strangers about physics and math. The author, a researcher in mathematical physics, responds to dozens of questions posed by inquiring minds from all over the world, ranging from the everyday to the profound. Rather than unnecessarily complex explanations mired in mysterious terminology and symbols, the reader is presented with the reasoning, experiments, and mathematics in a casual, conversational, and often comical style. Neither over-simplified nor over-technical, the lucid and entertaining writing will guide the reader from each innocent question to a better understanding of the weird and beautiful universe around us. Advance praise for Do Colors Exist?: "Every high school science teacher should have a copy of this book. The individual articles offer enrichment to those students who wish to go beyond a typical 'dry curriculum'. The articles are very fun. I probably laughed out loud every 2-3 minutes. This is not easy to do. In fact, my children are interested in the book because they heard me laughing so much." – Ken Ono, Emory University

Bestselling author and physicist Stephen Hawking explores the "masterpieces" of mathematics, 25 landmarks spanning 2,500 years and representing the work of 15 mathematicians, including Augustin Cauchy, Bernard Riemann, and Alan Turing. This extensive anthology allows readers to peer into the mind of genius by providing them with excerpts from the original mathematical proofs and results. It also helps them understand the progression of mathematical thought, and the very foundations of our present-day technologies. Each chapter begins with a biography of the featured mathematician, clearly explaining the significance of the result, followed by the full proof of the work, reproduced from the original publication.

A hilarious reeducation in mathematics-full of joy, jokes, and stick figures-that sheds light on the countless practical and wonderful ways that math structures and shapes our world. In Math With Bad Drawings, Ben Orlin reveals to us what math actually is; its myriad uses, its strange symbols, and the wild leaps of logic and faith that define the usually impenetrable work of the mathematician. Truth and knowledge come in multiple forms: colorful drawings, encouraging jokes, and the stories and insights of an empathetic teacher who believes that math should belong to everyone. Orlin shows us how to think like a mathematician by teaching us a brand-new game of tic-tac-toe, how to understand an economic crises by rolling a pair of dice, and the mathematical headache that ensues when attempting to build a spherical Death Star. Every discussion in the book is illustrated with Orlin's trademark "bad drawings," which convey his message and insights with perfect pitch and clarity. With 24 chapters covering topics from the electoral college to human genetics to the reasons not to trust statistics, Math with Bad Drawings is a life-changing book for the math-estranged and math-enamored alike.

The Mathematics Book is a how-to-do-it book embedded in a stylish coffee table book, created especially for adults with a minimal knowledge of mathematics. The book provides a practical mathematics course in line with international adult numeracy standards. It enables readers to develop a set of foundational maths skills - fractions, algebra, trigonometry, statistics and even long division! But mathematics is more than merely developing skills. The Mathematics Book enables readers to gain a global view of mathematics -the applications, the ideas, the romance, the beauty, the human endeavour and the pivotal role it plays in contemporary society. It also allows them to experience some of the challenges, satisfactions and pleasures that can be found in the amazing world of mathematics.

Experience the mysterious and magical world of numbers as never before. This unique book investigates mathematical marvels such as why daisies always have 34, 55, or 89 petals, why the world''s phone numbers appear in Pi, and other patterns and paradoxes that will make readers look at numbers in a whole new way.

Based on Fields medal winning work of Michael Freedman, this book explores the disc embedding theorem for 4-dimensional manifolds. This theorem underpins virtually all our understanding of topological 4-manifolds. Most famously, this includes the 4-dimensional Poincaré conjecture in the topological category. The Disc Embedding Theorem contains the first thorough and approachable exposition of Freedman's proof of the disc embedding theorem, with many new details. A self-contained account of decomposition space theory, a beautiful but outmoded branch of topology that produces non-differentiable homeomorphisms between manifolds, is provided, as well as a stand-alone interlude that explains the disc embedding theorem's key role in all known homeomorphism classifications of 4-manifolds via surgery theory and the s-cobordism theorem. Additionally, the ramifications of the disc embedding theorem within the study of topological 4-manifolds, for example Frank Quinn's development of fundamental tools like transversality are broadly described. The book is written for mathematicians, within the subfield of topology, specifically interested in the study of 4-dimensional spaces, and includes numerous professionally rendered

figures.

The fundamental mathematical tools needed to understand machine learning include linear algebra, analytic geometry, matrix decompositions, vector calculus, optimization, probability and statistics. These topics are traditionally taught in disparate courses, making it hard for data science or computer science students, or professionals, to efficiently learn the mathematics. This self-contained textbook bridges the gap between mathematical and machine learning texts, introducing the mathematical concepts with a minimum of prerequisites. It uses these concepts to derive four central machine learning methods: linear regression, principal component analysis, Gaussian mixture models and support vector machines. For students and others with a mathematical background, these derivations provide a starting point to machine learning texts. For those learning the mathematics for the first time, the methods help build intuition and practical experience with applying mathematical concepts. Every chapter includes worked examples and exercises to test understanding. Programming tutorials are offered on the book's web site.

We know that Differentiated Instruction helps all students to learn. Yet DI challenges teachers, and nowhere more than in mathematics. In this new book, written specifically for secondary mathematics teachers, the authors cut through the difficulties with two powerful and universal strategies that teachers can use across all math content: Open questions and Parallel tasks. Showing teachers how to get started and become expert with these strategies, this book also demonstrates how to use more inclusive learning conversations to promote broader student participation. Strategies and examples are organized around Big Ideas within the National Council of Teachers of Mathematics (NCTM) content strands. With particular emphasis on Algebra, chapters also address Number and Operations, Geometry, Measurement, and Data Analysis and Probability, with examples included for Pre-Calculus.

Physics can explain many of the things that we commonly encounter. It can tell us why the night is dark, what causes the tides, and even how best to catch a baseball. With In Praise of Simple Physics, popular math and science writer Paul Nahin presents a plethora of situations that explore the science and math behind the wonders of everyday life. Roaming through a diverse range of puzzles, he illustrates how physics shows us ways to wring more energy from renewable sources, to measure the gravity in our car garages, to figure out which of three light switches in the basement controls the light bulb in the attic, and much, much more. How fast can you travel from London to Paris? How do scientists calculate the energy of an atomic bomb explosion? How do you kick a football so it stays in the air and goes a long way downfield? Nahin begins with simpler problems and progresses to more challenging questions, and his entertaining, accessible, and scientifically and mathematically informed explanations are all punctuated by his trademark humor. Readers are presumed to have some background in beginning differential and integral calculus. Whether you simply have a personal interest in physics' influence in the world or you're an engineering and science student who wants to gain more physics know-how, this book has an intriguing scenario for you. In Praise of Simple Physics proves that if we look carefully at the world around us, physics has answers for the most astonishing day-to-day occurrences.

The Big Questions series is designed to let renowned experts address the 20 most fundamental and frequently asked questions of a major branch of science or philosophy. Each 3000-word essay simply and concisely examines a question that has eternally perplexed enquiring minds, and provides answers from history's great thinkers. This ambitious project is a unique distillation of humanity's best ideas. In Big Questions: Physics, Michael Brooks answers the 20 key questions: What is the point of physics? Is everything ultimately random? What is time? Why is there no such thing as a free lunch? What happened to Schrodinger's cat? Can I change the universe with a single glance? Are solids really solid? Which is nature's strongest force? Why does an apple fall? Do we live in a computer simulation? What is light? Is Earth's magnetic shield failing? Am I unique in the universe? Does chaos theory spell disaster? Can we travel through time? Is string theory really about strings? Why does $E=mc^2$? What is the God Particle? Why is there something rather than nothing? What is the ultimate nature of reality?

What is the universe? How big is the universe? How did the Universe form? Why do the planets stay in orbit? Are we really made from stardust? In Big Questions: The Universe, Dr Stuart Clark tackles the 20 key questions of astronomy and cosmology.

What are the strangest numbers? Where do numbers come from? Can maths guarantee riches? Why are three dimensions not enough? Can a butterfly's wings really cause a hurricane? Can maths predict the future? In How Big is Infinity?, acclaimed writer Tony Crilly distills the wisdom of some of the greatest minds in history to help provide answers some of the most perplexing, stimulating and surprising questions in mathematics.

Expanded to include connections to Common Core State Standards, as well as National Council of Teachers of Mathematics (NCTM) standards, this critically acclaimed book will help every teacher and coach to meet the challenges of differentiating mathematics instruction in the K–8 classroom. In this bestseller, math education expert Marian Small explains two powerful and universal strategies that teachers can use across all math content: Open Questions and Parallel Tasks. Showing teachers how to get started and become expert with these strategies, Small also demonstrates more inclusive learning conversations that promote broader student participation and mathematical thinking required by CCSS. Specific strategies and examples for each grade band are organized around NCTM content strands: Number and Operations, Geometry, Measurement, Algebra, and Data Analysis and Probability.

Bestselling author Simon Blackburn tackles the key questions in philosophy--and provides easy-to-understand and enlightening answers. In Big Questions: Philosophy, bestselling author Simon Blackburn addresses the 20 essential questions: What is the meaning of life? Am I free? Why is there something and not nothing? What do we really know? Is there such a thing as society? Can machines think? What is time? How can I deceive myself? Why be good? What fills up space? Can we truly understand each other? Why do things keep on keeping on? Are we rational? What am I? What are my rights? Is truth relative? Do we need God? What is human nature? What is beauty? Is death to be feared?

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This bestselling resource provides tools to help experienced and novice teachers effectively and efficiently differentiate mathematics instruction in grades K-8. This third edition includes key changes that will make it easier for teachers to use the tools in all quality state standards environments, as well as with many new classroom examples for each grade band. Easy, enlightening and mind-stretching, here are answers to the 20 biggest questions of evolution and what they tell us about life on Earth. The Big Questions series is designed to let renowned experts address the 20 most fundamental and frequently asked questions of a major branch of science or philosophy. Each 3,000-word essay simply and concisely examines a question that has eternally perplexed enquiring minds, and provides answers based on the latest research. This ambitious project is a unique distillation of humanity's best ideas. In The Big Questions: Evolution, Francisco Ayala answers the 20 key questions: What is evolution? Was Darwin right? What is natural selection? What is survival of the fittest? Is evolution a random process? What is a species? What are chromosomes, genes and DNA? How do genes build bodies? What is molecular evolution? How did life begin? What is the tree of life? Am I really a monkey? What does the fossil record tell us? What is the missing link? Is intelligence inherited? Will humans continue to evolve? Can I clone myself? Where does morality come from? Is language a uniquely human attribute? Is Creationism true?

Because fluency practice is not a worksheet. Fluency in mathematics is more than adeptly using basic facts or implementing algorithms. Real fluency involves reasoning and creativity, and it varies by the situation at hand. Figuring Out Fluency in Mathematics Teaching and Learning offers educators the inspiration to develop a deeper understanding of procedural fluency, along with a plethora of pragmatic tools for shifting classrooms toward a fluency approach. In a friendly and accessible style, this hands-on guide empowers educators to support students in acquiring the repertoire of reasoning strategies necessary to becoming versatile and nimble mathematical thinkers. It includes: "Seven Significant Strategies" to teach to students as they work toward procedural fluency. Activities, fluency routines, and games that encourage learning the efficiency, flexibility, and accuracy essential to real fluency. Reflection questions, connections to mathematical standards, and techniques for assessing all components of fluency. Suggestions for engaging families in understanding and supporting fluency. Fluency is more than a toolbox of strategies to choose from; it's also a matter of equity and access for all learners. Give your students the knowledge and power to become confident mathematical thinkers.

"An engaging voyage into some of the great mysteries and wonders of our world." --Alan Lightman, author of Einstein's Dream and The Accidental Universe "No one is better at making the recondite accessible and exciting." —Bill Bryson Brain Pickings and Kirkus Best Science Book of the Year Every week seems to throw up a new discovery, shaking the foundations of what we know. But are there questions we will never be able to answer—mysteries that lie beyond the predictive powers of science? In this captivating exploration of our most tantalizing unknowns, Marcus du Sautoy invites us to consider the problems in cosmology, quantum physics, mathematics, and neuroscience that continue to bedevil scientists and creative thinkers who are at the forefront of their fields. At once exhilarating, mind-bending, and compulsively readable, The Great Unknown challenges us to consider big questions—about the nature of consciousness, what came before the big bang, and what lies beyond our horizons—while taking us on a virtuoso tour of the great breakthroughs of the past and celebrating the men and women who dared to tackle the seemingly impossible and had the imagination to come up with new ways of seeing the world.

In this "provocative" book (New York Times), a contrarian physicist argues that her field's modern obsession with beauty has given us wonderful math but bad science. Whether pondering black holes or predicting discoveries at CERN, physicists believe the best theories are beautiful, natural, and elegant, and this standard separates popular theories from disposable ones. This is why, Sabine Hossenfelder argues, we have not seen a major breakthrough in the foundations of physics for more than four decades. The belief in beauty has become so dogmatic that it now conflicts with scientific objectivity: observation has been unable to confirm mindboggling theories, like supersymmetry or grand unification, invented by physicists based on aesthetic criteria. Worse, these "too good to not be true" theories are actually untestable and they have left the field in a cul-de-sac. To escape, physicists must rethink their methods. Only by embracing reality as it is can science discover the truth.

To what extent are the subjects of our thoughts and talk real? This is the question of realism. In this book, Justin Clarke-Doane explores arguments for and against moral realism and mathematical realism, how they interact, and what they can tell us about areas of philosophical interest more generally. He argues that, contrary to widespread belief, our mathematical beliefs have no better claim to being self-evident or provable than our moral beliefs. Nor do our mathematical beliefs have better claim to being empirically justified than our moral beliefs. It is also incorrect that reflection on the genealogy of our moral beliefs establishes a lack of parity between the cases. In general, if one is a moral antirealist on the basis of epistemological considerations, then one ought to be a mathematical antirealist as well. And, yet, Clarke-Doane shows that moral realism and mathematical realism do not stand or fall together — and for a

surprising reason. Moral questions, insofar as they are practical, are objective in a sense that mathematical questions are not, and the sense in which they are objective can only be explained by assuming practical anti-realism. One upshot of the discussion is that the concepts of realism and objectivity, which are widely identified, are actually in tension. Another is that the objective questions in the neighborhood of factual areas like logic, modality, grounding, and nature are practical questions too. Practical philosophy should, therefore, take center stage.

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