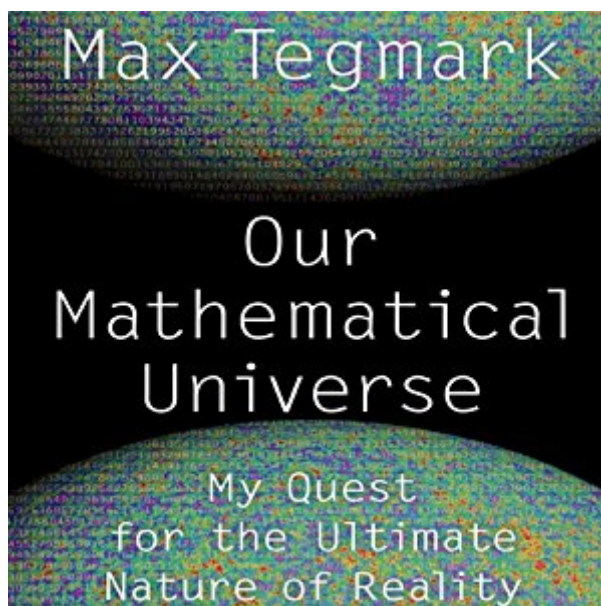


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# Our Mathematical Universe: My Quest For The Ultimate Nature Of Reality



## Synopsis

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.

## Book Information

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## Customer Reviews

This is a wide ranging, thought provoking book. There isn't much math notation but ample references are provided for further technical reading. The book has many interesting and counter intuitive thought experiments, scenarios. and theories. I valued Dr. Tegmark's descriptions of the way computers are used to calculate astronomical energy densities and cosmological constants from astronomical data. This is a good book for anyone desiring to update or challenge a world view. The last chapter provides an overview of the book and an inspiring view of the world, which if read first, can be a guide.

Books that discuss the nature of reality have become a cottage industry lately. Brian Greene, Stephen Hawking, Roger Penrose and now Max Tegmark have all attempted to explain the

physicist's view of the ultimate nature of reality to a popular audience. Penrose's book, with its advanced mathematics, is geared towards those with a technical background but the trend has been to simplify the science and make these books anecdotal and gentle. Tegmark seems to have discovered the sweet spot between hard core science and a fun read, using the word "geeky" as a red flag any time a technical detail is about to be broached. His language is reader friendly and easy to understand. Tegmark is a good writer and anyone that has seen him on television (Through the Wormhole, for example) knows that he is funny and well-grounded in popular culture. Our Mathematical Universe is a nearly perfect example of a popularized science book. Years of reading science books have produced a personal pantheon of the finest I've ever come across. There are several aspects of Tegmark's book that have placed it amongst the three finest popular science books I've ever read. The other two books are Albert Einstein and Leopold Infeld's *The Evolution of Physics* and Kip Thorne's *Black Holes and Time Warps: Einstein's Outrageous Legacy* (Commonwealth Fund Book Program). The first book, *The Evolution of Physics*, is still the clearest exposition of classical and (relatively) modern physics ever written, despite its age. It remains the most authoritative, concise and profound discussion of the source of Einstein's world-shattering ideas, and has never been surpassed as a book written by a great scientist for a popular audience. Kip Thorne's book combines personal reminiscence and scientific exposition with an elegance and depth that makes it my choice as the finest modern popularized science book. Thorne proved that you can write about science in an engaging manner without sacrificing either intelligence or necessary relevant technical detail. The attributes that raise Tegmark's book amongst the very finest in the genre are its engaging writing style, its willingness to discuss technical details about recent trends in cosmology without sacrificing either intelligence or clarity, and its almost subversive depth. Tegmark has a flair for discussing some really knotty topics like the significance of the cosmic microwave background, Einstein's theory of gravitation, the geometry of curved space, mathematically precise cosmology, dark matter and dark energy without losing the reader in a labyrinth of confusing and difficult scientific details. Tegmark teaches without ever being pedantic and he entertains while he clarifies and enlightens. There aren't many science writers who can write about such abstract and craggy subjects as cosmology, multiple multiverse levels, and mathematics as the ultimate nature of physical reality with Tegmark's wit and ease. If you are a fan of reading popularized science books, *Our Mathematical Universe* is one of the finest I've ever read and definitely worth your consideration.

Disciplined pursuits such as cosmology or small particle physics are bound to lead practitioners into

paradoxes and anomalies. Some practitioners revel in them as very features of the universe, or possibly of human consciousness; others try simply to solve them. Max Tegmark tries to solve them. In so doing he necessarily transcends the terms of his immediate training and professional research pursuits. He needs remedial help from the world outside his authoritative vision, from the everyday categories of logical implication, consistency, the cogency of rational argument, and informed imagination. Not surprisingly he draws for these categories from the unexamined commonsense culture we all share yet manages to make the products of his arguments appear as natural extensions of professional empirical science born in the manner of "hypothesis." Tegmark draws two distinctions in his book, one between scientific consensus about recent cosmic discoveries versus controversial/competing schools of scientific thought about what it all suggests (theory) and where science is moving, the other between the latter versus where Tegmark takes off into his own conjecture, which he allows many of his colleagues regard as bordering on fantasy. Somewhere transcending these distinctions is Tegmark's thesis that the universe itself is nothing more than mathematical relations. It is not an extreme stance for a discipline that promises to find equivalences between every empirical observation and mathematical calculation. But then he gets into consciousness, randomness of personal identity, infinite parallel universes of a unique sort, and doppelgangers. When it comes to research science, Tegmark is an uncontested authority and full participant in cutting edge discovery. You will delight in his lucid, reader-friendly accounts of consensus and controversy about what research is turning up about our universe, inflation, Big Bang, quantum physics, string theory, even multiple universes as conventionally understood. The great strength of this book is Tegmark's ability to make so much of this material intelligible to the general reader. Even if we do have to take some of this technical material on faith, we see where the author is coming from via his careful reviews of familiar territory and its links to marvelously unfamiliar territory. The conventional and consensus science in this book is very heady stuff. Perhaps it should be enough to say that this book is thoroughly enjoyable on every level, including some lively social commentary at the end. But when Tegmark leaves the domain of scientific expertise, while nevertheless straining to show his speculations as informed by that expertise, he makes some startlingly naive assertions about the nature of objectivity, consciousness, and humanity, offering them up as almost a priori axioms, as givens too obvious to investigate as topics in their own right. Some of the terms he coins are, without acknowledgement, similar to those in the humanities and social sciences that have been investigated for generations. "consensus reality" is a lot like culture, "internal reality" is a lot like individual subjectivity, and a third category, "external reality," seems to be the reality that only

physical sciences can reveal as "the real thing," i.e. real reality. Social scientists of all stripes, especially social phenomenologists, have shown such concepts to be way too problematic to be simply hawked, as in "there are" these realities (such an assertion would have to be made from outside these realities in any case), and while Tegmark seems relatively up to date on certain developments in philosophy (mostly the philosophy of science in an advocacy mode; otherwise he seems content to treat philosophy as a proto-science, a pre-scientific science that scientists invoke as a foil when criticizing one another for being "too" philosophical or "just" philosophical), the philosophies and research programs specifically devoted to the matters he takes up in the last third of his book (especially phenomenology) are nowhere to be seen. Hence Tegmark can spell out a "logical framework" and enclose it in a rectangle much as postulates are rectangled in geometry textbooks: "There exists an external physical reality completely independent of human beings." This is an odd assumption on its face, since human beings would have to be part of that reality in the first place and therefore not independent of it. Not to mention that there are people on our planet for whom such a postulate is not simply false but utterly unintelligible. Nevertheless I see Tegmark's reasoning and try to follow where he is leading us. He seems to be leading us in the direction of consciousness as a topic for physical science and cosmology, a hopeful sign since whatever else is true of consciousness, it, too, came out of Big Bang (or as Tegmark informs earlier, ongoing inflation) the same as everything else. What is there about Big Bang that would provide for this, and what is consciousness as a thing-in-the-world? Tegmark flirts with such questions, but in the end he does not go there. Instead he treats consciousness as a given and tries to explain what we are conscious of in light of principles he has laid out earlier about the nature of mathematical reality. This is similar to showing why we, situated as we are on a planet this size and shape, experience the earth as flat. Since we are ourselves mathematical, there are ways to derive how we would necessarily experience the mathematical universe that surrounds us, including our mathematical selves, our sense of time, our sense of embodiment, and each person's sense of self as unique and as having come to life once and only once in space-time— $\hat{A} \rightarrow \hat{A} \bullet$ —even though all of these experiences render false impressions similar to our impressions of a flat earth. The alternative to falseness would be, once again, the real reality that science has revealed or will reveal. As a strong advocate for science, I am happy to go along with this with certain caveats and qualifications. (In what sense can two plus two equal four independently of addition?) But when speculating creatively in an endeavor to solve revealed paradoxes or apparent incoherence (e.g. the way small particles spin in and out of existence according to whether or not they are "observed"), it is possible to arrive at new incoherence more troubling, perhaps, than the incoherence one is trying to resolve (e.g.

what is true about small particles must be true about big ones as well, including our bodies). When incoherence proliferates that way, we might just as easily see a *reductio ad absurdum* as see a demonstration of "what the numbers show." Take the idea that your individual biography is being lived by an infinite number of yous in parallel universes, i.e. you are just one of them. Add to that the notion that you and your numberless doppelgangers are constantly splitting off from one another into separate parallel universes by the second (or the microsecond; it's unclear what the unit of time is) to go their merry ways in an infinite branching contexture of alternative futures from the life you've lived so far. Tegmark doesn't exactly say this is true or that science can demonstrate it, but he comes awfully close. He does say he believes it's true, that "there are" these parallel universes inhabited with identical-yet-divergent people with identical-yet-divergent biographies to ours, including identical-yet-divergent histories. U.S. history without our Civil War comes to mind. Any imaginable alternative to the way things are happening here has to be happening somewhere; in fact, it has to be happening in an infinity of somewheres. I have a hard time imagining what it would be like for Tegmark believing his theory, and I wonder if he is being completely truthful. Of course "belief" is a mutable concept, so I qualify my doubt by saying I can't imagine Tegmark believing in doppelganger universes with the same kind of conviction that he (probably) believes that the Civil War happened (this time) or that India exists whether or not he has ever been there. To believe in doppelganger universes the same way one believes in India (or photons) would seem, to me, to be routinely troubling. I wonder, for example, whether it is proper to be jealous of all the yous that got the job you were hoping for but didn't get this go-around. Why did I get stuck being this one instead of that one? (And who, specifically, is stuck?) Integrating doppelganger belief into everyday belief would result in chronic entanglements concerning which one I am and what difference it makes. But belief might be professed belief to press a professional point, or an obstinate belief to declare one's confidence in "where the numbers lead no matter how ridiculous it sounds," or a challenging belief as in "show me where I went wrong," or it could be a hypothesis, or it could be a literary device. It also goes without saying that "belief" also includes religious belief. To that I say that it's easier for me to believe that Earth is six thousand years old and that God arranged false appearances to fool all the scientists than to believe in doppelganger universes. The "talking snake" (Bill Maher's foil) is easier for me to accept than an infinite number of Max Tegmarks, all discovering alternative universes in 2017, some proving them next week beyond a shadow of a doubt, others going down in flames because of poor choices about which graduate school to attend, still others never publishing anything at all, still others becoming sociologists, still others dying young on impact with a forty ton truck, and others never being born in the first place

because their parents never met. It is of course gratifying to see a research scientist of Tegmark's caliber willing to go out on a limb and share his ruminations about life, the universe, and everything, especially when he is so eager to share how his colleagues tell him he is going off the deep end. But could Tegmark be right? On that note, we must not forget the many scientific initiatives launched from ruminations that in their infancy seemed quite insane. Einstein comes easily to mind. But we also must not forget Stanley Moon's rejoinder to George Spigot's response to his calling George a "nutcase" for claiming to be the Devil. George says, "They said the same of Jesus Christ, Freud, and Galileo." Stanley replies: "They said it of a lot of a lot of nutcases too!" (The fact that George turns out to really be the Devil should not influence us in either direction.)

Love it.... I think. Or at least I think I would love it if I understood more of it. That is not a critique of Max and this book, but of the nature of reality itself. Really engaging and interesting book that not only builds the primary idea; that the universe is a mathematical structure, but provides a really strong overview of the current position of physics, mathematics and cosmology. If you are simply interested in reading a solid, well described summary of the origins of our universe across the biggest and smallest scales then you'll love it. It does that job really well, but wait there's more..... If you want your mind blown trying to conceptualise the (at least) 4 different ways there are infinitely many universes, then read this. My brain hurts - in a really good way.

Great read. Sometimes some re-read helps but the thesis is deep & clever. Weaves in his personal scientific evolution nicely. Boosts this mathematician's ego but skepticism might temper the boost a bit. Maybe even more than physical reality has a basis in deep and so far unexplored mathematical existence. Let the fun continue !!

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