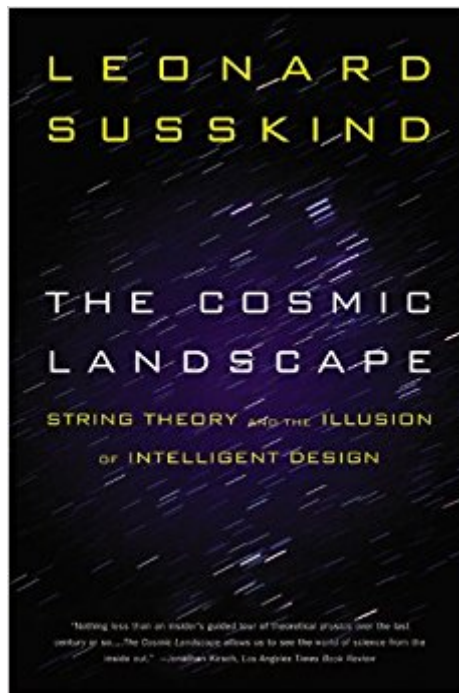


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# The Cosmic Landscape: String Theory And The Illusion Of Intelligent Design



## Synopsis

In his first book ever, the father of string theory reinvents the world's concept of the known universe and man's unique place within it. Line drawings.

## Book Information

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## Customer Reviews

Starred Review. As modern physics has developed a better understanding of how the universe operates at its most fundamental levels, one thing has become increasingly clear: we're damned lucky to be here at all. The laws of physics are precariously balanced, and were the value of one constant slightly different, life as we know it wouldn't exist. To explain the ridiculous improbability of it all, some physicists have turned to the "Anthropic Principle": the universe seems perfectly tailored to us because if it weren't, we wouldn't be here to observe it. The underlying rationale for this argument involves the "landscape" of potential laws of physics (which, it turns out, aren't so immutable after all), a whole bunch of extra dimensions and lots of particle physics. Luckily, Susskind's the father of string theory does the job right, guiding readers through the current controversy over the Anthropic Principle. Make no mistake: this is the cutting edge of physics as described by one of the sharpest scientific minds around. While the subtitle is a bit misleading (this isn't about intelligent design in the Kansas Board of Education sense, but actually a controversy at once bigger and less prominent), persistent readers will finish this book understanding and caring about contemporary physics in ways both unexpected and

gratifying. (Dec. 12) Copyright © Reed Business Information, a division of Reed Elsevier Inc. All rights reserved.

Physicist Susskind is a founder of string theory, and his first popular work will be of utmost significance to science readers. They will be challenged throughout by Susskind's ideas, of which strings are but a part; his driving curiosity is to discover why the laws of physics are what they are and so finely poised to permit life. Susskind discusses how slight alterations of physical values would destroy atoms and, hence, life. Deeming unscientific any proposition of a supernatural agency in setting the physical dials so exactly, Susskind advances a radical concept he calls the "landscape." Valiantly explaining it to his lay audience, Susskind, after introducing the moving parts of his theory (general relativity, quantum mechanics, vacuum energy), compares our universe to a rolling ball on an undulating landscape. Its place of rest equates to our laws of physics. In this extraordinary work, Susskind ushers us to the mind-bending edge of a possible paradigm shift.

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Leonard Susskind is a well known physicist, and quite an interesting writer. This book is very much aimed towards the lay person, the concepts are explained very simply in an understandable way. The footnotes in the Kindle edition are misaligned for some reason. Somewhere around 1/3rd of the way through the book, each footnote link will show the next footnote instead of its own. When you click on #8, you'll see footnote #9 and so forth. It's quite annoying, so hopefully will fix this at some point.

Author and String Theory developer Leonard Susskind wrote in the Preface to this 2006 book, "A lot of my research time is spent ... telling an imaginary admiring audience of laymen how to understand some difficult scientific idea... So it was natural that at some point I would decide to try my hand at writing a book for a general audience." (Pg. ix) He says, "Let me be up front and state my prejudices right here. I thoroughly believe that real science requires explanations that do not involve supernatural agents... Evidence has been accumulating for an explanation of the 'illusion of intelligent design' that depends only on the principles of physics, mathematics, and the laws of large numbers. This is what 'The Cosmic Landscape' is about: the scientific explanation of the apparent miracles of physics a cosmology and its philosophical implications." (Pg. xi) He continues, "This book is about a debate that is stirring the passions of physicists and cosmologists but is also part of a

broader controversy... where it has entered the partisan political discourse. On one side are the people who are convinced that the world must have been created or designed by an intelligent agent with a benevolent purpose. On the other side are the hard-nosed, scientific types who feel certain that the universe is the product of impersonal, disinterested laws of physics, mathematics, and probability---a world without a purpose... By the first group... I am talking about thoughtful, intelligent people who look around at the world and have a hard time believing that it was just dumb luck that made the world so accommodating to human beings. I don't think these people are being stupid; they have a real point." (Pg. 5-6) He explains, "The debate that this book is concerned with is ... between two warring factions of science---those who believe... that the laws of nature are determined by mathematical relations, which by mere chance happen to allow life, and those who believe that the Laws of Physics have, in some way, been determined by the requirement that intelligent life be possible." (Pg. 6-7) He observes, "String theorists are a special breed of theoretical physicists... The theory that they work on has often produced unexpected mathematical miracles, perfect cancellations for deep and mysterious reasons. Their view... has been that String Theory is such a special theory that it must be the one true theory of nature. And being true, it must have some profound mathematical reason for the supposed fact that the vacuum energy is exactly zero. Finding the reason has been regarded as the ... most difficult problem of modern physics... It truly is the mother of all physics problems." (Pg. 78) He argues, "paradigm shifts involve more than facts and figures. They involve esthetic and emotional issues and fixations on paradigms that may have to be abandoned. That the Laws of Physics may be contingent on the local environment... represents a devastating disappointment to many physicists, who have an almost spiritual feeling that nature must be 'beautiful' in a certain special mathematical sense." (Pg. 109) He adds, "What I have never heard is criticism based on the unfortunate inelegance or the lack of uniqueness of String Theory... My own guess is that the inelegance and lack of uniqueness will eventually be seen as strengths of the theory." (Pg. 127) He admits "If you purchased this book hoping to find the ultimate answer to how the universe began, I am afraid you will be disappointed. Neither I nor anyone else knows... But however it began, we know one thing. At some time in the past, the universe existed in a state of very large energy density, probably trapped in an inflationary expansion." (Pg. 302) He states, "Whether we use the language of the megaverse or the many-worlds interpretation, the parallel view, together with the enormous Landscape of String Theory, provides us with the two elements that can change the Anthropic Principle from a silly tautology into a powerful organizing principle. But the parallel view relies on the reality of regions of space and time that, apparently, are permanently beyond the reach of any conceivable observation.

For some people that is troubling. It troubles me... the parallel view seems more like metaphysics than science." (Pg. 324)He admits, "Who knows? Maybe God DID make the world. But scientists... resist the temptation to explain natural phenomena, including creation itself, by divine intervention. Why? Because as scientists we understand that there is a compelling human need to believe---the need to be comforted---that easily clouds people's judgment. It's all too easy to fall into the seductive trap of a comforting fairy tale. So we resist, to the death, all explanations of the world based on anything but the Laws of Physics, mathematics, and probability." (Pg. 355)He summarizes, "Throughout this book I have dismissed beauty, uniqueness, and elegance as false images. The Laws of Physics... are neither unique nor elegant.... But I confess: I am as vulnerable to the seductive charms of Uniqueness and Elegance as any one of my colleagues. I, too, want to believe that the grand overarching principles that transcend the rules governing any particular pocket of the universe are unique, elegant, and wonderfully simple... I often joke that if the best theories are the ones with the minimum number of defining equations and principles, String Theory is by far the best---no one has ever found even a single defining equation or principle!... nobody knows what its defining rules are, nor does anyone know what the basic 'building blocks' are." (Pg. 377-378)He concludes, "Is there a purpose to it all? I don't pretend to know the answers. Those who would look to the Anthropic Principle as a sign of a benevolent creator have found no comfort in these pages. The laws of gravity, quantum mechanics, and a rich Landscape together with the laws of large numbers are all that's needed to explain the friendliness of our patch of the universe. But... neither does anything in this book diminish the likelihood that an intelligent agent created the universe for some purpose. The ultimate existential question, 'Why is there Something rather than Nothing?' has no more or less an answer than before anyone had ever heard of String Theory. If there was a moment of creation, it is obscured from our eyes and our telescopes by the veil of explosive Inflation that took place during the prehistory of the Big bang. If there is a God, she has taken great pains to make herself irrelevant. Let me then close this book with the words of Pierre-Simon de Laplace... 'I have no need of that hypothesis.'" (Pg. 380)If you're looking for an "introduction" to String Theory; this definitely isn't it. If you're looking for interesting and mind-stretching speculations by one of the FOUNDERS of String Theory, this book may be right up your alley.

good read, hard to believe in many worlds

This is the first book I have read by Leonard Susskind, and I must say that I have thoroughly

enjoyed it. He notes the purpose in writing the book saying that the argument is not between religion and science, but between two factions of science. There are those who believe that the laws of nature are determined by mathematical relations, and life just happens to exist in this environment. Then there are those who believe that the Laws of Physics have, in some way, been determined by the requirement that intelligent life be possible. We are first given an introduction to various important concepts such as, the uncertainty principle, quantum electrodynamics, Feynman diagrams, the fine structure constant, quantum chromodynamics, among other things. And then comes what he calls the "mother of all physics problems" – the cosmological constant. There seems to be a sea of virtual particles (vacuum energy) consisting of every kind of elementary particle. This sea constitutes the cosmological constant and estimates peg it to a value about 120 orders of magnitude larger than observations. "That's so bad that it's funny," retorts Susskind. Our attention is now diverted to something called the Landscape, which is a space of possibilities. It's not a real place, but a mathematical construct, and each of the points in this construct represents a possible environment of vacuum; the Standard Model is just one point in this Landscape of possibilities. Picture it as something having highlands, lowlands, mountains and valleys. The differing heights represent potential energies, where at each point the energy of a pocket universe could exist. Some time is spent discussing the flatness of space, and why with visible and dark matter combined, we do still not have enough mass to produce flatness – we are left with a hyperbolic shaped universe. Enter dark energy. This component represents the cosmological constant, and guess what, it gives us our flat space. Susskind shows how cosmic microwave background radiation measurements, type I supernovae, the WMAP satellite data, and large oscillating blobs from the "surface of the last scattering" all enable us to prove the flatness. But all of this "fine tuning" confronts us with the motif: the universe appears to have been specially designed. Susskind tries now to provide evidence for the existence of this aforementioned Landscape. He noticed String Theory was moving, as he said, in a perverse direction. Instead of zeroing in on a unique system of laws, it was producing an ever-expanding concoction of possibilities. We are introduced to a concept called supersymmetry. "Almost everything we know about the theory involves a very special portion of the Landscape where the mathematics was amazingly simplified by a property [called supersymmetry]." He notes that these supersymmetric regions of the Landscape allow us to deduce many things without a mastery of the entire Landscape, and this supersymmetry

is important to tame violent quantum fluctuations that can affect particle masses. This discussion leads eventually to a pinnacle in something called M-theory. I can't do this topic justice in a brief paragraph; you simply have to read it yourself. The author explains everything quite well for the lay audience. We are now introduced to Calabi Yau manifolds, branes, compactification, fluxes, and conifold singularities. He discusses something called the KKLT construction involving a "snouty conifold singularity" and an anti-brane, which remarkably provides proof positive that the String Theory Landscape has valleys with a small positive cosmological constant  $\Lambda$  like our universe! It, in fact, has valleys where you can have a positive cosmological constant just like our universe, even though this construction was not like our universe. He shows the enormous possible configurations of the Calabi Yau space, and how in this huge number there will be a tiny "window of life," which requires no "fine-tuning" and provides an "anthropic window of opportunity"  $\Lambda$  in other words, a possibility where we could exist. Again, don't be thrown by the terminology, Susskind explains it all for you. Susskind continues to explain how our particular universe may have formed in this landscape via inflation of our pocket of space as it moved down a "potential energy ledge" resulting in the creation of the material of our universe through a process called reheating. We finally came to rest in our present valley with our "tiny anthropic cosmological constant." He notes that "the mathematics of String Theory seems to make the Landscape unavoidable." After talking about parallel verses series views of an eternally inflating history and something called the many-worlds interpretation, he concludes that elements are present to "change the Anthropic Principle from a silly tautology into a powerful organizing principle." We are then exposed to the Holographic Principle and the Principle of Black Hole Complementarity. Here we learn that the "voxels" that fill the volume of space can be stored as two-dimensional pixels that are each a Planck length long  $\Lambda$  a very, very, very small pixel size. This is quite interesting stuff as the implication is that information does not have a definite location in space! Susskind sums everything up by explaining how we might find testable evidence of all of this. For example, finding that our universe is, in fact, negatively curved, which would indicate that our universe was born in a bubble-nucleation event. Or the detection of huge cosmic strings that were expanded by Inflation  $\Lambda$  they would produce gravitational waves that could be detected some day. Even though he admits that String Theory is the best game in town presently, he acknowledges some fundamental problems: "nobody knows

what its defining rules are, nor does anyone know what the basic building blocks are. So we are left with a “Landscape of possibilities populated by a megaverse of actualities. We are fortunate to be in such a “friendly patch of the Landscape or I would not be here writing this.

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