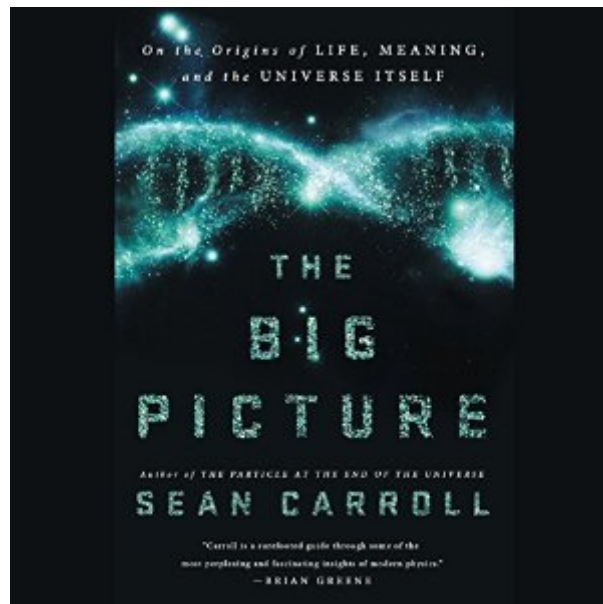


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# The Big Picture: On The Origins Of Life, Meaning, And The Universe Itself



## Synopsis

Does human purpose and meaning fit into a scientific worldview? Already internationally acclaimed for his elegant, lucid writing on the most challenging notions in modern physics, Sean Carroll is emerging as one of the greatest humanist thinkers of his generation as he brings his extraordinary intellect to bear not only on the Higgs boson and extra dimensions but now also on our deepest personal questions. Where are we? Who are we? Are our emotions, our beliefs, and our hopes and dreams ultimately meaningless out there in the void? In short chapters filled with intriguing historical anecdotes, personal asides, and rigorous exposition, listeners learn the difference between how the world works at the quantum level, the cosmic level, and the human level - and then how each connects to the other. Carroll's presentation of the principles that have guided the scientific revolution - from Darwin and Einstein to the origins of life, consciousness, and the universe - is dazzlingly unique. Carroll shows how an avalanche of discoveries in the past few hundred years has changed our world and what really matters to us. Our lives are dwarfed like never before by the immensity of space and time, but they are redeemed by our capacity to comprehend it and give it meaning. The Big Picture is an unprecedented scientific worldview, a tour de force that will be listened to alongside the works of Stephen Hawking, Carl Sagan, Daniel Dennett, and E. O. Wilson for years to come.

## Book Information

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## Customer Reviews

Sean Carroll is a successful theoretical physicist, skilled ponderer of philosophical questions and

gifted communicator of science. He brings all these qualities to bear in his big-hearted, ambitious latest book *The Big Picture*. The book is part sweeping survey of some of the most thought-provoking ideas in modern science, part sweeping rumination on two of the most fundamental questions that we can ask: How do we gain knowledge of the world? And how do we distill meaning from an impersonal, purely physical universe? The book can roughly be divided into two parts. The first part can be titled *How do we know* and the second can be titled *What do we know*. The siren song weaving its way through Carroll's narrative is called poetic naturalism. Poetic naturalism simply means that there are many ways to talk about reality, and all of them are valid as long as they are rooted in naturalism and consistent with one another. This is the central message of the book: we make up explanations about the world and we call these explanations *stories* or *models* or *ideas*, and all of them are valid in their own ways. The first part of the book explores some of the central concepts in the philosophy of science that make up poetic naturalism. Carroll starts from Aristotle and the ancient Greeks and progresses through the Arabs. He explores the investigations of Galileo in the seventeenth century. It was Galileo and his intellectual successor Isaac Newton who showed that the world operates according to self-sufficient physical laws that don't necessarily require external causes. One of the most important concepts explored in the book is Bayesian thinking, in which one assigns probabilities to phenomena based on one's previous understanding of the world and then updates this understanding (or *priors*) according to new evidence. Bayesian thinking is a powerful tool for distinguishing valid science from invalid science, and for distinguishing science from nonsense: one could in fact argue that all human belief systems operate (or should operate) according to Bayesian criteria. Bayesianism does introduce an element of subjectivity in the scientific process, but as Carroll demonstrates, this supposed bias has not harmed our investigations of natural phenomena and has allowed us to come up with accurate explanations. Another thread weaving its way through the book is that of emergence and domains of applicability. Emergence means the existence of properties that are not strictly reducible to their constituent parts. Although Carroll is a physicist and holds fundamental physics in high regard, he appreciates that chemistry has its own language and neuroscience has its own language, and these languages are as fundamental to their disciplines as photons and electrons are to physics. No field of inquiry is thus truly fundamental in an all-encompassing sense, since there are always emergent phenomena that offer stories and explanations in their own right. Emergence also manifests itself in the form of what are called effective theories in physics; these are theories in which the macroscopic behavior of a system does

not depend in a unique way on a detailed microscopic description: for instance a container of air can be perfectly described by properties like its average temperature and pressure without resorting to descriptions of quarks and Higgs bosons. As long as the two domains are consistent with each other (what Carroll calls "planets of belief") we are on firm ground. These ideas lay the foundation for the second half of the book which takes us on a sweeping sojourn through many of the key ideas of modern science. Carroll says that the most important description of the world comes from what he calls the "Core Theory". This theory ties together the fundamental forces of nature and particles like the Higgs boson; it is grounded in general relativity and quantum mechanics. It can explain the entire physical universe, from atoms to the Big Bang, certainly in principle but often in practice. If there's any one hard scientific lesson to take away from the book, it's that the universe is made up of quantum fields. Later chapters deal with topics like evolution in real time, photosynthesis and metabolism, leading theories for the origins of life, thermodynamics and networks in the brain. When Carroll talks about entropy, complexity and the arrow of time he is in his element; one important aspect of complexity which I had not quite appreciated is that complexity can actually result from an increase, not decrease, of entropy and disorder if guided the right way. The book also dwells in detail upon Rene Descartes since his ideas of dualism and pure thought seem to pose challenge to poetic naturalism, but as Carroll demonstrates, these challenges are illusory since both the mind and the body can be shown to operate based on well known physical principles. These ideas keep appearing in the later parts of the book in which Carroll deals with many thought experiments in philosophy and neuroscience that purport to ask questions about reality and consciousness. Some experiments involve zombies, others involve aliens simulating us; all are entertaining. A big question is subjective experience (or "qualia") which is sometimes regarded as some kind of impenetrable domain that is divorced from objective laws of nature. For the most part Carroll convincingly shows us that the same laws of nature that give rise to the motion of the planets also give rise to one's perception of the color red, for instance. This section of the book involving famous conundrums like John Searle's Chinese Room and Mary the Color Scientist is fascinating and highly thought-provoking, and while the thought experiments have no clear resolution, Carroll's point is that none of them violate the basic naturalistic structure of the universe and demand mysterious explanations. His discussion of consciousness is also very stimulating; he thinks that consciousness is not really a thing per se but an emergent property of organized matter. More succinctly, it's a useful invention, a description of a particular way in which matter behaves rather than something that is beyond our current understanding of natural

law; it is what we say rather than what is. Much of Carroll's discussion here reminds me, as cheesy as it sounds, of a line from *The Matrix*: words like love, care and purpose are mere descriptions borne of language - what matters are the connections they imply. The book ends by taking us on a tour of some of the most important philosophical questions that human beings have asked themselves; questions of meaning, purpose, emotion and free will. Personally I found this section a bit rambling but I cannot really blame Carroll for this: none of these questions have a definitive answer and all are subject to speculation. On the other hand, this little tour provides non-specialists with an introduction to well-known philosophers and philosophies, including constructivism, deontology and utilitarianism. The big question here is how meaning can arise from the impersonal natural laws that have been described so far. Neither Carroll nor anyone else knows the answer, and the book simply makes the case that all these qualities are emergent properties that are all consistent with poetic naturalism. You may or may not be satisfied by this answer, but it certainly provides food for thought. In a book as ambitious as this one there's bound to be some disagreement, and that's a good thing. Here are some questions I had: Generally speaking Carroll is on more firm ground when talking about science rather than philosophy. Quite oddly at one point, he uses poetic naturalism to argue against opposition to gay marriage and LGBT rights. While his support for these issues is one I heartily share, I am not sure poetic naturalism is the best or the most persuasive reason to uphold these causes: we should support them not because of but in spite of naturalistic reasons. Also, Carroll who is a self-professed naturalist spends several paragraphs describing how all of the arguments for a supernatural God violate naturalism. However I think religion has a purpose beyond describing the real world, and ironically this purpose lends itself to the same analysis that Carroll does of human qualities like care and love. I would think that based on much of the book's narrative, religion would be described as an emergent phenomenon that provides people with a set of stories and descriptions; these stories provide succor and a sense of community. Are these stories real? They may not be, and they are certainly not grounded in natural law, but Carroll himself says at one point that models of the world should be used because they are useful, not because they claim to be real. Shouldn't one say the same thing about the positive and personal aspects of religion? However, none of these concerns should detract from the sweeping scientific and philosophical journey the book takes us on. Carroll is an engaging, sympathetic and pleasant guide to the big picture, irrespective of whether you agree with him completely or not. Ranging over some of the most pressing questions that humanity has unearthed and continues to unearth, the one clear message in the book is an unambiguous one: we will always keep on searching, and this search will continue to propel

humanity past unexpected and exciting horizons. More than anything else the discussion drives home the grandeur of the universe and the human mind, and this is grandeur we should all revel in. Perhaps this bit of wisdom from Carroll's chapter on entropy where he is describing complexity in a cup of coffee sums it up best: "Those swirls in the cream mixing in the coffee? That's us. Ephemeral patterns of complexity, riding a wave of increasing entropy from simple beginnings to a simple end. We should enjoy the ride."

After having a countdown for this book, which spanned months, I woke up at 5 am on May 10th and thought, "It's finally here!" I opened my Audible library and it was better than Christmas. In the quiet of the morning, I began to listen to this deeply philosophical book and immediately fell in love with it. It felt like a Poetic Naturalist's version of Christmas- material gifts replaced by the gift of trying to understand the nature of our vast universe and the world in which we live. Those who have wanted to read Sean Carroll but didn't want to wade through the science will be happy with this book. In the spirit of Alexander von Humboldt, Carroll tucks much of the complex science away in an appendix for those who would like more detail. But, that doesn't mean this book is light on the science. To the contrary, Carroll, as usual, takes some of the most complex issues science has to offer, and packages them in a form that even people with little or no scientific background can understand. In fact, this book in particular is aimed at those who might have little education in the sciences and even less education about heuristics. It welcomes everyone to join in a thoughtful conversation about understanding what we know about our world and the wider universe. Does it have a purpose? Does its design imply any type of creator? Instead of insulting those who say that it does (I am guilty of this myself), Carroll provided a real way to put our beliefs to the test. He was very willing to consider the views of those who believe in God and provide a detailed method, which is both kind and built on logic, that can help us figure out whether a belief is true. If the preceding paragraph suggests to you that those with extensive education in the sciences (including cognitive science) will be bored or find nothing new, then I have represented the book poorly. Even people whose undergrad and grad career consisted of many of the following courses will find new ways of thinking about that information and connecting it to the Big Picture. Samples of related course material: Intro to Cognitive Science (including Kahneman's heuristics) Cognitive Neuroscience Biochem (including chemiosmosis) Evolution (including environmental modification of genes) Origin of life research (including Martin, Russell, and Lane's work on bioenergetics and others working on RNA world) Philosophy of Mind Carroll opened the door for \*everyone\* to think about and discuss what evidence we would need for any belief to be validated. Instead of

dismissing ideas of belief outright, Carroll employs a very gentle, yet fiercely logical style of problem solving. The result was powerful and reminded me of the deep humility and unfailing logic with which Darwin wrote his many books, including his autobiography. Prior to this book, if anyone had asked me if I wanted to read yet another book on creationism vs. science or the hard problem of consciousness (involving Chalmers unrealistic and pseudoscientific zombies), the answer would have been a resounding, "NO!" I feel as if too much of my thinking time has been wasted by these concepts that serve only to anchor our progress. I want to push past all of that. I want to never again allow that type of scientific sabotage to ruin the progress I might make in understanding the universe in a real and more complete way than my current view allows. Often reading about the efforts of those who wage war on evidence based knowledge leaves me frustrated, often wishing I could get that time back. That was not the case with this book. The whole time, even though I was reading things I thought I was tired of reading, my neurons were flooding my brain with wonderful dopamine bursts. Reflexive "Wows" kept reverberating from my brain. The book fits into the category "MINDGASM!" In a book, which includes such topics as: how we know what we know, the forces that govern the universe, properties of elements in relation to other elements, quantum mechanics, emergence and complexity, how we gather and evaluate scientific evidence, Carroll, in his usual relatable fashion, seamlessly included discussions about today's relevant issues in society such as transgender rights, marriage equality. I recall reading E.O. Wilson's book *Social Conquest Of Earth* and feeling somewhat confused about the organization of the book. He kept social issues separate throughout the book and then bombarded the reader with a litany of important social issues. I love both Wilson and his book, but the social issues didn't fit and felt as if they should be in another book. Carroll's humorous (yet serious) approach when discussing such issues makes me feel as if I am reading a 20 something university student with his finger on the pulse of the upcoming generations, while at other times, when he is discussing concepts that take a long time to learn, I feel as if I am reading a book written by a scientifically minded Zarathustra. In a crazy way, this writing style really works. Parts One, Two, and Three (the first half of the book) were basically an excellent summary of an entire 4 year experience as a major in Cognitive Science. After introducing such concepts as understanding cause and effect, understanding how things move and how momentum is conserved, and understanding how we come to adopt our belief systems, Carroll examined the many heuristics we employ when trying to understand how we know what we know. To figure this out, he introduced a sort of "best of" collection of thinkers. Marrying Cog Sci 101 (with a strong emphasis on Bayesian reasoning) with Epistemology and Philosophy 101, he tried to understand what thinkers such as Descartes and Princess Elizabeth of Bohemia, and Kahneman

thought about the nature of reality. The main questions scholars have been asking are, "How can I know what I know? How can I know what exists? How can I know if my beliefs reflect reality?" A take home point from Section Two is that people are all entitled to have their own prior beliefs. However, they are not entitled to have their own likelihood. There is an objective likelihood to be discovered, and it takes solid reasoning, and not tightly held belief, to make that discovery. \*\*\*\* see note at end. While discussing heuristics, Carroll gave a shout out to one of my favorite books -- Mistakes Were Made, but Not by Me. I love that book and am often disappointed that not too many people I have talked to seem to appreciate it in the way I do. I love that it got the recognition it deserved. Many books like it are sort of self-help oriented and veer too far from the science. Many authors fail to question if they are using the very heuristics they are writing about. Still others fail to question the methods to the studies they choose to include, bringing down the overall quality of the book. But, Tavis and Aronson did much better than most avoiding these pitfalls. They deserved some recognition, not from the self-help crowd, but rather from a scientist who is celebrated for his keen logic. In Part 4, Carroll related a humorous story about ending up on a plane, seated next to origin of life researcher Mike Russell. That was a great lead in to explaining Darwinian evolution, cellular formation, emergence, complexity (his complexity research sounds great! I am definitely going to read everything I can get my hand on concerning that), and ATP synthase (my very favorite protein channel!). If you are a bit fuzzy about what Free Energy is, this section will clear that up and relate it to exactly how your very own body works. (What a delicious section. I was too excited to see what came next. So I did not stop to listen again or take notes on this section. As soon as I am done writing this review, I am going to listen to this entire section again.) Theodosius Dobzhansky said, "Nothing in Biology Makes Sense Except in the Light of Evolution". Thanks to scientists such as Sean Carroll, Mike Russell, Jeremy England, and others bridging the gap between living and non living systems, it will soon be said that Nothing in Biology or the larger universe Makes Sense Except in the Light of Thermodynamics. If you want the best possible summary of how thermodynamics fits into the story of living systems (including how those systems likely came into being and how they evolved), then you will love this section. In Part Five, Carroll took on the philosophy of mind debate. You may have taken courses or read extensively about The Chinese Room, Mary, What it's Like to Be a Bat, Eliminative Materialism, and The Hard Problem. Even if you are extremely familiar with all of this, I would recommend reading Carroll's summary. Wow! I was engaged in a way that surprised me. He breathed new life into these debates. I was a tiny bit sad that he left out Andy Clark's work (especially in relation to Chalmers), but considering this book was more than 17 hours long (Audible), I understand that he didn't have time for

everything. It's just that Clark's work (along with the Churchland's work) is what made Philosophy of Mind so great for me. Carroll ended the book with what I can only say was a beautiful essay I didn't know I needed to read. If you are unfamiliar with the Is vs Ought problem, you can find out in this section what it is and why should you care. If you are well familiar with this question, you will enjoy the discussion provided on Carroll about morality. Deeply satisfying! A+! He ended on a more personal note than any thing I have read by him to date. It was truly a lovely book, from start to finish. I think Carroll will be remembered along side of Copernicus and Darwin for providing us with gentle but clear evidence that we are not special. Far from being a depressing nihilistic view of the world and universe, Carroll showed his reader (even if you read with your ears) how reality is actually more special than any false belief about being special. Understanding can be the deepest religion of all (idk if Carroll would put it quite like that, but it's my takeaway message).\*\*\*\*I was going to include in this review a bit about Sean Carroll's "planet v black hole belief system," but I posted about it on Facebook and butchered what was an excellent analogy. I can only say that you need to read it for yourself. If you get the analogy, you will forever ask yourself, "Am I being a black hole right now? "Am I following the evidence or am I fooling myself and holding tight to heuristically driven fallacies?" I can see a new viral way of thinking springing from this analogy -- e.g. insults or memes that include the statement, "Stop being such a black hole!"

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