# SUSANAARY BY ALYSSA BURNETTE UNTIL THE END OF THE By Brian Greene



# Summary of Until the End of Time by Brian Greene

Written by Alyssa Burnette

An overview of time, space, and human evolution.

## **Table of Contents**

Introduction	5
The Law of Entropy	6
Free Will Isn't Quite as Free as we Think	8
Our Brains Use Language, Storytelling, and Religion to Help us Find Meaning and Survive	10
Final Summary	13



#### DO YOU WANT THIS BOOK AS AN 20-MINUTE AUDIOBOOK?



Get the key insights of non-fiction books in minutes instead of hours. Listen to our free audiobooks while you workout or on your commute to work.



DOWNLOAD OUR FREE APP



#### Introduction

Have you ever sat around and pondered the meaning of the universe? Have you ever stared at some of the marvels in nature and wondered how they came to be? Many people are interested in learning more about the world and our place within it, but we balk at the technical jargon of a physics textbook. Physicist Brian Greene believes that no one should be prevented from exploring truths about the universe, so he set out to create a userfriendly guide that would examine some of the world's most complicated and interesting topics. Over the course of this summary, you'll learn about entropy and the role it played in The Big Bang. You'll also learn about the evolution of the self, free will, and our relationship with language, religion, and the art of storytelling.



#### The Law of Entropy

You might vaguely remember "entropy" as a fleeting concept from your highschool physics textbook, but unless you're a physicist, most of us don't need or want to remember its definition in our daily lives. However, entropy can be an intriguing and helpful concept to learn about if you want to understand the universe and your place within it. So, without time-traveling to highschool science classes, we'll put this complex concept in the most simplistic terms. Basically, entropy is the measure of uncertainty or randomness. We use entropy to determine the amount of energy which is unavailable in any given object and therefore, how much energy cannot be used by that object. If your head is already spinning, just know that-- for the purposes of this chapter-- the most important thing you need to know about entropy is that we can use it to inform our understanding of time.

How does it work? Well, let's start by considering the human perception of time. For example, we remember the past but not the future, and from this, we conclude that we haven't experienced the future yet and therefore don't know what will happen in it. Likewise, we are younger in the past but older in the present and future, so we conclude that time is asymmetric. This perception is the result of entropy or the uncertainty of what we can't yet know. Scientists have therefore studied the law of entropy and confirmed two things: that entropy will only increase with the passage of time and that it cannot reverse and decrease with time. Although this may not answer every question we have about the passage of time, at the very least, we can understand that entropy forms the foundation for the human conceptualization and experience of time.

In addition to explaining the concept of time, entropy is also useful for helping us to understand other complex truths about the universe. For example, we can use the concept of entropy to understand The Big Bang. Because entropy is the measurement of randomness and uncertainty, you might assume that it causes chaos rather than any form of structured growth. But actually, nothing could be further from the truth! The author observes that there are actually some instances in which an excess of entropy can result in the development of complex and organized systems. That's because entropy doesn't occur in a linear fashion. Rather, it exists on a sort of curvy continuum in which minimal complexity exists on both ends but a loop of high complexity is present in the middle.

To visualize this, consider what happens when you blend the ingredients of an Espresso Martini. When you first start pouring the vanilla vodka into the espresso, the two liquids remain separate at first. But then the vodka drifts to the bottom of the container, leaving no discernible signs that another liquid has entered the espresso. In the middle, however, the two liquids are coming together, flavors meshing until they reach the perfect harmony that forms their delicious blend of flavors. This internal complexity had to occur in order for the flavors to fuse and form one cohesive flavor rather than the impression that you're drinking two separate things from the same cup.

And we can apply this same analogy to the development of the universe. When entropy was at its lowest-- (at one end of the minimal complexity spectrum)-- that's when the Big Bang occurred. This, of course, shook everything up in much the same way that the ingredients of an espresso martini are jumbled up in a cocktail shaker. But after the initial outburst, entropy began gravitating toward the final end of the spectrum: back toward simplicity again. So, even though entropy is the measure of chaos, randomness, and the things we do not know, it's still instrumental in creating complex systems like our very own planet Earth. (Or the perfect espresso martini).



#### Free Will Isn't Quite as Free as we Think

In the previous chapter, we learned how principles like entropy can help us understand the existence of the universe. But now it's time to take a look at the scientific principles that can help us understand our place in the universe. We'll start with the concept of free will. Free will sits in an interesting position at the intersection of science and psychology. We need both to help us understand how our minds work. And, as you'll see in this chapter, the concept of free will is more nebulous than you might think. Because we seemingly have the freedom to make our own decisions, we assume that every human being comes equipped with "free will software." Just like a computer or an iPhone, it would seem that we arrive in the world fully loaded with the freedom to assess information and make rational choices based on that information. But as the author's research shows, that's not necessarily the case. Although we appear to have free will, the reality is that human beings are all subject to the stories and interpretations provided by our brains.

In fact, we are more or less controlled by the narratives that impact our lives. For example, if you were raised by parents who subscribed to a particular religion or taught you a certain set of moral values, the stories you tell yourself will be filtered through this lens. As a result, you might make decisions based off of questions like, "Is this what a good person would do?" or "Is this morally wrong?" Likewise, if you were subjected to a different set of values like racism, sexism, or homophobia, your choices and your worldview will be filtered through that lens. The same is true for people who have suffered intensely abusive or traumatic experiences.

But even if our free will isn't quite as free as we think, that's not to say that we are merely victims of our upbringing or our brain chemistry. Scientists have asserted that human beings do come preloaded with a conscience. Interestingly, however, in spite of that widely accepted theory, neuroscientists have never been able to point to a specific part of the brain and say, "That right there-- that's the conscience!" The same is true of the "self." Just as we believe that everybody has a conscience, we also believe that we are a;; individuals and that we have a self. But there is no part of the brain or body that can be identified as the "self." Despite this neuroscientific mystery, however, human behavior has shown us that human beings do possess both a conscience and a sense of self, even if we can't pinpoint their specific, physical locations. And our conscience does allow us to grow, change, and develop a new sense of morality. We can also adapt our behavior and make different choices as a result of that new information. That's why you're reading self-help books like this one-- because you know you have the capacity to learn and make better choices!



### Our Brains Use Language, Storytelling, and Religion to Help us Find Meaning and Survive

Most people would probably say that they love a good story. Whether you to prefer to consume stories in the form of a television show or a book, most people love getting lost in a narrative. But did you know that our brains also tell us stories to help us understand the world and the daily situations we encounter? That might sound a little crazy because you probably don't walk around every day telling yourself stories that begin with, "Once upon a time..." But "once upon a time" is not the standard formula for every story you'll ever tell! And if you don't believe that you tell yourself stories, just think about your thought process when you're imagining what will happen next at any point in your day.

For example, let's say you're about to walk into a meeting with your boss. You're late on the report she asked you to complete. So, as you approach her office, your steps might be tinged with trepidation and you might find yourself visualizing the outcome. You're wondering if she'll fire you. You're wondering if she'll be angry. Maybe you're imagining what she'll say when you walk in. Or maybe you're imagining what you'll say to defend yourself. Maybe she'll be cool about it. Or maybe it'll be catastrophic. No matter what, it's almost guaranteed that you've imagined outcomes for every possibility. And whether you've thought about them that way or not, these thoughts are actually stories that you tell yourself to predict the outcome of the day or to provide assurance or comfort.

And the same is true of stories that don't directly involve us. If you're like most people, you probably have childhood memories of ghost stories, Bible stories, nursery rhymes, or fables told to you by your parents. Some classics include stories like The Tortoise and The Hare, the tale of David and Goliath, or the story of Adam and Eve. These stories are intended to help us navigate the world because they form our understanding of big-picture concepts about human existence. For example, the classic fable of The Tortoise and The Hare teaches us that "slow and steady wins the race"; from this tale, we learn that if we do our best and take our time, we'll eventually win in the end. Likewise, the story of David and Goliath indicates that underdogs can triumph in the face of seemingly insurmountable opposition, and Adam and Eve's Biblical origin story highlights a Christian interpretation of the world's creation.

And indeed, it seems that everybody knows these stories. That's because we pass them down from one generation to the next as our parents and grandparents did to us. As a result, these stories and their lessons shape our worldview and our relationship with morality. But have you ever wondered why stories are so effective? Or how they survive to be passed down through generations? As is the case with many significant aspects of human existence, the simplest explanation is often the truest, and stories are no different. Quite simply, stories survive because they invite us to engage with them. They activate our imagination and our emotions. They enable us to live vicariously through characters. And in so doing, we are free to access moral insights that might escape us if someone spoke to us directly about our own behavior.

To consider how this works in practice, let's take a look at a very innocent fable and return to our analogy about the tortoise and the hare. While many myths take a much darker approach, examining critical elements of human morality, the fable of the tortoise and the hare is universally applicable to all ages. So, let's imagine that you struggle with the same issues embodied by the hare. You often bite off more than you can chew or you overestimate your own abilities. Perhaps you're a little more cocky than you should be and you let your pride get the best of you. So, imagine that someone came up to you and told you all those things about yourself. Would you be receptive to what they had to say? Would you be grateful for their insights and willing to take an honest, introspective look at your own behavior? Or would you feel attacked and resentful? Let's be honest-- for most of us, it would be the latter!

But what if someone told you the story of the tortoise and the hare? Because it's a fictional story that situates you as an outside observer, it's easy for you to take a step back and evaluate both characters' behavior in an objective light. From there, you might say, "Wow, that's so foolish of the hare! Doesn't he know he needs to slow down and take his time?" And if you're feeling especially open-minded that day, it's possible that the story might penetrate deeply enough for you to recognize that your behavior often mirrors that of the hare. In fact, it's possible that you guys have more in common than you would like. So, as you reflect on your newly-discovered insight, you have the opportunity to say, "Hey, I should change that! I'd be a lot happier and more successful if I took a lesson from the tortoise!" From this example, you can see how stories help us to learn more about ourselves, our morality, and the values we hope to cultivate.

But stories are also useful for making sense of the world. Today, many of us don't believe in a host of mythical gods-- in fact, 2 million people in the world don't believe in any higher power-- but we can still understand how myths help us interpret life. For example, when ancient cultures invented elaborate creation stories and attributed shocking phenomena to supernatural forces, we can understand that it helped them to imagine where the world came from and why certain things happened. Rather than existing in a state of chaos and confusion, it was easier to ascribe natural disasters like famines, plagues, and hurricanes to the wrath of a vengeful god. Believing that you could ward off these disasters by appeasing the gods generated a sense of security. However false it might have been, this sense of security was preferable because it allowed people to believe that they had some control over their futures. And whether we believe in god or science today, modern people still do similar things. So, it's easy to see how stories imbue our lives with a substantial amount of meaning!



#### **Final Summary**

The world is full of marvel, mystery, and wonder. It's no surprise that scientists, explorers, and philosophers have devoted their lives to learning more about the universe in which we live. Some of the topics we investigate are complex-- so complex, in fact, that science has not yet discovered all the answers. But that's part of the beauty of the human experience! Human beings are constantly evolving; as soon as we developed the power of speech, we used language, storytelling, and religion to add meaning to our existence. We also learned to use these concepts as tools for navigating life.

For example, we learned that language could help us communicate with one another and storytelling can help us interrogate truths about the universe and ourselves. We have also found meaning in the nebulous concept of free will. And even though scientists haven't quite been able to pin down the origin or existence of free will, we believe in it, and we use that belief to make choices that improve our personal development. As you can see from these examples, one thing is universal: the power and resilience of the human spirit. Just as we have evolved to navigate our existence, we will evolve to learn new truths about the universe.





#### DO YOU WANT THIS BOOK AS AN 20-MINUTE AUDIOBOOK?



Get the key insights of non-fiction books in minutes instead of hours. Listen to our free audiobooks while you workout or on your commute to work.



DOWNLOAD OUR FREE APP

