The Grand Design

I could not have picked a more appropriate book to finish off our Physics 311 course with. *The Grand Design* by Stephen Hawking and Leonard Mlodinow delve deep into not only the history of humanity and Earth, but of the universe as a whole. It read like a book written by Davies with the subject matter of the *The Four Percent Universe*, The Einstein Biography Movie and *The Elegant Universe* all rolled into one. Hawking and Mlodinow were able to use everyday examples to allow for simple understanding of even the most complex topics. I was able to increase my understanding of a number of ideas that had already been touched upon during our course.

The book begins with a rundown of human history. Although this may seem strange in a book that is supposed to explain the most basic workings of the universe, it is essential to see how human thought has evolved in order to understand what we know today and hope to understand in the future. They begin by describing how humans have been pondering the existence of life and the universe for hundreds of thousands of years. In this time frame, written history only dates back about 10,000 years and our scientific thought dates back even less than that – 2,500 years ago. In early human thought, it was believed that the gods were responsible for the entire phenomenon that occurred around them. One example of this was during eclipses it was believed that wolves caused the sun to be covered by the moon. In order to scare away the wolves, the humans during that time would make as much noise as possible to return the sun to its unobstructed location. Around 585 BC, Thales correctly predicted a solar eclipse. With this a new era where the world was understandable was ushered in. For the first time, it seemed that the moon would move out of the way even if they weren’t making all sorts of noise.

The idea that there were “Laws of Nature” would sit in the mind of intellectuals for hundreds of years, until the time of Isaac Newton. Newton was the first to come up with a Law of Nature to describe the world we lived in. His ideas on gravity began a race to figure out why the universe operates in the way it does. A fundamental redirection in human thought occurred once again which led us down the road of scientific determinism. Hawking and Mlodinow were very precise in what makes a law, a law. There can be no exceptions and no miracles. Newton’s ideas were utilized by many great minds that followed him, but perhaps the greatest was Einstein who turned Newton’s gravitational theory on its head. He postulated that space and time were not two separate entities, but rather were part of one fabric called space time. This space time fabric is stretched by very massive objects. Even light can be bent by the force of gravity. With this new theory of gravity, Einstein felt the outcome of his work needed to end in a unified theory of everything. This is where quantum mechanics come in.
Perhaps my favorite quote in regards to quantum mechanics is that “No one really understands quantum mechanics”. Hawking and Mlodinow explain the famous double slit experiment that displayed key elements of quantum mechanics. Although quantum mechanics still seems unreal to me, the amount of testing done and predictions made by the theory make it pretty hard to doubt. The holy grail of physics is the simplification of the quantum theory with the gravitational theory. This is no easy task, but there may be hope in a theory that was touched upon in class.

Hawking and Mlodinow speak of M Theory with an immense amount of excitement. It seems that the possibility that we are toying with the theory of everything is intoxicating to physicists. What makes M Theory so spectacular is its ability to combine the quantum and gravitational theories so elegantly. Much like Paul Davies in *The Eerie Silence*, Hawking and Mlodinow go into what M Theory would mean for the scientific world. One of the major aspects of M Theory is that it requires 11 dimensions to operate successfully. This may seem absurd, but it doesn’t take much to imagine the possibility of dimensions outside of our own. I imagine myself as a dot that migrates around an x and y grid. I would never know of the z-axis and could never jump out of my 2d world, but does that make the 3d world any less real? I suppose I need not be able to think of what these additional dimensions would look like, because it is likely I would never be able to see them if I cannot see them today, but accepting that they could be out there seems sufficient to me. If M Theory was proven to be correct, Hawking and Mlodinow perceive that we would have the schematics for the Grand Design.

The fascinating part of *The Grand Design* was that it really touched on every aspect of our entire course. An event like the Cosmic Microwave Background (CMBR) that was accidently discovered by two workers at Bell Labs was detailed. A few things I found interesting about the CMBR was that it is only 3 degrees above absolute zero and it has a nearly uniform temperature all across the universe. This nearly uniform temperature is evidence for inflation, which was talked about in many of our other books and movies. Although I did not refute inflation, I was continually wondering how the universe could expand faster than the speed of light. Simply said by Hawking and Mlodinow, the speed limit of light does not pertain to the fabric of space time itself.

All of this, along with our entire course has touched upon what happened after the universe started. Even Einstein’s equations cannot explain the origin of the universe. In this book though, it goes over how universes may be created. This is the idea of multiverses, or many different universes that come into existence like bubbles in a pot of boiling water. Some of these bubbles start out very small, but never make it to inflation because the laws of nature in that bubble are not sufficient to produce a sustainable universe and instead it expands and collapses too fast. Stars, galaxies and the like are never able to form. Our universe just happens to be one of the bubbles that had proper characteristics to inflate allowing for everything we see today. If thinking about a boiling pot of water, it is not hard to see the bubbles that come to fruition as steam bubbles. For every bubble that does come into existence, there are many more bubbles that sit on the bottom and become nothing more.
Hawking and Mlodinov wrote a comprehensive book detailing the history of not only humans, but of the universe as a whole. Considering all of this, I would recommend *The Grand Design* as a book that really brings together all of the different discoveries, ideas and theories that we have discussed throughout the course.