A Brief History of Time Book Summary, by Stephen Hawking

by Allen Cheng

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1-Page Summary of A Brief History of Time

Overall Summary

Where did the universe and everything in it come from? Modern science has developed new technology that allows us to answer such questions. Stephen Hawking details some of those breakthroughs, including a discussion on how our understanding has evolved over time.

Though people in ancient Greece figured out that the earth is round, thinkers like Aristotle still thought the earth was at the center of everything else. This theory wasn't really challenged until Nicholas Copernicus showed that planets including Earth orbit the sun. In 1687, Sir Isaac Newton devised his own laws related to gravity and theorized that all stars should exert this force on one another. He also wondered if there was a time when everything was in a single tiny place. God could fit into this theory as well.

Science is looking for one theory that ties together the two main theories of relativity and quantum mechanics. Those theories deal with massive celestial bodies on a large scale, as well as tiny particles on a small scale. Scientists are trying to find something that unifies those two theories into one big idea because they want to understand how we came about.

Newton put forth the idea that objects move at a constant speed unless forces act upon them. This challenges the belief of absolute space, because if you're on a train moving 40 miles per hour and throw something like a ping pong ball, it will travel much farther than expected by someone standing outside the train.

The idea of absolute time took longer to overcome. However, in 1865, James Clerk Maxwell discovered that light has different wavelengths and is faster than any other object. Albert Einstein later pointed out that light always moves at the same speed and is faster than anything else in his theory of relativity. The general theory of relativity also put forth that gravity warps—bends and curves—space-time. For example, time moves more slowly near objects with larger masses. Thus, though space and time affect objects' movements, objects' movements also affect space and time; neither is absolute.

In the mid 18th century, astronomers discovered that our galaxy is a spiral. In the 20th century, Hubble showed that there are other galaxies and that they're moving away from us. This explains why we don't need Einstein's cosmological constant to explain why the universe isn't collapsing in on itself—Einstein said it was his worst mistake.

A physicist named Friedmann found that the universe is roughly the same in all directions. He was able to prove this by measuring the universe's uniform microwave radiation. Some of his other models included a big bang at the beginning, which became widely accepted later with Penrose's work on black holes and Hawking's paper on them.

In the early 1800s, Laplace said that because science was doing such a good job at predicting things, we would be able to predict everything if we knew the exact state of the universe at one point in time. But Heisenberg's uncertainty principle proved him wrong when he tried to measure exactly where particles were with light. The more accurately Heisenberg wanted to measure this, the more it affected where particles were and their velocity. This lead scientists to create quantum mechanics.

Theories about the atom have been developed over time. Scientists discovered electrons, neutrons, and protons in the early 1900s. Murray Gell-Mann won a Nobel Prize for discovering that these were made up of quarks, which are different types of particles with specific spins. Particles also follow the Pauli exclusion principle, which states that they cannot be in exactly the same place at once because they repel each other. Further research has revealed more information about anti-particles (which occur when matter collides with antimatter) as well as force-carrying particles such as gravitational forces and electromagnetic forces.