

Groundbroken

My high-school physics teacher was the first to explain the “Double Slit Experiment” to me, and its complexity will forever shape my perception of our world. It marked the beginning of a personal expedition in which I discovered a universe of invisibility and imperceptions. As I stepped forward to observe math and science and their more complex theories, the boundary of “right and wrong” became skewed in many aspects of my life. Self-righteousness gave way to open-mindedness. History divides science and spirituality, but I’ve come to believe that both exist harmoniously.

The “Double-Slit Experiment,” my physics teacher explained, was first revealed in 1927. American physicists Clinton Davisson and Lester Germer inadvertently discovered something that would shake 2,000 years of scientific thought. While studying the surface of nickel with electrons, they noticed odd behavior. It didn’t reflect common physics—or even common sense. To acquire a simpler explanation of their findings, we can imagine an experiment in which we shoot a beam of electrons at two separate gaps on a wall. On the other side of the slotted barrier, there are clusters of electrons spaced in an even pattern along the entire wall rather than two big piles as anyone would expect.

So what does this mean? English scientist Thomas Young oddly had the same results when he conducted a similar experiment with light in 1801. It proves that electrons, and even large molecules, have wave-like behaviors. Once the particles passed the barrier, they experienced wave interference from each other. When adding two waves together, whether that be light, water, air, etc., they either enhance or diminish one

another. If the wave crest of one wave is combined with another equal wave trough of a separate wave, they will cancel each other out. Conversely, if two wave crests or troughs are combined, the wave is amplified. Some electrons were “canceled out” while some were proliferated through wave combination, explaining the clusters of electrons on the other side of the two gaps in the wall. My teacher’s concluding statement was expressed simply, but beautifully, “We don’t know whether anything is a wave or particle.” I was dumbfounded and wanted to find out some answers for myself. I was inspired to think.

Having tasted only a morsel of what the unknown complexities of the world had to offer, I craved more. A friend offered a collection of scientific exploration books to me, promising that they would keep me thinking. I started with *The Grand Design* written by Stephen Hawking and Leonard Mlodinow and then jumped to *Hyperspace* by Mikio Kaku. Both books brought ethereal ideas of time warps, parallel universes, higher dimensions, etc. Each night I would eagerly read and my understanding of the universe would wildly transform. The books investigated both cosmological and microscopic phenomena, beautifully tying the seemingly polar opposites together. Many only view space as the final frontier and forget the beauty that lies in what they touch and feel every day. The intricate bond between space and the microscopic world is becoming continuously apparent. What makes space more telltale and awe-inspiring when we can simply turn the telescope in the opposite direction and witness the marvels of atoms, nanotechnology, and Quantum Mechanics? The “Double Slit Experiment” only offers a glimpse at the vastly unexplored mysteriousness of the sub-atomic world.

In both books, I began to find the beauty and expression in math. I have always loved math and science and I consider myself a “left-brain” thinker. The passion of engineering—the urge to tinker, take stuff apart, and decipher how machines work—has and will forever be a part of me. However, I used to confine math to strict rules and procedures, naïve to the freedom it offers. These books and every succeeding calculus course I take unveil to me more and more the language of mathematics. Math provides us with the framework for how we interpret observations and perceive the physical world. Each theory and formula are born from the creativity of its inventor’s manipulation of numbers. Math and numbers are key to knowledge and simplification. Most remarkably, numbers don’t lie. Scientists use field equations to explain unseen forces in our universe such as gravity, light, electromagnetism, and nuclear forces. With some knowledge of math and physics, but mostly willingness to think outside the proverbial “box,” I was able to explore some ideas scientists have about the divine mysteries of our physical world. Its beginning, its ending, its purpose. . . More importantly, I learned our perception is sometimes fraudulent.

One theory that clashed with my foundation of observation is Hyperspace, the theory of a higher dimensional universe in addition to space and time and the theme of *Hyperspace*, one of the books I previously mentioned. I had always written off the idea of higher dimension, seeing it as a far-fetched explanation based on a concoction of science fiction. Imagining and visualizing different dimensions always seemed pointless and impossible. But this is where math’s flowing beauty is revealed. Michio Kaku explains in *Hyperspace* that physics becomes simpler and unified with more dimensions. He states that with a fifth dimension the equations of light and gravity appear to “fit together

precisely within the hyperspace field like pieces of a jigsaw puzzle” (Kaku, 1994, p. 26). This idea, that theories become simpler with more dimensions, fueled Einstein to spend much of his life searching for the “M-Theory,” or the Theory of Everything. Hyperspace theory can be an explanation of Quantum Mechanics. How do atoms and subatomic particles act in the microscopic level? The Double-Slit Experiment convinces us that we have much more to learn. Some scientists believe that electrons, atoms, and even small molecules don’t travel on one path from start to finish, but take every possible path—simultaneously! This unfathomable idea dazzled me for weeks, and returns us to Hyperspace theory. Are different dimensions involved?

Quantum Mechanics provides insight into the workings of the atomic world, but also, as Stephen Hawking and Leonard Mlodinow (2010) explain in *The Grand Design*, “dictate[s] a completely different conceptual schema, one in which an object’s position, [its] path, and even its past and future are not precisely determined” (p. 67). We have no idea what influences an electron to travel the way it does. The Heisenberg Uncertainty Principle guarantees us that we can never know simultaneously the velocity and position of a subatomic particle. I was continually reminded (and absolutely relished the fact) that there is much more to the universe than what the eye reveals. Just because one can’t prove something doesn’t mean it doesn’t exist! This sudden consciousness left more room for discovery and even more space for my imagination to explore. It’s difficult to restrain myself from detailing too much about these elaborate physics theories for lack of time. I want to focus rather on their immense effect upon me.

I began to see the link between science and purpose. How could these marvelous scientific concepts not spark a quest for deeper knowledge in how we fit into this

physical world? In *The Grand Design*, Hawking and Mlodinow (2010) write how traditional philosophy has fallen far behind modern discovery, “Scientists have become the bearers of the torch of discovery in our quest for knowledge” (p. 5). Some late weekend nights stand out from my first semester in college during which close friends (predominantly engineering/science majors) and I shared each other’s points of view about the physical world. Should we be scared of death, or is death just like before we were born? What is time? Is there a higher power? What is religion? Question after question seared into me my humility in this mysterious and beautiful world. We may not have all agreed on all the opinions shared, but I sensed a profound bond between us. Every one of us feels insecure in not knowing all the answers.

Life was a simpler, more linear plot before. It was constructed and developed by the most concrete thing in my childhood: religion. But these significant theological doubts and my recent passion for scientific phenomena slowly tore me away from my previous absolute of Heaven or Hell, black and white. I believe I’m coming to terms every day with the certainty of uncertainty. I’m a curious being and I want my life to teeter between the brink of discovery and insanity. Math, chemistry, and scientific exploration of the unknown—specifically the quest of the micro-frontier—help me find “moments of being.” These moments illuminate the faintest light of conviction among murky thoughts—moments during which tranquility reigns and imagination of the unknown translates into passion for knowledge. In these moments, anxiety doesn’t exist. I can imagine with science. Essentially, math and science combine to form a new lens through which to observe the world. We can never say something is for sure because humanity is always evolving. Scientific discovery embraces diverse thought, different

approaches, and new ideas. The underlying beauty is how this translates so succinctly into my way of life. I've learned that we can't see everything—much less know everything—and how we see things isn't the same as how everyone else does. My intention is not to preach science as a faith, but I believe it can nudge us in the right direction. Acceptance of diversity in thought and action while trying to uncover life's mysteries—that is my definition of life.

References

Hawking, S., & Mlodinow, L. (2010). *The Grand Design*. New York: Random House, Inc.

Kaku, M. (1994). *Hyperspace*. New York: Oxford University Press.