How Physics Led Me to Life

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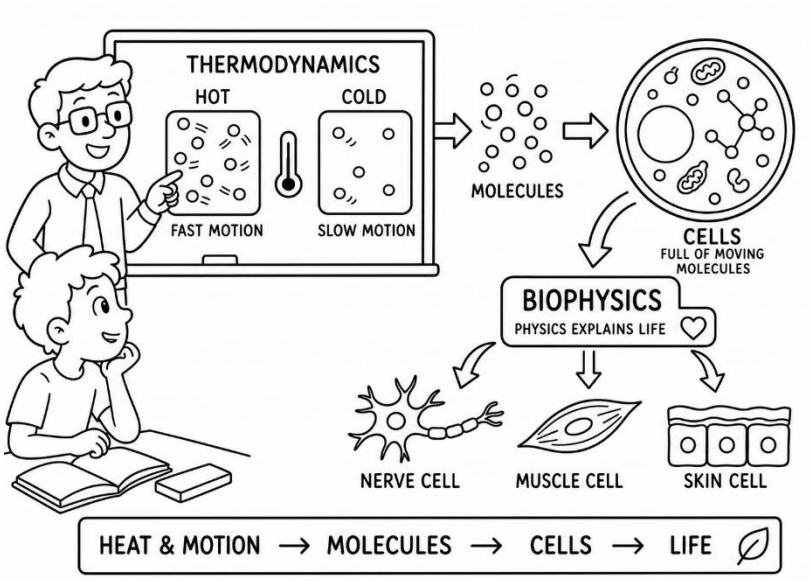

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The person who first made me strongly interested in science was my high school physics teacher.

He did not simply explain what was written in the textbook. When I was studying mechanics, he taught us not only about the motion of balls and the forces acting on objects, but also about the world of quantum mechanics beyond classical mechanics. Although classical mechanics can precisely predict many phenomena around us, strange phenomena appear in the very small world that cannot be understood using these methods. He explained these ideas with such excitement that I became fascinated by science.

At that time, I realized that science was not about simply acquiring completed

knowledge, but about moving toward what no one yet understands. There are still unknown rules hidden behind the world we see, and this deeply interests me.

Before taking his classes, I thought science was mainly about memorizing formulas and using them to solve problems. Of course, this is an important part of studying science, but his lessons showed me another side of it. A formula was not just a tool for getting the correct answer. It was a small window into how nature works. When one simple rule could explain many different phenomena, I felt as if the world had become a little more understandable. This feeling made me want to look for similar rules in other parts of nature.

His lessons also taught me that physics can connect familiar phenomena with the invisible motion of tiny particles. When we studied thermodynamics, he taught us that temperature is related to the motion of molecules. In a warm object, molecules move actively, while in a cold object, they move more slowly. When I heard this explanation, I was amazed that temperature, something we feel every day, could be explained by the motion of tiny invisible particles.

He then extended this way of thinking to living systems. He told us that the inside of a cell is filled with many molecules moving around, bumping into one another, binding together, and separating again. A cell is a small unit of life, but inside it, many complicated physical phenomena are taking place. This was the first time I realized that living things around us could also be understood as physical systems.

I was deeply impressed by this idea. At the same time, however, living things seem different from ordinary objects. A stone does not grow by itself, but living things do. A machine cannot repair itself, but cells in our bodies try to repair damage. Although these processes are based on the motion of molecules and the flow of energy, there are still many things that current physics cannot fully explain. I became interested in taking part in the effort to understand these mysteries, and this led me to study biophysics.

My teacher also supported me in studying for university entrance examinations. He did not just give me answers. Instead, he helped me think about why each answer made sense. Thanks to his guidance, I was able to enter the field I had hoped for. Without his classes and encouragement, I might not have chosen the path I am on today.

Now, I study life phenomena using physics and mathematics. In particular, I am interested in universal laws in living systems. By “universal laws,” I mean rules that are not limited to one specific animal, plant, or molecule, but may be shared by many different living systems.

My current research focuses on cell differentiation. Cell differentiation is the process by which cells become different types of cells, such as nerve cells, muscle cells, or skin cells. Many cells in our bodies have the same DNA, which is like an instruction book for life. However, even with the same instruction book, cells can choose different roles. This is one of the most fascinating mysteries in biology.

One important factor behind this process is the gene regulatory network. This is like a

network of switches inside a cell. Some genes are turned on, while others are turned off. These switches influence one another, and their interactions help decide what kind of cell each cell will become.

In my research, I use machine learning to find common structures in gene regulatory networks that cause cell differentiation. Machine learning is a method that allows computers to learn from many examples and discover hidden patterns. If we can find common structures behind cell differentiation, that is, universal laws, we may be able to understand more deeply how cells decide their future roles.

In the future, this research may also contribute to medicine. For example, technologies such as iPS cells aim to change the state of cells and use them for medical treatment. Such technologies may help treat diseases such as Parkinson's disease, in which the loss of specific nerve cells is an important problem. To make such technologies safer and more reliable, it is important to understand how cells change their identities.

My goal is to find simple rules hidden inside the complexity of life. Just as my high school physics teacher showed me the beauty of laws behind familiar phenomena, I hope to reveal the hidden order behind living systems. Through this research, I want to contribute to knowledge that may one day help human society.

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AI tools (GhatGPT) were used in this assignment to help create the image based on my own idea. They were also used to check and improve the English wording of the essay. However, the main ideas, figure concept, personal experiences, and research content

described in this essay are my own.

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