

# Learning Physics, Building People

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## Introduction

The subject of Physics used to be considered as a difficult one. You love it or you hate it. Moreover, you need special skills applying maths because it is its tool. Physics is related to very analytical people, sort of one track mind, may be poor in creativity or imagination out of numbers. Why should I learn Physics? Is it only for special gifted minds? Why is Physics important molding my personality? There is a way of teaching or learning Physics that implies solving problems, but not understanding a single one. Perhaps the students go through the subject and sometimes with remarkable marks. But almost nothing is left in their personality.

## Brief Ideas About the Brain

Brain learns from experience. That experience let the epigenetic factors to be shown. High intensity of the stimulus pins up the bond between neurons, creating new neural connections. I still remember the song I was listening to on the radio when a car crashed into mine, with my little daughter sleeping in the back seat... it was forged on fire in my hippocampus! Repetitions are necessary to strengthen the neural tracts. It is also clear that association between concepts improves the learning process. Both processes are related to the long term potentiation and the memory.

We must not forget the role of affectivity. It is prior to our decision making frontal cortex. Sometimes we like something and we don't know why. It is hard to find the words to express why or how we love, for example. The limbic system is mainly in charge of affectivity (amygdala, mammillary body, hippocampus...). There is also a very interesting part of the brain, probably not so popular as the amygdala. Anterior cingulate cortex is activated when something is not right for us, when we receive contradictory information. It is located immediately after the corpus callosum

and before the neocortex. As we are going to see later, it is a very important part of the brain when you are learning Physics.

The brain has to make decisions. A lot of them daily. From an evolutionary point of view, our life depends on it. We have to evaluate a situation in the shortest period of time as possible. A predator could be around, for example. It is not reasonable to take control of every single tiny decision. When something like this occurs, there is probably a pathology behind this behaviour. And here is the jewel of the crown, the frontal lobe. The frontal cortex (dorsolateral, prefrontal and ventral areas) makes conscious decisions. It is the part of the brain we think with. But the frontal lobe is the last one to be myelinated, so the limbic system always acts before the frontal lobe and, depending on the age, takes control of the decision making. Just think about an adolescent going nuts, misbehaving. Let's mix all these factors together.

## The Brain in The Process of Learning Physics

What makes Physics an especially difficult task is the fact that there are preconceptions. When we want to learn something about the natural world and the way it works, we really don't think too much about it and the limbic system creates an intuition of what is happening. Sometimes we succeed, but sometimes we don't and our brain needs help from the executive functions, the frontal lobe. What is the trigger of the help sign? The anterior cingulate, of course.

The preconceptions become misconceptions when we believe them. And we have to access formal education if we want to learn how the world really works. It implies energy (sources dedicated to supply energy to the brain), intention and time if we want to succeed in this contradictory moment for the brain. So, you thought you were going to learn something at once... But it is not your fault you don't understand Physics! You just need time and

a bit of self-esteem. Everyone has walked the same contradictory path, even the last Physics Nobel Prize.

## Is It Possible to Understand Physics?

Absolutely, considering the way we learn, we can develop some strategies. We need a bond between the subject and the students. But every brain, every person is unique, so we need an attractive starting point, something close to the students to get their attention, films. Movies allow us to introduce the laws we want the students to learn and move through a Socratic method. The students can analyze the preconceptions they have and check if the laws they are proposing are right or not, going back to the same scene or moving to a different one.

At this point, the students not only have to learn something because it is going to be a part of a test (extrinsic motivation), but also because they want to (intrinsic motivation). When the intrinsic motivations are involved, the learning process is easier. It is the affectivity working for them! The dimension of knowledge is set up by every single student. But this is only the very beginning...

## What Can a Student Get from Learning Physics?

But we also need a bond between students and the teacher, an environment of confidence. That is why the teacher must have a special ability to know what the students are and how they are, trying to enhance their potential, respecting their times and building a relationship that allows them to climb a hill before going to a higher peak. The students become more creative, linking

concepts and designing experiments, because they understand natural phenomena. And more curious, because they always want to go further, thinking about the implications of the concepts or their applications.

The students are prepared for listening to others, to discuss different points of view, with respect, accepting errors as a part of the learning process, as part of living learning. They find out they are clever and pretty good at explaining an idea to others in their own language, which is growing technically and in precision, step by step, clarifying their minds with their classmates. They discover relations among Physics and Arts, music, literature, architecture, sculpture, photography... as part of transversality, linking the subject with previous concepts they already have, avoiding isolated boxes of knowledge. And this is a very personal process (unique brain), there are not two ways of learning something identical. That is a holistic perspective of learning. Not only they learn, but also, they discover themselves, the others and the beauty of Nature.

They help each other in order to understand new concepts, they are more patient because they come up with a common feeling of confusion in a concept or happiness when they find out the right answer for the given situation. Some years later, they can forget Physics laws, they always can retake those concepts and the way they got them, but there is only one thing they will never forget: how they built their personality learning Physics.



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