When my supervisor left for a conference to Canada, I had a week or so to do things my way. I went to the workshop and used the scraps in the storage room to make a small chamber. I had no funding so I had to be creative. I used a tungsten-inert gas welding machine as my plasma source, a bottle of water as my DIY flow meter and “borrowed” some raw materials from the lab I was working at, just enough for the experiment but not enough for them to notice that something was missing!

The experiment was a success but it was difficult for an undergraduate to be taken seriously for his research. That was until I sent an email to Patrice Mélinon, a well-known scientist at CNRS whose works I used to follow very closely, after reading one of his papers in Nature Materials. To my surprise, this famous authority in the field wrote back within hours and he was fascinated by the results; so much so that he offered to run characterization tests in his lab. Fast forward to early 2013, after about 2 years of hard work and a sizable number of rejections from leading journals, with Prof. Mélinon’s support and guidance, I managed to publish the results in Scientific Reports, the newest addition to Nature’s family of prestigious journals at the time. Around the same period, I had also won the James Dyson Award for designing a new economy class seat called AirGo and was being constantly featured in news both locally and worldwide after an interview with ABC’s Genevieve S. Brown.

Things started to change for me, but I never expected what was about to happen next. One day, the Engineering Dean proudly told me that the Vice Chancellor, Tan Sri Ghauth Jasmon was organizing a private lunch for me. After lunch, the Vice Chancellor gave me an envelope saying that “Here is the entire tuition fee that you have paid so far and from now on, you do not owe us anything”.

Back in late 2010, I was an engineering undergraduate at University of Malaya who was barely doing okay. With an average grade of B, I was right in the middle and there was nothing exceptional about my academic abilities. Like many other students, I could easily get bored and distracted during lectures, but unlike them, I found the class boring for completely different reasons. To me, higher education should have been more about producing meaningful knowledge rather than recycling and memorizing basic concepts. I wanted something more hands-on and I did not mind committing to longer hours of studying as long as there was a clear target. Like how most people would do when they are bored, I used to browse on the web, often reading random entries on Wikipedia.

One day I came across this new space propulsion system known as the Variable Specific Impulse Magnetoplasma Rocket or VASIMR in short and I was instantly hooked. I started reading books on plasma physics during my classes and soon I got familiar with this new technology called plasma-assisted combustion which simply put uses ionized gas to improve the fuel efficiency of large-scale combustion engines. I remember that I prepared a 12 page proposal exploring the possibility of using RF generators beside the usual dielectric-barrier discharge to produce plasma at higher temperatures and see if there is any optimum temperature at which combustion takes place more efficiently.

My academic adviser was inviting at first and said he would consider applying for a new research grant if I could come up with the details of funding requirements.

Unfortunately he was not as enthusiastic when he found out it would cost about a million dollar or so to build the experimental setup I designed. He asked me to join an existing project on combustion synthesis. As much as the names may sound similar, this project was nothing like what I had proposed, but there was no other option so I had to take it. To make things worse, the project was lagging behind and running out of fund. The idea was to synthesize highly endothermic compounds (that need a lot of energy to form) using assistance from exothermic reactions, i.e. solid-state combustion. I could immediately see that the idea was interesting on paper but not taking into account the difficulties of heat transfer, it was very impractical in reality.
That was a generous gesture, but it did not stop there. Despite the fact that I was still an undergraduate, he offered me a job as a scientist, asking me to discuss the details of my appointment with Prof. Lam Sai Kit, who was in charge of the High Impact Research (HIR) program, the largest research initiative in Malaysia. The day after, Prof. Lam gave me a tour of the labs and introduced me to several researchers whose projects were of interest to me. The speed at which all of this happened was very surreal.

By April 2013, I had already started my new job as the “HIR Young Scientist”. I knew that people who had vouched for me were taking a big risk and I was not planning to disappoint them. However I was never put under pressure to deliver. On the contrary, I was given complete freedom to take my time, explore my interests and work on any project no matter which field of science it belongs to. The ability to tackle problems on my own terms enabled me to take on multi-disciplinary projects from dental implants to engineering ceramics, renewable energy and inorganic chemistry.

The outcome was an exemplary success. I exceeded my KPI, sometimes by 150%. The papers were published in prestigious journals, some of which no one else in the university had managed to break into to that day. We were getting featured quite frequently on front covers and news outlets in more than 15 countries. Before I even realized it, other professors were following my footprints, having found the inspiration and courage to aim for top journals. I was also happy to offer help by not only supervising graduate students but also assisting professors whose research skills were excellent but lacked the ability to draw meaningful connections, develop a compelling argument and defend its novelty. Some of the results that they had completely given up on were now being dug out of their backup hard drives by me.

Although to be honest, not all projects that I was involved in were successful. Many in fact heavily relied on a trial and error process which never produced conclusive results and were thus abandoned. Some ended up in disagreement when it came to choosing methodology and interpreting the experimental data. But for each failed experiment, there was a successful counterpart too. What I learned was that there is no single path to the solution, rather a number of partial solutions that individually might fail but once put together work nicely. The catch is that sometimes only trying the partial solution and failing make you see the greater picture. Such failures also train you to be good at presenting an argument which can stand against scrutiny, mostly because you have already questioned yourself in a similar fashion after failing to arrive at the expected outcome.

I often refer to this as “The Pattern”. A scientific work should represent a consistent system of thoughts and arguments and that is pretty much independent of the specific field of science. To be well-versed in developing The Pattern, one needs to be extremely diligent, going through hundreds and hundreds of studies before you can draw a conclusion. Forging international collaborations, another pillar of high-quality research, demands time and patience and above all transparent communication. When I joined HIR, I was blessed to have been given the liberty to do just that. I never had to give up on papers that were getting rejected left and right. Instead of just submitting them to a lower tier journal, I could spend the necessary time to improve on them and end up publishing them in journals higher in ranking than those I initially got rejection from.

I conclude my story by emphasizing that young scientists, being outsiders who are not bound by preconceptions, may have fundamentally new ideas that, if given a surviving chance, could contribute greatly to our scientific endeavor. Undergraduates in particular can take their time to develop their critical thinking skills given that they are not in haste to complete a thesis or publish the results. Establishing positions like the “HIR Young Scientist” for undergraduates, who undertake the effort to carry out independent research and prove their worth, would help encourage students to take a more productive approach to higher education. Being part of the HIR team has contributed to how I carry out research today in so many valuable ways and I am grateful for such an exceptional opportunity. It is my hope that this story would inspire other undergraduates here and elsewhere to dare to go beyond the routine and achieve the unimaginable.