**Why?** I still remember how shocked I was when I saw that drone in the MIT museum. It is labeled as “Locust Micro-UAV” but it actually means “low cost micro-UAV.” I clearly remember a picture of that drone that I saw not long ago in a magazine on airplanes. I was amazed by how advanced its designers thought, having such a special way of deploying it. That article didn’t mention but I thought it must be a new product of a world-famous company. So when I saw a picture of five MIT aerospace engineering students displayed right next to that drone, I couldn’t move my eyes. I looked around with a very different state of mind, and I saw that drone just being one small project amongst so many others. I don’t like making “toys.” Everything I have designed or made were all originated from my crazy thought based on observations of my surroundings. I have mixed feelings during college visits, when I see displayed student projects no better than what I was doing in high school. Shouldn’t college students have studied much more advanced subjects? Shouldn’t their projects be spectacular when higher knowledge is applied? Therefore, I have made up my mind after that visit to the museum.

**Using new tools:** I really made the best use of everything I learned. Things I learned always become new tools for my projects. With the help from these new tools, I get to improve my designs in terms of generations. There are very large gaps between the previous generation and the new. Every new generation was created not only because they include improvements on certain sides of the old model, but also because I applied new methods in the designing process. The very first example was when I first jumped ahead and learned sketching. Although I showed artistic talent and enjoyed drawing before the earliest memories I can recall, I never applied my drawing skills into the designing process until the end of elementary school, when I learned sketching. I had never expected I would make such a great use of it, since my motivation was simply to challenge myself by being in a classroom with high school students. As I slowly stood out of my class, I realized that I was not only improving my drawing skill, I was also getting more sensitive about shapes and structures. I started imagining three dimensional objects in my head whenever I think of a new design, and with just pen and paper, I get to sketch them out whenever I want. I have to say my designing process rarely takes place on paper, it was more just me trying to transport the object out of my head. However, I can’t remember everything that had been in my head. I can only remember and build one single thing in a short period. Many great ideas were lost before I started drawing. By sketching out what’s in my head, I get to keep those designs that I didn’t have the materials, knowledge, or time to make. There are three major factors that allow me to develop further on the path of engineering during middle school. Since I grew up in the city Beijing, I had never gotten my hands on blacksmithing or wielding. That caused a problem on my ability to build metal things. As a result, I had to realize my ideas through wood, foam, and fast glue. I discovered a type of metal can for coconut juice that had the perfect thickness: it’s strong enough to support the requirements of certain designs and it can be cut and shaped. This “coconut juice metal” took a huge role in the productivity boom during my last two years in middle school. Occurring in the same period, I learned to use another thing through the building of RC airplanes. I was much more interested in building than flying those. mean, I’m just the type of person that needs to build things, and I’m always searching for something to build. As I was making wooden structures of those planes, I realized there is a well-developed market for RC airplane players. I was able to buy controllers, servos, and batteries, then apply them on my own designs, without having any knowledge on circuits and electricity. At that time, all I had learned was the “V” labeled on my battery had to be the same number as the small light bulb I have, and there are two wires: positive and negative. Whenever I want to test something, I just have to plug wires in the correct portal. I didn’t have to build circuits or write codes for that. By adopting the controlling system inside RC airplanes, I was no doubt gaining a much much easier access to make my designs moving and remote controlled. Along with improvements in material and electronics, the last element was group working. During the last year of my middle school, I got to know Tony, who just transferred to my middle school. He was like me but also in different aspects. He had a much greater base of knowledge in all science related fields, while I was better at making greater use of the limited knowledge I had. When I worked with Tony, I was the one envisioning unrealistic designs. Tony, unlike many others I have met, never shut me down because of how crazy I was. He never said something like “you can never do this, because...” He always made his comments like “this is great, but first you need to figure out how to deal with the … issue.” Looking back at that time, these three elements were the keys. The next leap my designs performed was caused by the use of CNC machines and CAD. Although compared to people around me, I have a much higher productivity in terms of crafting, I faced hardship as the things I designed are getting bigger and more complex. I was aware of the existence of CNC cutters and how they play a role in the manufacturing process, but in my mind it was a very costly method which I cannot afford. With help from a teacher, I get to gain another engineering tool. He has friends who own factories that have huge CNC machines. He told me that after loading a blueprint into the machine, I could receive my parts in metal within minutes. In order to transform sketches that I read into drawings CNC machines can read, I selected a class that taught me CAD. Because I was so eager to master Solidworks to a degree so that I can start modeling my own designs, I spent 50 hours through a two week period in the computer lab. And I finally did the CAD drawing of my suit. Besides all the advantages we know for having a 3D model of a design, that CAD drawing of my suit offered me an opportunity to convince others. For all my previous projects, no one believes I had the ability to make what I envisioned, until I actually put out the final product. A CAD drawing somehow made my design more “realistic.” I was able to create a club using that suit as an advertisement. Right now, I am about obtaining another tool that will bring my projects to another level. I realized the importance of codes. I am taking an introductory class in C language. At the same time, I am learning python on my own. Based on my previous experience with Solidworks, I believe the effect these efforts will soon emerge out of my next project. I envy those fast learners, who are able to just get a hold of whatever they want. A friend of mine in high school was a genius, he was the one I really looked up to. His brain was “two weeks faster” than mine. I got that because he understood a new concept in our physics class which took me two weeks of studying to understand. The only way for me to get a similar grade in that class was to throw in a much longer time. Being in the same class with him taught me a bitter truth: everyone has their field of specialty and limits. Stuffing knowledge into the brain is indeed harder for me, but the ability to pull it out is not something I have ever questioned myself. I noticed my strength and weakness, but I was not satisfied with only staying in my comfort zone. Although I am going to use my strength as a major tool of fixing problems, I also want to make sure even my weakness is as good as others’ strength. Due to my experience with my genius high school friend, I figured out the only way to tackle a weakness is spending massive energy and time. I did get a chance to test that method.

**SAT and MIT:** When I have decided that I want to work toward MIT, my parents helped arrange a meeting between me and a MIT professor. The professor said something like this: I know you have these amazing works, but if you don't have a 1500 on your SAT, they don't have much. I thought about that meeting deeply. I deeply appreciate him being honest. I’ve heard too many people telling me that I just need to do things I’m interested in and there is no need to work on something that I won’t get a result. I know that I can’t just try to avoid everything like that. There will be a moment that I have to become the best at something that I was terrible at through my life. And this is the time. I mean, at that level, everyone has to be at the 1% on standardized testing while having their own special fields. So, challenge accepted, and challenge completed. I know the process would make a great motivational story, but all I care about was that I gained a first ever example on my new method.

**Career choice:** I understand the difference between science and technology; therefore, I chose technology as my path. Besides coming up and testing theories in the lab, I prefer working on the application of science into products that improve our life. The more I learn, the more tools I will be able to use.

**Gen 1:** First generation suit: This was the first suit I made. I have always wanted one since the beginning of middle school. I had high expectations for it and aimed for too complicated structures. I spent two years researching without making any functional models. During the final year of my middle school, I decided to change my plan. I thought that I must start making something else my dream for building robotic suits will always remain unrealistic. Even a suit made of cardboards and foam is better than nothing. I knew as soon as I started the first one, all ideas would come to me and push me to make the second, the third, and more. Although it is a suit made of cardboard and foam, designs in those suits are special. I wanted to make a different suit than what was generally shown on the internet. Besides all the projects those military companies were working on, what I saw were just ones that try to imitate the shape and color of Ironman. Even for the real ones that companies were working on, they were focused on the strength of the suit. So I decided to attack the problem at a different angle. I focused on building a whole body suit that can be folded into a box, like the Mark 5 suit in Ironman 2.

**Gen 2:** After I gained confidence from the making of my first suit, I planned on making the second one just a few months after. For this one, I tried to aim for simplicity. I was in my last year in middle school and I didn’t know how to do CAD, not even two dimensional ones. However, I was introduced to a cheaper access to a CNC machine, one that uses lasers to cut metals. I knew it would open a new door for me, but the machine only reads CAD. My father is an architect and he works with CAD all the time. He told me that he can draw some simple CAD for me. Therefore, I tried to make the drawings as simple as I could, and finally ended up with only 11 different shaped parts. I added 8 servos on that suit and tested them using the RC airplane setup I knew. I tried to use a servo controller instead, but I never didn’t figure out how it works.

**Gen 3:** The third generation was my least favorite one. It only differs from the second by those extra plates mounted on its frame. I was just trying to figure out how and where I can mount armor on the frame. Although the third generation suit doesn’t have as many stunning features as all other ones, it was a necessary step toward the designing of future models.

**Gen 4:** Since I can’t come up with any better frame design than that of the third generation, I made the fourth generation focusing on the armor. I realized a problem when I was making the previous suit: it was very hard to put on. Putting on the second generation wasn’t a problem because it didn’t have those mounting plates on them. As long as I want to have full body armor on my suits, I will not be able to put on the suit easily. I thought about designing a suit that can split into parts, like the Mark 42 from Ironman. If each individual part of the suit can be easily worn separately, the total amount of time to put up the suit can be reduced. I assume in the future whoever is wearing that suit will be facing his danger instead of giving his back to it. Armors at the front of the suit need to be stronger and with better integrity. I chose to put the opening mechanism on the back of my suit, trading the percentage of armor coverage for convenience to put on the suit. I didn’t choose to make the armor in one single material. I thought it would be better to use several layers of different materials to achieve the desired durability. I used balsa wood for the basic frame of different armor plates as an effort to reduce weight. According to my research on bulletproof vests, it is common to have two layers working together to stop impacts. The outer layer is the impact plate, which was made of KEVLAR that takes most of the bullet’s impact. The inner layer is made out of fiberglass, which prevents major deformation of the suit and stops the shock transferred from the outer layer. The combination of these two types of layers is classic for modern day bulletproof vests. In addition, I decided to put another layer on the surface of the suit. I put down a layer of ceramics that was designed to slightly change the path of the bullet as it is hit and crashes, avoiding a direct impact on the suit. I used magnets as locks on the suit, but they were only able to hold the suit together when I was standing still. As long as I start moving, I run the risk of falling parts. As a result I had to add mechanical locks on top of every magnet to secure the plates, but that contradicted the whole idea of speeding up the time of putting on the suit. I tried to add wooden locks inside the suit so it is able to stand up even without a person inside. I was successful at the beginning, but all those locks broke due to one fall of the suit. Since they were made inside the suit, I wasn’t able to replace them after they broke.

**Story of Gen 5:** The third and fourth generation focused on two very different functions: frame and armor. For a period of time I thought I was going to make two different types of suits, one that gives the user strength, and the other offers protection. However, all diverging things have a dream of reunion. It was a winter night during my sophomore year, my friends invited me to go ice skating with them on a frozen pond in our school. I went there with them but weren’t brave enough to join them on the ice. I sat on a bench and watched them having fun skating. I was staring at their movements, and a cold breeze on my face inspired me. I suddenly thought of a design that surpasses the previous generations so far, one that combines the third and fourth generation perfectly. I ran back to my dorm and sketched down that design. But the number one reason why that design finally turned into a real product was related to a new skill I learned very recently: Solidworks.

**Learning CAD:** During sophomore year, my school offered a new elective course called mechanical design, which teaches students on how to use 3D modeling software. I signed up for that class for fun. Our first mission was to design a phone stand, using very simple “sketch” and “extrude” functions. People in my class all said they finished that project within an hour by following the exact steps of the instruction. I thought in addition putting my high school’s logo on that phone stand I designed would be fun, so I explored all functions on my own. That thought of mine resulted in me spending eight hours in the computer lab for that project. I wasn’t embarrassed when my classmates laughed at me for spending that much time on a simple project, it’s just my own way of learning. The payoff proved my point shortly after. I applied those simple Solidworks functions into the new design I just sketched down after that epiphany. I spent another fifty hours within two weeks to model that new suit. Solidworks turned out to be just the right tool to be an extension of my brain and enables me to deal with much more complex designs. I felt like the appearance of that mechanical design class in my life was at the perfect time. If I didn’t have CAD to do the modeling, I would quickly fail the new suit design. As a result, my head would have stopped designing suits unless it finds a new occasion that allows any breakthroughs. I know many high school students know how to do it, but with Solidworks in my hands, my designs were able to enter a new level of complexity.

**Gen 5:** The fifth generation suit was a keystone on my path that exceeded all my other previous projects so far. The usage of CAD and CNC made it a sign of me starting to transform from just making “toys” to designing industrial products. The goal for that suit was no longer just trying to imitate the functions of Ironman. I aimed for a low-cost functional bulletproof suit that can also enhance the user’s strength, but most importantly, can be mass produced right at the time. I wanted to be the “wizard” that turns fantasy to reality. Sure many companies were developing all types of exo-skeletons, but none of them were selling “armored robotic suits.” Beside the overall importance that fifth generation suit represents, there are also many worth mentioning details on it.

**Details of Gen 5:** Modifications on the frame can be organized into two efforts: allowing the suit to completely open from the back and enabling more movements that the suit can perform. For the suit to open from the back, one modification was on a part that connects the body frame to legs. For all previous generations I placed it at the back for unknown reasons. Just switching the position of that part, I was able to increase the integrity of the entire front of the suit. Another modification was on the shoulders. For previous generations, arms were mounted with two plates that attached both front and back of the body frame. By attaching arms only to the front, I not only made it easy to put on, but also enabled a new movement at shoulders. All other modifications on the frame for quicker suit up were based on the fourth generation suit. New designs for the armor were also influenced by the making of generation 4. I replaced balsa wood frames with machine cut aluminum frame to reduce manufacturing time, changed the resin plus fiberglass combination to fiberglass tape since there are no longer any curved surfaces, increased layers of KEVLAR for better protection, and abandoned the use of plastic on the surface because it was heavy and didn’t really do anything. Every armor plates on that suit was connected to the frame by strong Velcro to increase modularity. When an armor plate is damaged, it can be quickly replaced. I was at a peak in terms of the enthusiasm for designing. I thought I was on the right path and was ready for another explosion of ideas. Unfortunately, I had to stop those projects. (Refer to SAT and MIT: )

**Leadership 1:** I can still remember a comic about the two types of leadership. The first drawing shows a leader at front, pulling a giant rock with his crew. The second drawing shows a boss sitting on the rock while he tells his crew to pull the rock. Although I really value leadership and many people agree with the second type, I can never become the one that gives orders. The first type is like the tip of a sword that takes all strength as one point and penetrates the problem. The second type is more like a formula for sword making, one that provides instructions. Confidence is one of the components why I can never become the boss. I always tend to hide within the crowd whenever I join a new group, only stand out and take over when I am familiar with the surroundings and have total confidence that I can do the job better than everyone else. As a leader, I have always faced the hardest part of a problem myself. For example, when I was in our high school’s FIRST robotics team, I took the hardest part of the robot as the project for my subdivision group. We had to design and build a climbing mechanism on our robot that catches the rope and ascends the robot. If the climber malfunctioned during the competition, our team’s robot would be smashed to the ground. I went against that pressure designed and made the first prototype when the majority of the team didn’t even believe we could have a climber. For all previous years the FIRST competition challenged participation teams for all kinds of climbing and our team never tried any. I was being that leader in front of the team and pierced through a barrier like the tip of a sword. Ever since I designed the first climber, our team started doing the climbing challenge for all upcoming years. A leader should exemplify the team spirit, being the one that everyone can count for whenever they face hardships. I can’t be the one that only tells others to try to solve a problem before even trying the case myself. Believing in such logic, I used the CAD drawing of that fifth generation suit as an attraction and started a club during my sophomore year called the creators club. The main reason I started that club was because the only thing our school had for engineering students was the robotic team during the winter for FIRST competition. I thought it would be a good idea to have another opportunity for us to do robotics stuff. Also, for FRC we had to use designated materials and work on similar robots every year. I believed that it would be nice to make an opportunity for students in our school to experience new methods and use new materials. In the creators club, I was trying to form an environment that whenever an idea is proposed, instead of saying “No, that’s not going to work.” Say “In order for this idea to work, we need to work on…” Although I thought such teamwork philosophy was the highlight of my club, many people came just because they were interested in my suit. Unfortunately, I went on a path of SAT and couldn’t come up with any new impressive designs. As a result, my club didn’t last long. There I saw cons of the “tip of a sword” type of leader: the team can only maintain integrity when the leader is functioning all right.

**Leadership 2:** A qualified leader is not only a superhero that leads a team to win, but also an ordinary person who creates team spirit. Since I started high school in the United States, I have been the team leader in the FIRST Robotics Competition for two consecutive years; our team won the first prize each year. I was elected captain for the third year but turned it down. Through my first two years, I thought of some questions for myself. Although I have excellent technical skills, I found three problems that faced me. First, I tended to communicate with the more capable members but neglected new members who were not proficient in the field. Second, I sometimes focused too much on the outcome, paying scant attention to the process. Third, I overly emphasized speed, always hoping the projects could be completed in a very short time. These questions may not have troubled powerful technicians but, for leaders, the most important priority is to take care of the needs of the players. To overcome my difficulties, I passed the opportunity to lead the school robotics team. . To solve the first two problems, I joined the school's JV basketball team. I am not a particularly good basketball player and, indeed, I had never played basketball before. But still I tried and my teammates were tolerant of me. In the beginning, I lacked even the most basic skills, like dribbling and passing. The team itself was not much better but, though we badly lost every game, everyone was very friendly with each other and the atmosphere was very warm. Through following my coach’s winter training schedule, by the end of the season, I was able to help my teammates during the game. This experience allowed me to carefully consider the impact of a team's environment on team growth. A team cannot rely on only a few members, it must rely on the whole. And, while striving for victory, we should pay more attention to the process, because these experiences are shared with the players.

**Entomology:** Why do caterpillars not grow big? It is because an insect's gas supply system does not support them enough to grow very large in the current environment. Oversized caterpillars easily die due to insufficient oxygen. The factors that limit caterpillars’ size are not natural enemies of the outside world or their lifestyles, but internal structure. As long as the gas supply system does not change due to genetic variation, caterpillars will remain small. I realized many things while observing insects. One important lesson is that we ought to build better internal systems, rather than blaming external factors. If you want a better life, check on yourself. Observing insects became my source of inspiration and helped me devise various strategies in my life. In junior high, I went to the Amazon to collect sleeve butterfly samples and participate in a project on genome sequencing. During this experience, I found that most of the time, modern entomology research is done in the laboratory. I designed art decorations and mechanical innovations such as robots and iron man armor based on insects. But it was not until high school that I found an opportunity to transition in the direction of entomology, and was able to use my knowledge to extend to the field of genes. I started to list possible applications from the magic behind the wing patterns of butterflies. I am convinced that it has the magic math and statistics reasons behind its making and wrote an article for my prediction. It is possible that I will not find amazing results and possible that I will not use the results for many years. But my focus is exploration and I believe that scientific research cannot be aimed only at finding amazing conclusions. Rather, exploration of the unknown should be the goal.

**Art:** I was born with an interest in fine art. Since I was young, I would doodle on the wall at home and started to study professional sketches in elementary school. I started practicing how to copy objects onto paper. Later, I felt that I should draw living things and I began to use patterns to simulate my feelings about imagined environments. At first, I drew closed and independent patterns and eventually, not satisfied with these static forms, I created patterns that seemed continuously growing. Starting at a point and expanding endlessly outward, some blooming into surrounding layers, and some curved along a trajectory. My goal was not to arrange basic graphics and let the viewers produce pure and beautiful effects like a mandala, but to integrate stories into the patterns I designed. My passion for design laid the artistic foundation for my mechanical design as well.