Two Months on the Other Side of the World

(How Beijing Introduced Me to *Arabidopsis Thalliana*)

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Thank You (谢谢)

To the World Food Prize Foundation: I am incredibly grateful for this opportunity. Excited though I was before the internship, it has far exceeded my expectations.

To Lisa Fleming and Ambassador Quinn: Thank you for your extreme dedication to the program and your enthusiasm for continuing Norman Borlaug's work.

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A Very Brief Introduction

"Suppose a brother or sister is without clothes and daily food. If one of you says to him, 'Go, I wish you well, keep warm and well fed' but does nothing to meet his physical needs, what good is it? You show me your faith without deeds, and I will show you my faith by what I do."

-James 3:15-17

I've never met someone who is pro-injustice. Virtually no one is happy with the idea of starving children in developing countries; virtually no one can read devastating statistics on poverty and violence and wholeheartedly approve. People don't need to be intellectually convinced these are problems—they already know that. But what good is mere intellectual conviction if no deeds are done, no effort put forth to solve the problem? What good will be accomplished if humanity is content to simply be upset about the statistics?

The World Food Prize Foundation knows this. And so they work on making people care—care enough that they will take action. That's why they gave me and seventeen other high-school students two-month internships to do research at institutions all over the world. None of us were expected to solve the world's problems. Rather, the internships were designed to make us care deeply about the "big issues" in the world, creating a desire that will remain beyond the internship and lead us to make an actual, long-term difference.

This is how I found myself standing in the Des Moines airport six days after my seventeenth birthday. My first flight would take me to Chicago. The second would take me to Beijing, China.

Another Culture

During the first month of my internship, I wrote down my observations on Chinese culture. Upon re-reading them a month later, I realized that many were only partially accurate. Even now, I am sure I cannot do China full justice through my summary—it is simply too vast, too diverse, and too complex to completely understand. The more I learn, the more I realize I don't know. Nevertheless, there are some cultural aspects which are immediately clear and unique.

The people themselves are distinctive—not only by their dark hair, dark eyes, and small stature, but also by some common personality traits. The most immediately noticeable characteristic is extreme generosity. This frequently came into play during mealtimes. While in America we tend to view food as either "mine" or "not mine," in China there is much more sharing. Friends will readily share meals and snack food. The students in my lab gleefully offered me fruit, bread rolls, Chinese jello, and rice cakes, and they gleefully accepted whatever food I offered in return. This generosity soon became one of my favorite parts of Chinese culture. But food wasn't their only gift to me. They also offered me their time, which was of much

greater value. Although these students are incredibly busy, they took time to eat with me, talk with me, and teach me procedures. They never made me feel as if I were a burden: they always treated me like an honored guest.

The overwhelming kindness of the Chinese people is less easily definable, but certainly not less real. There is an undercurrent of genuine concern for the other person in their conversations. Their teasing is gentler, their questions go beyond a mere courtesy, and they are as good at listening as talking.

Chinese work ethic is also outstanding. Students work virtually around the clock. Although their day doesn't usually start until eight thirty and they take a few hours off around noon, they often remain in the lab until ten or later at night. What's more, the concept of weekends hardly exists. Most students work seven days a week or, at the least, six. While I much prefer a five day workweek, I admire the discipline it takes to stick with such a rigorous schedule.

I was surprised by the generally quiet, reserved nature of the Chinese people. Many of the graduate students were initially very shy around me, even though they are markedly older (seven to twelve years). At first I attributed this to nervousness to speak in English. Now, however, I think they are simply more shy than Americans. The Chinese people sometimes have difficulty being comfortable with those they do not know well—they are less likely to make small talk with strangers and more reluctant to begin conversations. Even their conversations with friends are relatively quieter and less animated. Still, there are positive aspects to this shyness. They tend to be more thoughtful, tactful, and better listeners. Conversations are more meaningful and there is less idle chatter.

America would also do well to copy China's respect for elders. When taking a photo, the Chinese place the eldest or most distinguished person in the middle as a beautifully symbolic sign of respect. On several different occasions, I would observe a parent walking with a teenage child through the streets. The parent would say something to the child, and I would wait for the child to respond with the sarcastic, indifferent tone often heard from American children. And I am still waiting, because so far I have not heard any children address their parents with even a trace of disrespect.

China, on the other hand, would do well to copy America's broader acceptance of diversity. It is unfortunate how little respect the people have for their own beauty. They deem foreigners to be much more attractive than themselves and covet white skin, light hair, and light eyes. Their billboards are plastered with blonde, Caucasian models. Chinese girls walk under umbrellas to prevent their skin from becoming tan. In many ways this is a lovely custom, but the root of it is a self-discrimination which is not at all lovely. Throughout my internship, I have seen far too many beautiful, beautiful girls look at their skin and, with intense frustration, say "Hei Si!" ("Black!")

In my opinion, one of the most difficult "gray areas" is China's approach to education and work. High school students are completely devoted to their schoolwork. They put in immense effort studying for a standardized test, because the test results completely determine which university they will attend. On the bright side, they develop discipline and learn as much as they can. They spend more time with their classmates and develop closer relationships. College decisions are easier. The one severe drawback is that they are not encouraged to pursue any other hobbies—no sports, bands, choirs, or any other kind of extracurriculars. As a result, they sideline all other interests (or at least, pursue them at a much lesser degree) as soon as they reach high school. This continues well into their higher education, as most graduate students have few hobbies outside of work, friends, and family.

But whatever I write about China today will likely change very soon. After a long history; China is modernizing. Construction is happening everywhere. Fast food places have already sprouted up, as have malls. Technology is appearing rapidly. Right now, the country is in an uncertain, in-between stage—certainly not an undeveloped country, but not quite on the modern cutting-edge either. And the people are also torn between the two—still fairly traditional, but increasingly lured by American ideals and materialism. Freedom has been planted in the minds of the younger generation, but not so completely that they would instantly forgo communism. Although I can make a guess, I don't know what will happen to China or America. One thing that I will never be able to say is that I don't care what happens to China. It's a beautiful, unique country. As it modernizes and develops, it may change and fall away from some of its traditions—and of course it has every right to modernize. But to be honest, I hope it keeps some of its distinctiveness, too.

A Bilingual Country

After spending time in China, I cringe at America's reluctance to accept other languages. China is highly bilingual—most people speak some English, student papers are often written in English, and signs frequently have the English translation written beneath the Chinese characters. As a foreigner, this was highly comforting . I was never made to feel guilty for not speaking Chinese. If anything, the Chinese people were thrilled to practice their English with me.

Rather than making me complacent, this bilingual attitude encouraged me to learn Chinese. If the Chinese people put forth such effort to communicate with me in my language, the least I could do was try to return the favor.

Easier said than done. Many words in Chinese incorporate a blend of sounds not used in the English language, and several syllables have different meanings depending on the tone and context. Still, the graduate students were incredibly patient teachers.

The effort was well worth it. Whenever I spoke a little Chinese, I was rewarded with huge smiles from the Chinese people. Just as they never judged me for only speaking English, neither did they judge me for my broken, rudimentary Chinese. Instead, they are just grateful that I am trying to learn their language.

It is a language worth learning— not only does each word have a meaning, but the syllables making up the word also have a meaning. I intend to continue learning Chinese in America. When I am proficient, perhaps I will return to China and, this time, speak with the people in their own language.

The Project

A Brief Introduction to the Transgenic Controversy

Even if you have never heard of transgenic crops, chances are that your life is affected by them. Transgenic soybeans compose ninety three percent of the United States' soybeans, while transgenic corn makes up seventy percent of the United States' corn. And right now, transgenic crops are perhaps the most controversial topic in agriculture.

The definition of a transgenic plant is deceptively simple: a plant that has been modified for an agricultural reason. By that standard, any plant that has been selectively bred could be counted as transgenic. However, the term is usually understood to mean a plant that has been genetically engineered. This process transfers DNA between two different plants, and is capable of taking a desirable trait from one plant and introducing it into a different plant.

Transgenics has some relatively obvious benefits. It can create plants with disease resistance, high pH tolerance, more nutrition, better taste, enhanced texture, and improved shelf life. Stronger, hardier transgenic plants require less water, fewer pesticides, and less tillage (thereby reducing soil erosion.) However, the benefits are not without drawbacks. Genetic engineering is an uncertain process, and scientists cannot always control when and where in the plant cell the transgene will activate. A common problem, "silencing," occurs when either the transgene or an adjacent gene fails to work once the transgene is inserted. This instability can cause plants to be infertile, produce toxins or allergins, have poor overall fitness, or reduce in yield. Other drawbacks of transgenic plants go beyond the plants themselves. Plant genes interact with the environment in complex and subtle ways, and it is possible that an altered genome could trigger environmental damage or trigger a harmful reaction in humans. Finally, since most transgenic plants have a "marker gene" that makes them resistant to either an antibiotic or a herbicide, they could theoretically transfer their antibiotic resistance to bacteria or their herbicide resistance to weeds.

My Experiment: Moving Potassium Genes Into Arabidopsis

At first glance, Arabidopsis thaliana seems to be one of the more useless plants on this earth—a strange choice for scientists to work with. It is a member of

the mustard family and has very little nutritional value. However, it does have enormous value as a "guinea pig" plant. Arabidopsis' small genome is completely and extensively mapped by scientists. It is easily manipulated and responds well to genetic engineering. Furthermore, its life span is roughly six weeks—short enough that scientists can quickly see the results of their experiment. So while it would admittedly be laughable to try to feed the world with Arabidopsis, it is quite practical to test techniques for feeding the world on Arabidopsis.

This summer, I had the privilege of assisting two graduate students with their experiment. The specific genes that I worked with were the potassium channel gene and the potassium transport gene—we removed both genes from cotton and inserted them into Arabidopsis. The potassium transport gene, true to its name, serves to transport potassium into a plant. The potassium channel gene controls the amount of potassium that is allowed entrance into the cells. Both of these genes affect the overall amount of potassium that the plant receives—and since potassium is a vital nutrient, it affects overall plant growth and health. Therefore, an improved potassium gene should result in a healthier, taller plant.

Our success or failure can be determined by the height of the transgenic plants. If they are taller than regular plants, then the experiment is likely a success. If they are the same or less tall than regular plants, then the experiment is likely a failure. Of course, if the experiment is a success, there are still several more steps to go through before it is put into practice—the next step would be testing the process on a more "important" crop such as corn or wheat.

A Multi-Step Process

Graduate experiments are lengthy procedures, often taking years to fully complete. During my two month stay, I saw neither the beginning nor the ending of the experiment. I wasn't able to observe the first step, where RNA was extracted from cotton and then cDNA was created using a reverse transcription process. I wasn't there when the cDNA was sequenced to ensure that it was correct.

I did witness the next part of the process—creating a recombinant vector (a vector containing the transgene.) In one vial, we placed the cDNA and in the other vial we placed the vector. Then we added double distilled water, buffer, and restriction enzymes to each vial. The buffer and double distilled water provided a good medium for the reaction to take place, while the restriction enzymes made the correct "cuts." Restriction enzymes are designed to search for certain nucleotide sequences and cut them—in this case, the restriction enzymes cut the transgene out of the cDNA sequence and also cut the vector open so that it could receive the transgene. We then put the vector and the transgene into one vial and added ligase, which attached the transgene into the vector. The vial was then incubated at approximately thirty-seven degrees Celcius for five hours.

The vector was transferred into Escherichia coli (E. coli) through a heating process. Both the vector and the E. coli were placed in the same vial and heated to forty-two degrees Celcius. The sudden heat enabled the transgene to bore a hole through the E. coli wall, thus creating transgenic E. coli.

After this, the E. coli was spread into a petri dish containing kanamycin and rifampicin. Both kanamycin and rifampicin are toxic to normal bacteria. However, the transgene is resistant to both and so the transgenic bacteria should also be resistant to both—this resistance is known as a "marker gene" that allows scientists to determine which bacteria are transgenic.

Theoretically, all of the normal bacteria could not survive the toxic medium and so the remaining bacteria clumps were all transgenic. However, this was not always a precise process and needed to be verified. Verification was done by putting half of each clump in a Lithium Borate solution (this medium allowed for the E. coli to grow freely) and then performing a Polymerase Chain Reaction and gel electrophoresis on the other half.

Polymerase Chain Reaction (PCR) is an ingenious way to turn one DNA strand into a million within twenty cycles (assuming 100% yield.) The process is fairly straightforward and will go on indefinitely, so long as there are resources available.

Our resources included thirty five and half microliters of deionized water, four microliters of dNTP, five microliters of Pfu buffer, one microliter of both left and right primer, two and a half microliters of the plasmids to be replicated, one microliter of DNA polymerase, and paraffin liquid.

The deionized water and Pfu buffer provided the best medium for the reaction to take place in. The left and right primers were small bits of DNA, only about twenty base pairs (nucleotides) long. These primers were complimentary to the beginning of the transgene: the left primer was complimentary to one strand while the right primer was complimentary to the other. The plasmids provided the material to be replicated and the dNTP provided plenty of nucleotides as "building blocks" for the new DNA strands that were formed. DNA polymerase was the mastermind that puts all the building blocks together, with the ability to sequence a complimentary sequence of nucleotides based on one strand of DNA— so long as a few nucleotides (the primers) exist to provide a base. Paraffin liquid is an oil that will form a protective layer over the solution and keep the water from evaporating during the heating process.

With the exception of the oil, all components of the solution were stored in a cool environment prior to use (the double distilled water is stored at -20 degrees Celcius.) This ensured maximum efficiency during the process. The components were added in a vial with the DNA polymerase added second to last and the oil added last as a protective coat. The solution was centrifuged for a very short time (and low speed) to ensure that the oil and solution were well separated.

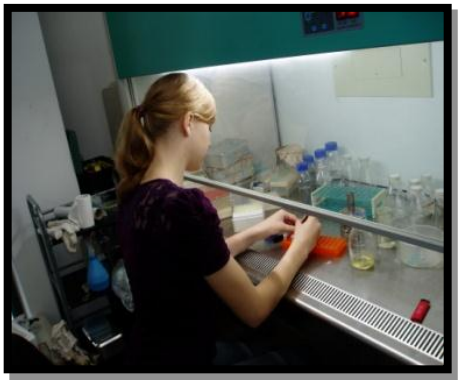
Finally, the thermal cycling began.

First, the solution was heated for five minutes at ninety-four degrees Celcius to initially break open the DNA strands. Then there were thirty five cycles of the following: thirty seconds at ninety-four degrees Celcius (to break open the DNA frames and create two separate strands), followed by thirty seconds at fifty eight and a half degrees Celcius (lowering the temperature enough for the primers to attach to the base of their gene), and five minutes at seventy-two degrees Celcius (giving DNA polymerase enough time to fill out the rest of the sequence by attaching complimentary nucleotides). Thus, two separate strands of DNA were created. As the cycle occured the second time, the two strands turned into four; and with the third cycle the four strands turned to eight. The process can repeat indefinitely until either the heat cycles are stopped or the resources run out.

Typically, one thousand bases take about one minute to sequence—however the pFU DNA polymerase required twice the time of other polymerases. It is well worth the extra work, since pFU DNA polymerase is both more stable at high temperatures and also proofreads the sequences that it is building. Once these cycles finished, there was a seven minute period at seventy-two degrees Celcius—this time enabled the DNA strands to stabilize and strengthen, reducing the risk of breakage. Once finished, the solution was stored between four and sixteen degrees Celcius.

After the PCR was completed, we tested the results by a process called "Gel Electrophoresis." First, we created a gel square composed of roughly one percent agarose (a crystal-like powder that can turn into gel) and ninety-nine percent TAE (a liquid buffer). We also added roughly one microliter of GelRED, a nucleic acid stain which made the DNA much more visible during scanning. Finally, the solution was poured into the mold and allowed to set.

The finished result was a gelatinous square with small slots for us to insert the samples. We used the syringe to mix the vector with a stain and then syringed the vector into one of the small slots. We then put a small amount of DNA marker into a separate hole. Finally, we generated an electrical current. The electricity caused the particles to move through the medium—the smaller particles were able to wiggle through the pores in the agarose gel more easily, while the larger ones had more difficulty and were consequently slower. With this knowledge, the size of a particle could be determined by how far it moved in a given time (so long as we knew the concentration of a medium.) We then determined whether our vector had the right number of base pairs in its DNA—too few pairs meant it was unlikely to contain the transgene.



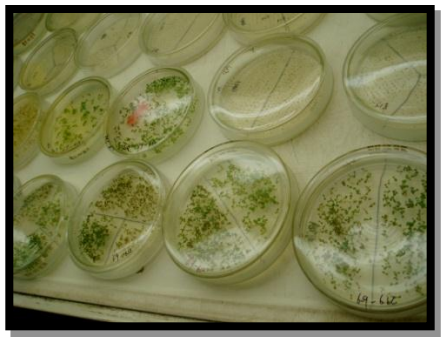
The DNA marker spread out and left indicators at various base pairs—for example, 500

BP, 1000 BP, 12000 BP, etc. After a time, we scanned the gel under a white light and a transilluminator—by comparing the vector to the DNA marker indicators, we determined the length of the vector.

If the vector was good, we proceeded to the next step. We found the corresponding E. coli in the Lithium Borate vial and added Agrobacterium to the mixture. This was placed into liquid nitrogen and then subjected to high temperatures (twenty-nine degrees Celcius). The transgene moved into Agrobacterium, thus creating transgenic Agrobacterium. Unlike other bacteria, Agrobacterium has a highly unique ability to hijack plant cells and make them replicate its own DNA. Since agrobacterium's natural DNA contains a Ti plasmid (a tumor inducing gene) this process is usually damaging to the plant. However, once the Ti plasmid is cut out, the transgene can be inserted in its place. Remarkably, agrobacterium will continue to hijack the plant cells, except it is now causing them to replicate the transgene.

As with the E. coli, we spread Agrobacterium onto a petri dish containing kanamycin and rifampican. The surviving Agrobacterium clustered together in small white spots. Typically, we used about five to ten of these—again, half of each spot was placed in Lithium Borate and the other half was used for PCR and gel electrophoresis. The half in the Lithium Borate was allowed to grow under optimal conditions overnight (220 revolutions per second and 36.9 degrees Celcius). Later, this was used for sequencing. After running the PCR, we performed gel electrophoresis to determine which spots were "good" (have the transgene) and which ones were "bad" (without the transgene).

However, electrophoresis could only determine if the Agrobacterium had the right DNA length—it could not actually distinguish if it has the correct DNA sequence. So after noting all the "good" clumps, we found the corresponding LB buffer vials and sent part of them to a company to sequence for us. If the sequence was correct, we could be confident that clump was transgenic. Then we took the remaining part of the LB buffer and waited for it to reach a concentration of about 1.2 OD (a measure of concentration based on how well the substance absorbs light). The next step was creating an "Agrobacterium Solution."



Agrobacterium Solution was created by combining five grams of sucrose, ninety-eight milliliters of water, one milliliter of calcium chloride, and one milliliter of "major elements" (potassium nitrate, ammonium, monopotassium phosphate, and magnesium sulfate). It was sterilized by heating to 121 degrees Celcius for twenty minutes. Once sterilized, Agrobacterium was added and the solution's concentration was measured— anything between 0.6 and 0.8 OD was considered acceptable.

When applied to plant seeds, the chemicals opened up the cells and allowed the agrobacterium to enter. The agrobacterium then hijacked the plant DNA and caused it to replicate the transgene, thus making the seed transgenic. Before applying to the plant seeds, however, we needed to cut any flowers off the Arabidopsis (because they were too far along to be transformed.) The transformation was done by carefully syringing small drops of water onto every bud. Once the seeds matured, we harvested them and planted them in a medium containing the marker genes. If they survived, they were likely transgenic—in which case they were transferred into a rich soil and allowed to grow naturally.

The only intervention made after this point was carefully tying plants to small wooden poles for support, as they had a tendency to droop over during their later stages of growth.

Once fully grown, we compared the height of the transgenic plants to the height of non-transgenic plants. If the transgenic plants were taller, the experiment was likely a success.

I do not know whether our experiment is, in fact, a success. During my two months internship I learned a great deal about the transgenic process, observed quite a bit, and helped some… but there simply was not enough time to be a part of the whole experiment.

Two Months—My Experience

Beijing, China

As I walked out of the airport, there was no doubt that I had left my small, quiet hometown.

Cars, bikes, buses, and pedestrians swarmed on the roads and sidewalks. The air had an indescribably foreign quality to it—a combination of smog and heat and something totally new to me. We drove by towering buildings, massive crowds, vendors selling food, and notices written in Chinese characters. The conversation in the car was Chinese, punctuated by the occasional English question directed towards me.

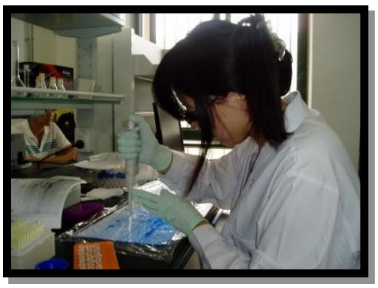
Yes, I was on the other side of the world. The first couple of weeks, I would realize this with a sense of dullness—I wasn't at all homesick or lonely, but neither was I comfortable with the Chinese culture and people yet. I viewed my internship as a mild inconvenience that would eventually produce a good result—a brief sentence to a strange environment that would, if nothing else, be an interesting experience. The next four weeks, I began to get more comfortable. Parts of China still seemed strange and unfavorable compared to the U.S. But there were also parts I liked very much. And now that I am at the very end of my last two weeks—just about to leave—I have become very attached to this city and this country. It is a

foreign culture, yes. And I am on the other side of the world. But that is exactly what has made this internship such a wonderful experience.

My Lab Work

The lab work was nothing like I expected. Before leaving, I envisioned myself spending long hours meticulously working through one huge experiment. The reality was completely different. In fact, the first few weeks, I hardly did any lab work at all. Rather, I spent time doing online research about the transgenic process, and observing a few lab procedures. At the time, I was extremely anxious to get to the "real lab work." Once I actually got into the lab, however, I was thrilled to realize that my online research had prepared me to understand and carry out the procedures.

My lab work was also surprisingly diverse. Certainly, I spent considerable time studying the transgenic process and working with that experiment. But I was also involved in many other types of research. One of the Ph.D. students allowed me to assist her with a high-level experiment involving wheat proteins. Through this, I was introduced to several entirely new procedures. I learned how to store samples of wheat in liquid nitrogen and later grind them into a liquid, how to do a two-dimensional gel electrophoresis, and how to extract proteins from the gel. This experiment also led me to discover my one shining talent as a lab scientist—the ability to delicately pull apart wheat roots using a small foreceps.



Initially, I had few "odd jobs" since the graduate students were extremely careful not to overwork me. But after awhile, I was able to convince them that I genuinely enjoyed helping in whatever way possible and managed to obtain a small stream of "odd jobs." Ironically, these ended up being among my favorite parts of the internship. One night, I wrapped boxes in tin foil. Sometimes I would wash the lab equipment. My favorite odd job involved wrapping samples of cotton in tin foil and throwing them into a vat of liquid nitrogen.

As far as regular hours, I had none. Each day, I would show up promptly at 8:00 a.m., leave for lunch at about 11:30, return at 2:00 and leave around 5:30. Some days, I would be busy with experiments the whole time, while other days I would do lab work for only two or three hours and spend the rest of the time on my paper. On about seven occasions, I was permitted to work at night—and this quickly became something that I greatly enjoyed and looked forward to.

In the end, my lab work arrangement was wonderful. I had enough similarity in my tasks that I could become familiar with them and begin to understand them on

a deeper level, but I also had enough one-time "odd jobs" to keep things new and interesting.

My Life as an Intern

In some cases, such as the lab work, my expectations for this internship were completely wrong. But in other instances I was absolutely right. I expected that I would try new and different things and I certainly have. I also expected that the internship would be a great experience—I couldn't possibly have been more correct.

One of my first "new experiences" was Chinese transportation. It's completely different here—and not only because there is so much of it. In America, my transportation was basically limited to walking, running, and driving. Here, I have gotten familiar with subways, buses, two-story buses, taxis, trains, high-speed trains, and even riding two people on a normal bicycle. One notable journey involved three bus rides, two taxis, a great deal of waiting in lines, and one sixteen-hour train ride. Riding the Beijing subways was always a fascinating experience—there is something phenomenal about being a foreigner in the middle of a subway. My proudest moment of Chinese transportation, however, wasn't my first train ride or becoming familiar with the subways. It was when I successfully traveled alone on the Beijing buses from my university to Peking University. Maybe it's not much to be proud of, but for a small-town girl with severe directional deficiency, it felt like I had climbed Mount Everest.

The food was another experience—and, at first, not a positive one. One change I did enjoy was the lack of formal dining rules. As long as you don't make loud noises, spill food on the person next to you, or commit an over-the-top food atrocity, anything goes. The rest, however, was not initially enjoyable. The chopsticks were utterly different, and at first I was so hopeless at them that the graduate students offered to get me a fork. The food can only be described as foreign. Fruits, dairy, and sweets were barely recognized as food groups. Rice, vegetables, meats, and noodles dominated the scene, and many were covered in strange sauces. Even foods that looked completely familiar, like fresh carrots, often tasted unrecognizable due to these sauces. But the food has slowly grown on me. The noodles are nothing short of delicious; I've acquired a taste for the tofu; and the Chinese litchi fruit is foreign in the best possible sense of the word. Even some of the vegetables in sauces have grown on me (though others remain as unattractive as before), and I've even mastered the art of chopsticks. All the same, I happily anticipated my return to American food.

As far as sights and places go, I was bombarded with new things so quickly I could scarcely process them all—The Great Wall, The Birds Nest, Tiananmen Square, Ming Tombs, Tianjin Markets, The Beijing Zoo, Summer Palace, The National Museum, Temple of Heaven, and much, much more. I'm actually not much of a

sightseer, but even I could appreciate visiting these world-famous landmarks. The Great Wall was truly remarkable—its length, its history, and the beautiful mountains surrounding it.

I also had two incredible opportunities to travel—first to Hubei, and second to Anhui. At Hubei, I was able to visit the fields where the graduate students test their research and see the infamous Wu Qiao acrobatics. Both were more eventful than expected. During one of the acts at Wu Qiao, the magician noticed that I was a foreigner and brought me onstage as a volunteer and guinea pig. After we left, one of the Ph.D. students informed me that I had just helped one of the more famous magicians in China (His nickname translates into "Ghost Hand," because he performs his trick so quickly.)

Still, the most impactful aspect of Hubei was the field research. There were parts that I didn't understand—most notably, a project which somehow tested the impact of different soil textures, residue, tillage, and other factors all in one. How they will determine which factor caused which outcome is far beyond me. But others were both understandable and fascinating. Since the Hubei area doesn't get enough rain to support a corn in the summer/wheat in the winter rotation, one student tested the effects of planting corn with rows of peanut plants on the bottom. Not only is this a creative way to grow two plants with less water requirements, but the peanut plants would also help bring nitrogen into the soil.

As I looked around at all the research plots and heard about all the different issues being tested, I realized that global hunger is indeed a multifaceted issue. No one can really "solve" world hunger. Instead, people take a tiny fragment– maybe coming up with the idea for improving one gene of one plant that will work under one soil/weather condition. Maybe another person's job is to take the idea out of carefully primed "lab soil" and onto some research fields– and another person's job to finally take it to the farmers.

In some ways this process is encouraging. It transforms world hunger from a monstrous issue that must be tackled at once into smaller, manageable issues that actually have potential to be solved. At the same time, I am frustrated. Progress is so slow— maybe one gene here, one farm there— and new problems crop up constantly. Even the solutions often have drawbacks which need their own solutions. In some ways, I almost wish that world hunger was a massive issue that could be fixed with one equally massive effort.

At the first research station there was a large group of fairly young children who worked in the fields. They were extremely excited to see a foreigner and came rushing out to meet me. We talked as much as my rudimentary Chinese would allow (in other words, we said hi and exchanged names) and then the photoshoot began. I was passed from person to person for pictures. My hair was examined. My skin was examined. When I had to go, they waved enthusiastically.

For some reason, I felt incredibly guilty about their excitement to see me. They greeted me like I was a celebrity, but it seems like they should resent me. I have such an easy life compared to them. My hardest work is homework, not laboring in a

field. I have everything I need and plenty of things on top of that. Sure, I've heard how lucky I am several times— but I never really truly realized it until I met these children. They have as much "spark" as any American child I've seen, and it seems incredibly unfair that they should be at a lifelong disadvantage from the moment they are born.

Hubei was a wonderful, if painful, learning experience. It caused me to think, and it also gave me my first real taste of injustice. Issues like world hunger and poor living conditions were mostly just abstractions before. Now they are a little more real and a great deal more unsettling– and, in the case of world hunger, being unsettled is probably a very good thing.

This was hammered home even more a few days later. I glanced out the lab window one day and noticed a man scrubbing the window, even though it was clearly about to rain. His was a face I'd seen far too often lately—not him, specifically, but the face of the disadvantaged Chinese worker. The situation could hardly have been much more symbolic. I sat in the bright, warm room, safe from whatever harsh weather may occur. He stood outside in the brewing storm, washing the windows and looking into a room where he could never sit. Finally, he finished. As he walked away, I thought that I could hear him humming.

My second traveling opportunity, to the China Cotton Conference in Anhui, was significant in a different way. I went with eight of the kindest graduate students in existence. They never showed the faintest bit of irritation at having to tow a high school student along. Rather, they took excellent care of me. They taught me how to play cards, frequently brought me food and water, expressed a genuine interest in me, ran with me, offered to go and get me some Chinese medicine when I showed traces of a cold, and were more attentive and welcoming than I thought humanly possible. Anhui also taught me that I can, literally, climb mountains. We climbed to the top of Huan Shang—popularly considered the most beautiful mountain in China. Being someone who considers all mountains incredibly beautiful, climbing this mountain was an experience that will undoubtedly stay with me for a lifetime.

I have had many other new experiences here—from playing badminton to learning how to make a toast (with a non-alcoholic drink) to visiting the campus "playground" (a sort of rudimentary collection of outdoor exercise machines) to attending a Chinese party.

Just having independence has been a new experience. I am living by myself in a dorm for two months, away from the guidance of my family, teachers, and friends. I have learned to manage my own time, to wash my own clothes (by hand), and to buy my own food from the supermarket.

This freedom is easily the most unique aspect of my internship. I've come to realize that freedom brings greater potential—greater potential for success and greater potential for failure. Of course it grants the opportunity to make the wrong choices. During the internship I could have poorly managed my free time, wasted my spending money, and done a variety of other things with little immediate consequences. But freedom also makes the right choices that much more meaningful, because they are truly voluntary and done with pure motives.

In no instance has this been more true than with religion. I attend a Christian school in a predominately Christian town. Praying, attending church, and reading the Bible have simply been a nonnegotiable part of life. So it was definitely something of a "culture-shock" to suddenly be in a largely non-religious environment.

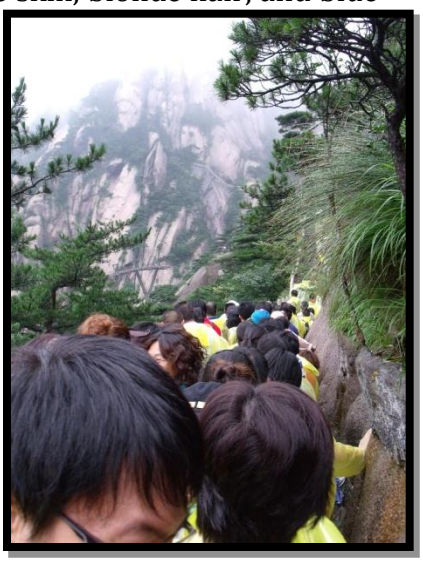
Interestingly, all aspects of my religion took on much more meaning in this non-religious environment. They became something that I actively chose to do, rather than something I was just expected to do. Instead of being woken up on Sunday morning for a church service, I had to wake myself up and hold my own church service for an hour. So when I was given the opportunity to attend one of Beijing's international churches, I jumped at the chance. And I'm glad I did—it was highly moving to attend a church where everyone was there because they loved God; rather than because it was expected of them. The congregation treated church as a joy rather than a duty.

This was also the first time in my life that I was frequently asked serious questions about my religion. Again, I am grateful for this. The questions made me think and think hard. Through thinking and talking, I developed a fuller understanding—not only of my own religion and perspective, but also of others.

The internship has gradually lured me out of my comfort zone. It's introduced me to new activities, new people, and a new culture. It's taught me how to be independent. It's made me think through all my convictions and think deeply about issues I don't yet have convictions about. It's caused me to be more unsettled about life's "big issues"—injustice, poverty, hunger, racism. I still don't have the answers to any of these issues—in fact, I don't really know what I'm going to do with them once I get home. But now that I am unsettled, now that I care, I know that I will do something.

Becoming a Minority

My experience with race was consistently striking. I stand five feet, eleven (and a half) inches off the ground with uncommonly pale skin, blonde hair, and blue eyes. Set in my hometown, a place of Dutch heritage, my appearance is standard in every aspect. Set amid the small-statured, dark skinned, black-haired, dark eyed population of Beijing, China, I am unusual in every aspect. I am suddenly an ethnic minority.



Whenever I stepped out of my dorm room, the intensity of others' reactions to me acutely reminded me of my race. The most common reaction was a simple stare, not unlike the stare a child would give to a fascinating new animal. Bikers have swerved off the sidewalk while they were craning their necks to stare at me. One middle-aged woman carrying a popsicle was so fixated that her popsicle slid off the stick unnoticed and she nearly tripped on it with her next step. Often, I would catch the word "mei guo ren" (American), usually spoken in excited tones. I was whistled at, winked at, questioned in Chinese, and asked to take so many photos that my friends joked I should charge a small fee. My favorite reactions were the small children, who would break into broad grins upon seeing such a strange human being. Even the service people constantly gave me special treatment, simply by virtue of being American. Never in my life have I been given such attention, nor told so often that I am beautiful—by strangers, by food-servers, by the cleaning ladies, by my labmates.

Though I was there for two months and walked past countless people, I only experienced one obviously anti-American reaction. While I was riding a bus, I became aware that the lady standing next to me was staring me down with more than the usual intensity. I turned to look at her and smiled. Immediately, her eyes widened with a combination of fear, disgust, and shock that I was not expecting. After standing like that for a moment, she ran to the back of the bus.

But, honestly, neither the positive nor negative reactions stuck with me because the vast majority of them were superficial. It was too extreme. I doubted that people were actually that excited to see me personally, or curious about me as a person—no, they were excited and curious about me as a foreigner, an American.

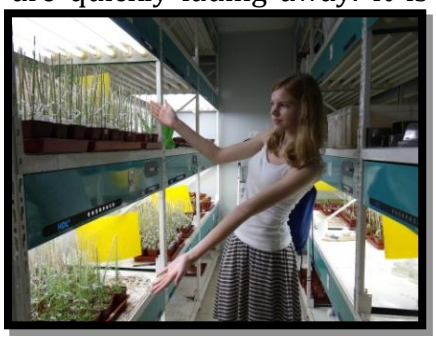
This had a surprising impact on me. Regardless of what I was like as a person, I would still have generated these initial positive, welcoming reactions. And these reactions were a huge part of what made me feel welcome in China. I wondered how different my stay would have been if the majority of initial reactions were negative, if every time I walked down the street, I was met with hostile stares rather than curious ones, if the cafeteria workers went out of their way to give me the worst food instead of the best. The difference would be overwhelming and

painful. Yet it has happened before to other ethnicities, many times—even in my own country.

For the first time in my life, I have become acutely aware of racism—of the uglier, more blatant forms, and also of the subtleties. Ethnicity is, literally and figuratively, the most superficial aspect of a person—simply an external feature. What a pity it is that humans treat that external feature as if it decides personal worth.

The End?

As I write this from my lab computer at CAU, my remaining hours in China are quickly fading away. It is incredible how much China has changed since I've arrived here—the food has transformed from barely edible to delicious, the people have gotten even friendlier, the traffic has become less hazardous, the university has become more beautiful. Or maybe I'm the one who has changed.



At any rate, I have no doubt that I will miss China. Now that I'm entering that stage of saying goodbye, I realize just how much I like it here and a large part of me wants to stay longer.

But the other day as I walked down the street, a pair of brilliant blue eyes stood out—a dazzling contrast to the surrounding mass of dark eyes. I was paralyzed by this unexpected, familiar beauty in such a foreign environment. All I could think was "They are like me—like the people in my home." And, as much as I may like it here… it's still not home.

Truly, there's nothing quite like being surrounded by the unfamiliar to make you appreciate the familiar. I have gained an appreciation for China throughout this internship—as I expected. What I didn't expect was that China would teach me appreciation for America as well.

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