

## Bonsai Tree

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As the only female in the Kyushu University mathematical department building, Dr. Kimiyo Yamamoto had to run the 100 meter distance between the mathematical building to the main office just to find a restroom, similar to the movie, Hidden Figures. But that was over 50 years ago, in 1961-- shouldn't things be different by now? However, Kimiyo's story is pretty recent, only 5 years ago, and in some places gender biases still exist even today. But Yamamoto says that women must stay strong and persevere through them, because that was what allowed Kimiyo Yamamoto to become the courageous person she is today.

The first thing that I thought of when I met Kimiyo Yamamoto is that she isn't one of those trees that shoots up directly into the sky. Most people's paths are like christmas trees, starting wide on the bottom and gradually narrowing down. Her path is more like a bonsai tree, turning and twisting in different directions, and yet, still maintaining a perfect balance. It is a path most aren't courageous enough to take. Though she sprouts many branches, they all start at the same place, similar to her life that is surrounded by one passion, mathematics.

Kimiyo Yamamoto has always loved math since she was little, but when she had to decide between the Osaka Medical College, where she could learn to become a doctor, and graduate school, where she could continue with her passion for mathematics, she chose medical school. Both subjects were dear to her, but since she knew very few female mathematicians that succeeded in a mathematical career, she decided to take medical school and not risk the chance. But a few years later, in 2012, she read the book, "Seimei No Suuri" or "Mathematics for Life Science", explaining how it might be possible to find a pattern in cancer growth and make a mathematical equation that would be able to predict the best time for treatment. Overjoyed, she knew that this was what she wanted to research! Never had she imagined that she would be able to use mathematics for medical purposes, and she was delighted. It was as if a huge part of her that had been stored away when she had chosen medical school was coming back!

With the knowledge of her husband, a radiation oncologist treating patients with pancreatic cancer, she decided that she was going to start her research with pancreatic cancer then move on to other types of cancer. But besides the help of her husband she says that many people have supported her. Yamamoto spent most of her time on mathematics, even though she was in medical school, making her unusual. This uniqueness was what caused most employers to turn away from her, not wanting to take the risk. Fortunately, one professor employed her allowing her to continue her mathematical studies.

Since then, Yamamoto has continued to make her dream a reality. In 2017, Yamamoto was invited to present her research at the 74th Annual Meeting of the Japanese Cancer Association. She was nervous and scared at first about how people would react to her idea, but to her surprise, everybody was hopeful. Some comments given to her were, "If that was a thing, that would be helpful," "Wow, I never thought of that before, what a cool idea." Support such as these continue to make her motivated.

Currently, she is studying abroad from Japan at Harvard University and is collecting CT scans of patients with pancreatic cancer, so that she can find a pattern in the data. Since CT scans are personal information, Yamamoto struggles to collect data. But she continues to persevere, repeating to herself one of her favorite Japanese sayings, "ishi no ue ni mo san nen". This means that even the coldest rock will warm up after sitting on it for three years, so what the saying is trying to convey, is that you should give everything you can before giving up. Yamamoto says that this saying has saved her many times from quitting her career, and without it she does not know what she would have been doing right now.

She also says that periodic successful discoveries help her keep her motivation high. She feels excited when she looks for a mathematical equation, filling 2-3 pages of a notebook, and it fits the recorded data perfectly. When this happens, she shouts "this is it!" What's incredible is how she makes an equation herself and checks it with the data, rather than making the computer calculate an equation based on the data.

What Yamamoto is dreaming about has not yet been accomplished, and very few people are researching such an unknown area of collidance between mathematics and cancer. But Yamamoto says that because of all the failures she has already experienced, she knows how to overcome failures and isn't afraid to fail again; she wants to take on the challenge. Though doctors generally decide on a specific type of treatment based on records, there is still no specific formula that they can abide by, making it harder to decide on the best treatment. If Yamamoto succeeds, then doctors will have a much higher probability of giving patients the most fitting treatment. Yamamoto's motivation that has and continues to keep her going is her dream of saving people with her mathematical formula.

Yamamoto advises young kids who want to pursue a career in math to keep studying mathematics and expanding their background knowledge, because without strong background knowledge, it is harder to open up to all the different possible ways of using mathematics. Even if you do not like one type of mathematics, there are several other types that you may like. She also advises that kids should learn programming, because graphing her data has really helped her in mathematics and she believes that the next generation is mathematics on computers. Even though gender biases still exist, Yamamoto says, "Don't be discouraged by them, persevere through them." This perseverance is what allows Yamamoto to continue in her profession in mathematics, and like the bonsai tree, which can live for over a hundred years, her passion for mathematics never dies.