[Episode 24 - Sophie Germain Transcript]

My name is Kylee Robertson, and for the next few minutes I'm going to talk about the life and achievements of a brilliant woman named Sophie Germain. Sophie was born on April 1, 1776 into a wealthy merchant family. Her father, Ambroise-François Germain possessed an extensive library filled with a variety of books and subjects. This library provided Sophie with challenges and amusement during the long days she spent indoors. For in 1789, the Bastille fell and the French Revolution began leaving France a dangerous and violent city. On one of these days when Sophie was perusing the shelves, she came across the story of the death of the Greek mathematician Archimedes. According to what she read Archimedes had been so interested in a math problem that when he was approached and questioned by an invading Roman soldier, he didn't answer, and thus was speared. Sophie was intrigued by this subject that she concluded must be the most interesting thing in the world as Archimedes was so consumed by it that it lead to his death, and so she began her own pursuit of knowledge in mathematics.

At first her parents were not supportive of her interest in math. At the time, it was not a subject that was studied by women. In fact, in order to deter her from staying up late into the night studying number theory, her parents took away her candles, clothes, and blankets, but Sophie refused to give up. Hiding candles in her room, she continued to determinedly teach herself until her parents finally gave her their blessings and even funded her research throughout her life. As Sophie increased her knowledge of number theory and calculus, she was eventually in need of tutor who would take her more seriously and be able to teach her the world's newer mathematical discoveries. Luckily for her, in 1794 a school of math and science opened, the École Polytechnique. There was only one problem. The school only allowed male students, and Sophie despite her genius and dedication, did not meet that requirement. Rather than letting this deter her, Sophie found a way to get lecture notes and problems continuing to further her education despite society's prejudices. She would submit answers to the problems using the pen name Monsieur LeBlanc, and thus kept her gender and identity a secret. However, she was unable to keep up this rouse for long as her work was so profound, she piqued the interest of her professor, Lagrange, who asked to meet the brilliant LeBlanc. Much to Sophie's dismay, she was forced to come clean about her identity, but to her surprise Lagrange, while shocked, was supportive and still impressed with her work, and so he became her mentor and helped to advance her skills in mathematics. Because of her dedication to the subject and her luck in finding a mentor who was supportive of her endeavors, Sophie gained the education she desired and began her own research in mathematics.

Sophie Germain made many contributions in the field of number theory, one of the most prominent being her work on Fermat's Last Theorem. Fermat's Last Theorem challenged that unlike the Pythagorean Theorem where *a* squared, plus *b* squared equals *c* squared, there were no whole number solutions to any closely related equations, such as *a* cubed plus *b* cubed, equals *c* cubed, etc. This theorem was one of the most challenging at the time as there were an infinite number of equations and an infinite number of values for *a*, *b*, and *c*. Sophie was to make a major breakthrough in the proof that others would later build upon. Taking a more general approach, Sophie proved that for any equation, *a* to the *n*, plus *b* to the *n* equals *c* to the *n*, where *n* was a prime number, *p*, such that $2p + 1$ equaled a prime as well, there was most likely no solution to the equation. This was a major break in a proof that until then no progress had been made. And this was to be Sophie's greatest contribution to number theory. Feeling like she had made an important discovery in the proof, Sophie wrote to the renowned Carl Frederick Gauss, once again using the pen name Monsieur LeBlanc in fear of being ignored because she was a woman. Gauss was impressed by her work and very interested in the possibilities that opened for solving Fermat's Last Theorem. He began correspondence with Monsieur LeBlanc and would have contributed all of the work to Sophie's pen name. However, just as Professor Lagrange had discovered her true identity, Gauss also learned of her secret. Once again Sophie was lucky. Gauss did not disregard her when he learned the truth, but was instead pleased and impressed by her dedication and brilliance. Also, now knowing her true identity, Gauss was able to give credit for the work made in Fermat's Last Theorem to Sophie rather than to the mysterious LeBlanc. Gauss continued correspondence with Sophie, mentoring her and inspiring much of her continued work. After several years of research and number theory, Sophie developed an interest in physics and switched her focus to this new field. In particular, she studies the properties of elasticity: how a solid material will deform under an applied force and then regain its original shape. Her work helped create the basis of the modern theory of elasticity. Attending an event at the French Academy of Sciences, Sophie saw a demonstration where metal plates and sand gathered atop them were vibrated at the same frequency of a violin. The sand would fall into a fixed pattern on the plate caused by some parts of the plate standing still while others moved a lot. A contest to find the answer to what dictated these patterns was created, and Sophie entered it. Her first entry was a hypothesis about how the elasticity was related to the curvature of the surface. However, she submitted this with no proof and with no error in her derivations, and

thus did not receive a prize. As no solution was offered after the first two-year period of the contest, it was extended and Sophie tried again. This time she fixed her calculations and performed experiments showing that her hypothesis was correct in special cases. Her work gained an honorable mention and she also published her findings in Memoir on the Vibrations of Elastic Plates. At the same time, many others were researching and attempting to find a mathematical explanation for the patterns formed on these plates, and they all built on each other's works, each doing their part to find the modern theory of elasticity. Sophie received a gold medal from the institute for her research and was allowed to attend the lectures at the Academy of Sciences. Gauss had requested and convinced the University of Göttingen to give Sophie an honorary degree, but sadly she passed away before receiving this gift. Gauss highlights many of Sophie's qualities in a letter he wrote to her. He said, a taste for the abstract sciences in general and above all, the mysteries of numbers is excessively rare. One is not astonished at it, the enchanting charms of this sublime science are revealed only to those who have the courage to go deeply into it. But when a person of the sex which according to our customs and prejudices must encounter infinitely more difficulties than men to familiarize herself with these thorny researches succeeds nevertheless in surmounting these obstacles and penetrating the most obscure parts of them that without doubt she must have the most noblest courage, quite extraordinary talents, and superior genes. Sophie overcame the prejudices shown to her for being a woman pursuing the field that at the time was considered only for men. She rose from studying secretly at night in her room to being awarded gold medals for her insightful findings. She showed her brilliance, capability, and determination, and provided a foundation for many important theories. That's all. I hope you enjoyed listening. Thanks!