

MSE Final

1. Women's place during and after WWII.

• *Europe before WWII*

- ***Marie Curie***: the first woman to win a Nobel prize in 1903 (physics), went on to become a double Nobel prize winner in 1911, both for her work on radiation. She was the first person to win two Nobel prizes, a feat accomplished by only three others since then. She also was the first woman to teach at Sorbonne University in Paris, France.
- ***Lise Meitner***: played a major role in the discovery of nuclear fission. As head of the physics section at the Kaiser Wilhelm Institute in Berlin she collaborated closely with the head of chemistry Otto Hahn on atomic physics until forced to flee Berlin in 1938. In 1939, in collaboration with her nephew Otto Frisch, Meitner derived the theoretical explanation for an experiment performed by Hahn and Fritz Strassman in Berlin, thereby demonstrating the occurrence of nuclear fission. The possibility that Fermi's bombardment of uranium with neutrons in 1934 had instead produced fission by breaking up the nucleus into lighter elements, had actually first been raised in print in 1934, by chemist Ida Noddack (co-discover of the element rhenium), but this suggestion had been ignored at the time, as no group made a concerted effort to find any of these light radioactive fission products.
- ***Emmy Noether***: revolutionized abstract algebra, filled in gaps in relativity, and was responsible for a critical theorem about conserved quantities in physics. One notes that the Erlangen program attempted to identify invariants under a group of transformations. On 16 July 1918, before a scientific organization in Göttingen, Felix Klein read a paper written by Emmy Noether, because she was not allowed to present the paper herself. In particular, in what is referred to in physics as Noether's theorem, this paper identified the conditions under which the Poincaré group of transformations (now called a gauge group) for general relativity defines conservation laws. Noether's papers made the requirements for the conservation laws precise. Among mathematicians, Noether is best known for her fundamental contributions to abstract algebra, where the adjective noetherian is nowadays commonly used on many sorts of objects.
- ***Mary Cartwright***: was a British mathematician who was the first to analyze a dynamical system with chaos. Inge Lehmann, a Danish seismologist, first suggested in 1936 that inside the Earth's molten core there may be a solid inner core. Women such as Margaret Fountaine continued to contribute detailed observations and illustrations in botany, entomology, and related observational fields. Joan Beauchamp Procter, an outstanding herpetologist, was the first woman Curator of Reptiles for the Zoological Society of London at London Zoo.
- ***Florence Sabin***: was an American medical scientist. Sabin was the first woman faculty member at Johns Hopkins in 1902, and the first woman full-time professor there in 1917. Her scientific and research experience is notable. Sabin published over 100 scientific papers and multiple books.

• *US before WWII*

- Women moved into science in significant numbers by 1900, helped by the women’s colleges and by opportunities at some of the new universities. Margaret Rossiter’s books *Women Scientists in America: Struggles and Strategies to 1940* and *Women Scientists in America: Before Affirmative Action 1940–1972* provide an overview of this period, stressing the opportunities women found in separate women’s work in science.
- In 1892, Ellen Swallow Richards called for the “christening of a new science” – “oekology” (ecology) in a Boston lecture. This new science included the study of “consumer nutrition” and environmental education. This interdisciplinary branch of science was later specialized into what is currently known as ecology, while the consumer nutrition focus split off and was eventually relabeled as home economics, which provided another avenue for women to study science. Richards helped to form the American Home Economics Association, which published a journal, the *Journal of Home Economics*, and hosted conferences. Home economics departments were formed at many colleges, especially at land grant institutions. In her work at MIT, Ellen Richards also introduced the first biology course in its history as well as the focus area of sanitary engineering.
- Women also found opportunities in botany and embryology. In psychology, women earned doctorates but were encouraged to specialize in educational and child psychology and to take jobs in clinical settings, such as hospitals and social welfare agencies.
- In 1901, Annie Jump Cannon first noticed that it was a star’s temperature that was the principal distinguishing feature among different spectra. This led to re-ordering of the ABC types by temperature instead of hydrogen absorption-line strength. Due to Cannon’s work, most of the then-existing classes of stars were thrown out as redundant. Afterward, astronomy was left with the seven primary classes recognized today, in order: O, B, A, F, G, K, M, that has since been extended.
- Henrietta Swan Leavitt made fundamental contributions to astronomy. Henrietta Swan Leavitt first published her study of variable stars in 1908. This discovery became known as the “period-luminosity relationship” of Cepheid variables. Our picture of the universe was changed forever, largely because of Leavitt’s discovery.
- Edwin Hubble, renowned American astronomer, were made possible by Leavitt’s groundbreaking research and Leavitt’s Law. “If Henrietta Leavitt had provided the key to determine the size of the cosmos, then it was Edwin Powell Hubble who inserted it in the lock and provided the observations that allowed it to be turned”, wrote David H. and Matthew D.H. Clark in their book *Measuring the Cosmos*. Hubble often said that Leavitt deserved the Nobel for her work. Gösta Mittag-Leffler of the Swedish Academy of Sciences had begun paperwork on her nomination in 1924, only to learn that she had died of cancer three years earlier (the Nobel prize cannot be awarded posthumously).
- In 1925, Harvard graduate student Cecilia Payne-Gaposchkin demonstrated for the first time from existing evidence on the spectra of stars that stars were made up almost exclusively of hydrogen and helium, one of the

most fundamental theories in stellar astrophysics.

- Canadian born Maud Menten worked in the US and Germany. Her most famous work was on enzyme kinetics together with Leonor Michaelis, based on earlier findings of Victor Henri. This resulted in the Michaelis–Menten equations. Menten also invented the azo-dye coupling reaction for alkaline phosphatase, which is still used in histochemistry. She characterised bacterial toxins from *B. paratyphosus*, *Streptococcus scarlatina* and *Salmonella* ssp., and conducted the first electrophoretic separation of proteins in 1944. She worked on the properties of hemoglobin, regulation of blood sugar level, and kidney function.
- World War II brought some new opportunities. The Office of Scientific Research and Development, under Vannevar Bush, began in 1941 to keep a registry of men and women trained in the sciences. Because there was a shortage of workers, some women were able to work in jobs they might not otherwise have accessed. Many women worked on the Manhattan Project or on scientific projects for the United States military services. Women who worked on the Manhattan Project included Leona Woods Marshall, Katharine Way, and Chien-Shiung Wu.
- Women in other disciplines looked for ways to apply their expertise to the war effort. Three nutritionists, Lydia J. Roberts, Hazel K. Stiebeling, and Helen S. Mitchell, developed the Recommended Dietary Allowance in 1941 to help military and civilian groups make plans for group feeding situations. The RDAs proved necessary, especially, once foods began to be rationed. Rachel Carson worked for the United States Bureau of Fisheries, writing brochures to encourage Americans to consume a wider variety of fish and seafood. She also contributed to research to assist the Navy in developing techniques and equipment for submarine detection.
- Women in psychology formed the National Council of Women Psychologists, which organized projects related to the war effort. The NCWP elected Florence Laura Goodenough president. In the social sciences, several women contributed to the Japanese Evacuation and Resettlement Study, based at the University of California. This study was led by sociologist Dorothy Swaine Thomas, who directed the project and synthesized information from her informants, mostly graduate students in anthropology. These included Tamie Tsuchiyama, the only Japanese-American woman to contribute to the study, and Rosalie Hankey Wax.
- Mary Sears: a planktonologist, researched military oceanographic techniques as head of the Hydrographic Office's Oceanographic Unit.
- Florence Straten: a chemist, worked as an aerological engineer. She studied the effects of weather on military combat.
- Grace Hopper: a mathematician, became one of the first computer programmers for the Mark I computer.
- Mina Spiegel Rees: also a mathematician, was the chief technical aide for the Applied Mathematics Panel of the National Defense Research Committee.
- Gerty Cori was a biochemist who discovered the mechanism by which glycogen, a derivative of glucose, is transformed in the muscles to form lactic acid, and is later reformed as a way to store energy. For this discovery she

and her colleagues were awarded the Nobel prize in 1947, making her the third woman and the first American woman to win a Nobel Prize in science. She was the first woman ever to be awarded the Nobel Prize in Physiology or Medicine. Cori is among several scientists whose works are commemorated by a U.S. postage stamp.

- **US after WWII**

- Kay McNulty, Betty Jennings, Betty Snyder, Marlyn Wescoff, Fran Bilas and Ruth Lichterman were six of the original programmers for the ENIAC, the first general purpose electronic computer.
- Linda B. Buck is a neurobiologist who was awarded the 2004 Nobel Prize in Physiology or Medicine along with Richard Axel for their work on olfactory receptors.
- Biologist and activist Rachel Carson published *Silent Spring*, a work on the dangers of pesticides, in 1962.
- Eugenie Clark, popularly known as The Shark Lady, was an American ichthyologist known for her research on poisonous fish of the tropical seas and on the behavior of sharks.
- Ann Druyan is an American writer, lecturer and producer specializing in cosmology and popular science. Druyan has credited her knowledge of science to the 20 years she spent studying with her late husband, Carl Sagan, rather than formal academic training. She was responsible for the selection of music on the Voyager Golden Record for the Voyager 1 and Voyager 2 exploratory missions. Druyan also sponsored the Cosmos 1 spacecraft.
- Gertrude Elion was an American biochemist and pharmacologist, awarded the Nobel Prize in Physiology or Medicine in 1988 for her work on the differences in biochemistry between normal human cells and pathogens.
- Sandra Faber, with Robert Jackson, discovered the Faber–Jackson relation between luminosity and stellar dispersion velocity in elliptical galaxies. She also headed the team which discovered the Great Attractor, a large concentration of mass which is pulling a number of nearby galaxies in its direction.
- Zoologist Dian Fossey worked with gorillas in Africa from 1967 until her murder in 1985.
- Astronomer Andrea Ghez received a MacArthur “genius grant” in 2008 for her work in surmounting the limitations of earthbound telescopes.
- Maria Goeppert-Mayer was the second female Nobel Prize winner in Physics, for proposing the nuclear shell model of the atomic nucleus. Earlier in her career, she had worked in unofficial or volunteer positions at the university where her husband was a professor. Goeppert-Mayer is one of several scientists whose works are commemorated by a U.S. postage stamp.
- Sulamith Low Goldhaber and her husband Gerson Goldhaber formed a research team on the K meson and other high-energy particles in the 1950s.
- Carol Greider and the Australian born Elizabeth Blackburn, along with Jack W. Szostak, received the 2009 Nobel Prize in Physiology or

Medicine for the discovery of how chromosomes are protected by telomeres and the enzyme telomerase.

- Rear Admiral [Grace Murray Hopper](#) developed the first computer compiler while working for the Eckert Mauchly Computer Corporation, released in 1952.
- [Deborah Jin's](#) team at JILA, in Boulder, Colorado in 2003 produced the first fermionic condensate, a new state of matter.
- [Stephanie Kwolek](#), a researcher at DuPont, invented poly-paraphenylene terephthalamide – better known as Kevlar.
- [Lynn Margulis](#) is a biologist best known for her work on endosymbiotic theory, which is now generally accepted for how certain organelles were formed.
- [Barbara McClintock's](#) studies of maize genetics demonstrated genetic transposition in the 1940s and 1950s. She dedicated her life to her research, and she was awarded the Nobel Prize in Physiology or Medicine in 1983. McClintock is one of several scientists whose works are commemorated by a U.S. postage stamp.
- [Nita Ahuja](#) is a renowned surgeon-scientist known for her work on CIMP in cancer, she is currently the Chief of surgical oncology at Johns Hopkins Hospital. First woman ever to be the Chief of this prestigious department.
- [Carolyn Porco](#) is a planetary scientist best known for her work on the Voyager program and the Cassini–Huygens mission to Saturn. She is also known for her popularization of science, in particular space exploration.
- Physicist [Helen Quinn](#), with [Roberto Peccei](#), postulated Peccei-Quinn symmetry. One consequence is a particle known as the axion, a candidate for the dark matter that pervades the universe. Quinn was the first woman to receive the Dirac Medal and the first to receive the Oskar Klein Medal.
- [Lisa Randall](#) is a theoretical physicist and cosmologist, best known for her work on the Randall–Sundrum model. She was the first tenured female physics professor at Princeton University.
- [Sally Ride](#) was an astrophysicist and the first American woman, and then-youngest American, to travel to outer space. Ride wrote or co-wrote several books on space aimed at children, with the goal of encouraging them to study science. Ride participated in the Gravity Probe B (GP-B) project, which provided more evidence that the predictions of Einstein's general theory of relativity are correct.
- Through her observations of galaxy rotation curves, astronomer Vera Rubin discovered the Galaxy rotation problem, now taken to be one of the key pieces of evidence for the existence of dark matter. She was the first female allowed to observe at the Palomar Observatory.
- [Sara Seager](#) is a Canadian-American astronomer who is currently a professor at the Massachusetts Institute of Technology and known for her work on extrasolar planets.
- Astronomer [Jill Tarter](#) is best known for her work on the search for extraterrestrial intelligence. Tarter was named one of the 100 most influential people in the world by Time Magazine in 2004. She is the former director of SETI.

- **Rosalyn Yalow** was the co-winner of the 1977 Nobel Prize in Physiology or Medicine “together with Roger Guillemin and Andrew Schally” for development of the radioimmunoassay technique.
2. **Women’s contributions during the Manhattan Project, as well as timeline of prominent women leading up to the discovery of the bomb.**

July 1898 - French scientists Marie Curie and Pierre Curie publish their discovery of radium in *Comptes Rendus de l’Académie des Sciences*. In the December issue of the same journal, the Curies announce their discovery of polonium, named after Marie’s homeland of Poland. The Curies in 1903 share the Nobel Prize in physics with Antoine Henri Becquerel; Marie is the first woman scientist to win the Nobel Prize.

1906 - 1932 - Physicists and other scientists delve into the complexities of the atom, determined to understand its structure and to gain the ability to break it apart.

January 1934 - French scientists Frédéric and Irène Joliot-Curie, daughter of Marie Curie, publish their discovery of artificial radioactivity in *Comptes Rendus de l’Académie des Sciences*. The husband and wife team bombard boron, aluminum, and magnesium to produce isotopes of these elements not found naturally. This discovery leads to the production of cheap and plentiful radioactive materials for medical purposes.

February 1939 - Scientists Lise Meitner and Otto Frisch, her nephew, publish a theoretical interpretation of the Hahn-Strassmann results in *Nature*. In the letter, titled “Disintegration of Uranium by Neutrons: a New Type of Nuclear Reaction” Meitner and Frisch introduce the term “fission” to describe the splitting of a nucleus to produce energy in a nuclear chain reaction.

1941 - 1945 - Maria Goeppert-Mayer works on the Manhattan Project at Columbia University, working in the Substitute Alloy Materials Laboratory performing uranium isotope separation experiments. Maria is a German-born American theoretical physicist and goes on to win the Nobel Prize in 1963 for her nuclear shell model.

December 6, 1941 - President Franklin D. Roosevelt authorizes the Manhattan Engineering District (later called the Manhattan Project) with a \$2 billion appropriation to build an atomic bomb. Thousands of women were essential throughout the entire project to its success.

1942 - Along with their kids, Nella and Giulio, Laura Fermi and her husband Enrico Fermi move to Chicago for her husband’s work at the Metallurgical Laboratory at the University of Chicago. Laura and her husband have a “voluntary system of censorship” about his work; Laura doesn’t ask questions and Enrico doesn’t offer information. Laura becomes a regular host for the Met Lab workers, and volunteers with the Red Cross. Her family later moves to Spartan Army housing in Los Alamos, New Mexico, in 1944, where she works in the Health Group taking blood counts. She published *Atoms in the Family* in 1954 and five other books during her life.

1942 - At age 23, Leona Woods Marshall Libby, is the youngest and only female team member to build and conduct an experiment with the world’s first nuclear

reactor pile, alongside Enrico Fermi. Leona is the only woman present when the reactor goes critical, and is instrumental in the construction and utilization of Geiger counters for the experiment analysis. Later on she helps solve the problem of xenon poisoning at the Hanford plutonium production site, and oversees production of the plutonium reactors at Hanford.

1942 - A University of Pennsylvania alumna, Charlotte Serber, becomes the first female division leader at Los Alamos Laboratory. Charlotte was the head of the Library Division, and responsible for procuring books and resources, organizing, and managing the library of reference books and scholarly journals on physics, chemistry, engineering, and metallurgy. Charlotte built the Library from zero books to over three thousand, and oversaw staff to type, edit, and reproduce the work of the Lab technicians. She was the keeper of secrets - and had no previous library experience when she began this undertaking.

1943 - Grade school teacher Elise Novy founds a Girl Scouts troop in the Secret City of Oak Ridge. This is the first youth organization allowed on site. In 2018, Girl Scouts and Oak Ridge is celebrating the 75 anniversary of this partnership

1943 - 1946 - Moving with her husband Robert to Los Alamos, Ruth Marshak, knows nothing about the town, what work her husband is doing, or how long they will be staying. Ruth works in the Housing Office at Los Alamos and teaches third grade at the Site Y's Central School, where experimental blasts in nearby canyons that shake the foundation of the school and frighten the students. Ruth later organizes a group of women to write short stories about the project, which become the book *Standing by and Making Do: Women of Wartime Los Alamos* (published in 1987).

1943 - General Leslie Groves requests a detachment of the Women's Army Corps be assigned to the Manhattan Engineer District, to provide military personnel to handle the heavy load of classified and sensitive mail and records relating to the Project. By the end of the war, more than 400 members of the Women's Army Corps served in the Manhattan Engineer District.

1944 - A refugee of Nazi Germany, Lilli Hornig, moves to Los Alamos with her husband, Don. Even though Lilli has a graduate degree in chemistry from Harvard, she initially is offered a job as a typist. Lilli starts working on plutonium chemistry, and later transfers to the explosives group when concerns arise about potential reproductive damage from exposure to plutonium. She signs a petition advocating demonstrating the atomic bomb's destructive power as a warning to Imperial Japan, rather than dropping it on civilian populations there. Lilli went on to found Higher Education Resource Services, a nonprofit working to advance females pursuing higher education and wrote/edited three books on women in science.

1944 - Toni Oppenheimer, daughter of J. Robert Oppenheimer, Director of the Los Alamos National Laboratory, and Katherine "Kitty" Oppenheimer, is born at Los Alamos. Security requires that Toni's birth certificate list the anonymous "P.O. Box 1663" as her birthplace. She is one of many children born at the Manhattan Project sites, and is on site until age three when her father becomes the Director of the Institute for Advanced Study in Princeton.

1945 - Floy Agnes "Aggie" Lee graduates from the University of New Mexico and moves to Los Alamos to join the hematology laboratory. Aggie collects blood from

the researchers, and analyzes the blood cell information. She frequently plays Enrico Fermi in tennis after work, without knowing who he is, as all employees are referred to by employee number instead of by name for secrecy. Aggie's parents are Pueblo Indian and White, and she is one of the few Native Americans working on the Manhattan Project. Later, she works at Argonne National Laboratory and earns her Ph.D., all while being a single mom.

July 1945 - A Swarthmore graduate, Frances Dunne, is recruited from her job at Kirtland Air Force Base to begin work at Los Alamos with the Explosives Assembly Group. She is the only woman on the team, and part of the assembly crew for the Trinity test, the world's first nuclear explosion, which explodes on July 16, 1945.

1966 - Lise Meitner is the first woman to receive the Enrico Fermi Award for her pioneering research in naturally occurring radioactivity and extensive experimental studies leading to the discovery of fission. The Enrico Fermi Award is one of the oldest and most prestigious science and technology honors bestowed by the federal government.

3. **Prominent and deserving women who were left out of the Nobel Prize and why. As well as relationships seen among those who have won the prize.**
4. **The Civil Rights Act of 1964 and gender role.**
5. **Feminism and the women's liberation movement - how the perceptions of women's role in science changed.**
6. **Topics covered in Why so Few?**
 - **X** [Grace Hopper Segment on 60 minutes](#)
 - [Cathy Wolf, Human-Computer Inter. Pioneer](#)
 - [Madame Curie Complex: The Hidden History of Women in Science](#)
 - [Women's Contribution to ENIAC Remembered - /mse/txt/eniac.txt](#)
 - [Women's contributions to the National Bureau of Standards.](#)
 - [When women stopped coding](#)
 - [Science doesn't explain tech's diversity problem, history does](#)
 - [Why so few? Women in Science, Tech, Engn. and Math](#)
 - **X** [Calculating Ada - the countess of computing](#)
 - [Why Ada Lovelace Day Matters](#)
 - [The Finkbeiner Test, Double X Science](#)
 - [Gender Questions Arise in Obituary & her Beef Stronganoff](#)

7. How the number of women in STEM has changed through the years. Which fields have seen growth/drop?
8. Increasing African American Women to Engineering.
 - [Ignored Potential & /mse/pdf/africanWomen.pdf](#)

Other Links

1. *[X Women in Aviation](#)*
2. *[X Solving the Equation](#)*
3. *[National Science foundation](#)*
4. *[2 astronauts made history in nasa first all female spacewalk](#)*

Notable Women

1. **Elizabeth Rona** - </mse/txt/elizabethRona.txt>
2. **Leona Libby** -
3. **Cecilia Payne-Gaposchkin** - [Cecilia Payne-Gaposchkin](#)
4. **Maria Goeppert Mayer** - </mse/pdf/rosalindFranklin.pdf>
5. **Chien-Shiung Wu** - Known as the first lady of physics and queen of nuclear research. She studied at Berkeley after getting her degree in China. She then accepted a position at Princeton as the first female instructor. In 1944, she joined the Manhattan Project at Columbia University during WWII that produced the first nuclear weapon, she helped develop the process for separating uranium into the u-235 and u-238 isotopes by gaseous diffusion producing large quantities of uranium as fuel for atomic bombs. After leaving the Manhattan Project, she spent the rest of her life in the physics department at Columbia University. Meanwhile, she was approached by Sung Da Lee and Chen Ming Young, two theoretical physicists who grew to question a hypothetical law and elementary particle physics, the law of conservation of parity. She then conducted an experiment that disproved the law of parity, which led a Nobel Prize for the male physicists in 1957, but Wu was excluded. In 1958, she was the first woman to earn the Research Corporation award and the 7th woman elected to the National Academy of Sciences, she was also the first woman to serve as the president of the American Physical Society.
6. **Maria Mayer** - </mse/pdf/rosalindFranklin.pdf>
7. **Gerty Cori** -
8. **Dorothy Crowfoot Hodgkin** - helped with the advancements of x-rays crystallography which is a tool used to see the arrangement of atoms and molecules. She was born in Cairo Egypt in 1910 to archaeologists, she spent her childhood in Egypt in England but spent much time away from her parents because of WWI. She studied chemistry at Oxford, then phd for philosophy from University of Cambridge and it was here where she became interested in x-ray crystallography. She earned the Nobel Prize in Chemistry in 1964 because she was able to decipher the structures of insulin, penicillin and vitamin b12 which further helped in diabetes and infectious diseases.
9. **Rosalind Franklin** - </mse/pdf/rosalindFranklin.pdf>
10. **Rosalyn Sussman Yalow** - </mse/pdf/rosalynSussman.pdf>
11. **Fay Ajzenberg-Selove's** -
12. **Barbara McClintock** - </mse/pdf/rosalindFranklin.pdf>
13. **Jane Goodall** - </mse/pdf/janeDiane.pdf>
14. **Diane Fossey** - </mse/pdf/janeDiane.pdf>
15. **Birute Galdikas** - </mse/pdf/janeDiane.pdf>

16. [Louis Leakey](#) -
17. [Margarett Hamilton](#) - In 1958, received her undergraduate degree in mathematics and was married shortly after. She put graduate school on hold, and got a job at MIT as a programmer to support her husband while he pursued his law degree at Harvard. She learned to predict weather and detect enemy planes which got her a job at NASA. She discovered a flaw on rocket because her daughter was playing in the simulator and pressed a button, so she programmed the software to correct for this error just in case the astronauts would do the same. July 20th 1969, Apollo 11 was able to land on the moon thanks to her software program. Software programming is popularized because of her. [Her code got humans to the moon and invented software itself](#)
18. [Sally Ride](#) - [/mse/txt/sallyRide.txt](#)
19. [Rachel Carson](#) - DDT, pesticides that was harmful to humans but still used because of lack of acknowledgement. Rachel Carson discovered that it was very harmful for humans which turned into her writing "Silent Spring". [/mse/txt/rachelCarson.txt](#)
20. [Hedy Lamarr](#) - [X pbs & /mse/txt/hedyLamarr.txt](#)
21. [Grace Hopper](#) -
22. [Ada Lovelace](#) - [/mse/txt/adaLovelace.txt](#)
23. [Katherine Johnson](#) - Katherine G. Johnson is a pioneer in American space history. A NASA mathematician, Johnson's computations have influenced every major space program from Mercury through the Shuttle. She even calculated the flight path for the first American mission space. Born in 1918 in West Virginia, Johnson was a talented student who entered college at only 15 years old. At West Virginia State University, W.W. Schiefflin Claytor, the third African American to earn a PhD. in mathematics, recognized Johnson's abilities and motivated her to take advanced math. Johnson would go on to earn a graduate degree in mathematics. In 1953, Johnson was contracted as a research mathematician at the Langley Research Center with the National Advisory Committee for Aeronautics, the agency that preceded NASA. She worked in a pool of women performing math calculations until she was temporarily assigned to help the all male flight research team and wound up staying there. Johnson's specialty was calculating the trajectories for space shots which determined the timing for launches, including the Mercury mission and Apollo 11, the mission to the moon.
24. [Paula Hammond](#) - Childhood curiosity in northwest Detroit: father had phd in biochemistry and mother had masters in nursing, her father would interest her into chemistry. It was in high school where she discovered chemical engineering. She fell in love with MIT on first site where she earned her degree in chemical engineering and also where she found her husband John Hammond a mechanical engineering student. Together they ended up working at Motorola as the first African-American process engineers. Later, her and her husband pursued to further their education. She got her master's in chemical engineering at Georgia Institute of Technology. Then she returned to MIT for her phd, but she also had daughter and separated, being a single mother. Her daughter became a transgender and also her son is studying psychology at Northeastern. She created polymers for revolutionary drug delivery systems. The first of her three major research areas. She developed nano-particles for cancer. Nano

technology for soldiers. In 2009, Paula presented her research on polymer batteries to Obama, which informed his speech on clean energy. The sponges Paula designed for the battlefield she hopes to soon develop for use by paramedics and hospitals. Pursuing new ways to deliver RNA in the treatment of cancer and infectious disease.

25. **Lydia Villa-Komaroff** - The early influences of her mother and uncle set Lydia Villa-Komaroff on the path to becoming a scientist. Along the way, numerous other mentors influenced her decision to obtain her PhD in biology and also taught her important life lessons. As a post-doctoral fellow, Lydia Villa-Komaroff was a key member of the team that showed for the first time that bacteria could be induced to produce insulin. She spent the next twenty years researching growth factors and development before moving to science administration. Currently, she is Chief Scientific Officer at CytonomeST. Amongst her many accomplishments, she counts being a founding member of the Society for the Advancement of Chicanos and Native Americans in Science. </mse/pdf/lydia.pdf>
26. **Catherine Wolf** - A pioneering psychologist in the field of human-computer interaction, has been living with amyotrophic lateral sclerosis (ALS, or Lou Gehrig's disease) for 20 years. She invented first gesture-based system for collaboration called We Met.
27. **Mildred Dresselhaus** - Mildred Dresselhaus passed away at the age of 86 on February 20, 2017. Prior to her passing, she spoke with MAKERS about her career as a scientist. Known as the "queen of carbon science", Mildred Dresselhaus was a pioneer in nanoscience and a strong advocate of bringing more women into STEM. Born in New York on November 11, 1930, Dresselhaus originally planned to become a teacher. After receiving her Bachelor's degree from Hunter College in 1951 and later continuing her studies at Cambridge University as a Fulbright Fellow, she was encouraged by Nobel Prize winner Rosalyn Yalow to pursue physics. This change of direction led her to earn her Master's degree from Radcliffe College and later her PhD from the University of Chicago, where she was mentored by the world-renown physicist Enrico Fermi. In 1960, Dresselhaus began working at the Massachusetts Institute of Technology, where she stayed for 57 years. During her time there, she worked in different positions at the Solid State Division of Lincoln Laboratory and the Department of Electrical Engineering, eventually becoming a member of the electrical engineering faculty in 1968. There, Dresselhaus became the first female professor at MIT to hold a full, tenured position and helped organize the school's first Women's Forum. Outside of MIT, Dresselhaus served as the director of the Office of Science at the U.S. Department of Energy; president of the American Physical Society and American Association for the Advancement of Science; chair of the governing board of the American Institute of Physics; and treasurer of the National Academy of Sciences. Throughout her successful career, Dresselhaus became a woman of many firsts, receiving the first solo Kavli Prize and becoming the first woman to win the National Medal of Science in Engineering. She is also the winner of both the Presidential Medal of Freedom and National Medal of Honor and the co-author of eight books and approximately 1,700 papers. [Mildred Dresselhaus](#)
28. **Marie Tharp** - Oceanic cartographer Marie Tharp helped prove the theory of continental drift with her detailed maps of the ocean floor. She landed a position at Columbia University in 1947, as an assistant to Bruce Heezen who was collecting depth measurements across the Atlantic Ocean. During expedition, they used echo

sounding collect depth data which involves sending out high-frequency sounds/pings which records time delay returning back. Then these data were plotted to build a profile of the terrain below. During these times, women were not allowed to go on these expeditions, so she remained at the university to process the data converting rows of X measurement into detailed profile of the ocean floor. Initially, the ocean floor was thought to be flat, but she discovered the emergence of a long v-shaped cleft which supported the vengas as continental drift theory. Heezen was skeptical of Tharps' idea of the continental drift because he thought it was just "girl talk". Another student, Howard Foster at the same time was plotting earthquakes in the same region of the Atlantic Tharp was plotting her continental drifts. After this discovery, Heezen had no choice but to take her claims more seriously. Renowned explorer Jacques Cousteau believed this idea was wrong so he offered to go on an expedition to file the ocean floor which in turn proved Tharps' claims to be true. This would soon give Tharp the position of the most outstanding cartographers of the 20th century.

29. **Cady Coleman** - As a chemist and an astronaut, Cady Coleman boasts an impressive list of accolades that orbit around science and space. The former United States Air Force officer has logged nearly 4,500 hours and 180 days in space as a NASA astronaut. She's a veteran of two space shuttle missions, and participated in a six-month tour on the International Space Station. Coleman is also an American chemist with a doctorate in polymer science and engineering from University of Massachusetts Amherst and a Bachelor's in chemistry from Massachusetts Institute of Technology. While completing work for her Ph.D. at UMASS, she joined the U.S. Air Force as Second Lieutenant. She retired from the Air Force in 2009. Coleman later served as a liaison to NASA's newest Commercial Space partners where she helps assemble and integrate supply ship operations aboard the International Space Station. She retired from NASA in 2016.
30. **Ellen Ochoa** - Ellen Ochoa is an inventor, NASA astronaut, and director of Johnson Space Center. In addition to being the first Hispanic-American woman in space, she holds three U.S. patents. Listen to her story on becoming an astronaut and what she did to commemorate her first flight into space. As she was headed to space, she got flags from the National Women's Party that was used early of the 20th century as women were fighting for their right to vote. Then she took pictures and was proud to represent as a woman in space.
31. **Edith Clark** - A pioneering female electrical engineer, born in 1883 rural Maryland, one of eight children. She was the first woman to earn an electrical engineering graduate degree from MIT in 1919. She was the first woman employed by General Electric. She was the first woman elected as a fellow and the first woman to present a technical paper to the predecessor society to the famous Institute of Electrical and Electronics Engineers. She was issued a patent for a graphical calculator, which simplified calculations necessary to solve electronic power transmission line problems. She was also inducted into the National Inventors Hall of Fame in 2015, which celebrates the achievements of US inventors and patent holders.

Latest Statistics on Women in Science and Engineering

1. The National Science Foundation report's on statistical information about the participation of Women, Minorities, and Persons with Disabilities in Science and Engineering (S&E) education and employment. This is mandated by the:
 - *The Science and Engineering Equal Opportunities Act (Public Law 96 - 516)*
2. Women, persons with disabilities, and underrepresented minority groups representation in Science and Engineering education and employment is smaller than their representation in the U.S. population.
 - *True*
3. Although women have reached parity with men among S&E bachelor's degree recipients, half of S&E bachelor's degrees were awarded to women in 2016, they are still underrepresented in S&E occupations.
 - *True*
4. As an example of the underrepresentation of women in S&E fields, the share of S&E research doctorates awarded to women in 2017 was 41% versus their 51.5% of the population and 47% of the labor force.
 - *True*
5. Which of the following is "correct" in regard to the latest statistics on educational attainment?
 - *Women's highest degree shares are in psychology and biosciences; the lowest, in computer sciences and engineering.*
 - *Of all science and engineering (S&E) degrees awarded in 2016, women earned about half of bachelor's degrees, 44% of master's degrees, and 41% of doctorate degrees, about the same as in 2006. However, the proportion of degrees awarded to women in S&E fields varies across and within broad fields of study.*
 - *Among students enrolled in graduate school in S&E fields in 2016, the number (17,630) of female students are larger than those for male students (4%, 12,970).*
6. Which of the following is correct in regards to women and minority groups?
 - *In 2016, women from underrepresented minority groups earned more than half of the science and engineering (S&E) degrees awarded to their respective racial and ethnic groups at all degree levels — bachelor's, master's, and doctorate.*
7. Which of the following is "correct" in regards to employment?

- *Looking at reasons for not working, women are much more likely than men to report family responsibilities (27% versus 6%). Men are much more likely than women to report being retired, perhaps because a majority of older cohorts of scientists and engineers are male*
 - *Looking at the unemployment rates of scientists and engineers in 2017, the rates for both women (2.9%) and men (2.6%) were lower than that of the U.S. labor force (4.4%), indicating a strong demand for those with S&E expertise.*
 - *Women were much more likely than men to report that family responsibilities resulted in their part-time work schedules, whereas men were more likely than woman to report that they were retired from another job.*
8. Which of the following is “correct” in regards to Women and underrepresented minorities in terms of occupation?
- *Female scientists and engineers were more likely than male scientists and engineers to work in a non-S&E occupation (48% versus 42%).*
 - *Among scientists and engineers working full time in 2017, women generally made less than men in each broad occupational group. Women have lower median salaries than do men in most S&E occupations.*
 - *The share of academic doctoral positions held by women has increased, and although underrepresented minorities have also gained ground, their share of these positions remains small.*
9. Which university is the top U. S. baccalaureate institutions of science and engineering doctorate recipients for women?
- *University of California, Berkley*
10. Doctoral scientists and engineers employed in universities and 4-year colleges according to all academic position were about the same overall for women and men.
- *False*

Questions on the Hidden Figures Film

1. As John Glenn prepared the morning of his first launch into space, the numbers that the IBM computer projected as his point of entry into the atmosphere came into question as they differed from the previous day's numbers. Glenn, just hours before launch, is notified of this and expressed his desire to have the numbers double-checked and requested "that smart lady" to refigure the numbers. That smart lady was , who had previously been dismissed from the NASA team since computers like her were no longer needed because of the IBM machine.

- *Katherine Goble Johnson*

2. At the very onset, it is easy to see the sheer lack of respect shown to the key women in this movie, which were

- *Katherine Goble Johnson, Mary Jackson, and Dorothy Vaughn*

3. Another instance of reverence is shown as ... is respectfully confirmed as the person who made the numbers work on the IBM machine and is later promoted to supervisor. Later on, she and her colored team are asked to train the white women as to how to work with this computer, demonstrating further acknowledgement and respect. During this Civil Rights era, such a request was unheard of, which further demonstrated the depth of respect given.

- *Dorothy Vaughn*

4. Katherine Goble Johnson's superior Mr. Harrison, asked as to why she is always away from her desk for extensive breaks her reason was because

- *She had to use the "colored" bathrooms several blocks away in another building.*

5. The movie illustrates the story of how these three women overcome the obstacles of being both black and female at a time when neither was given the respect deserved.

- *True*

6. ... would write up the report with her name on it only to be told by her coworker, Paul, that she was not allowed to include her name in the report because computers did not write reports, even though it was apparent that she had done the work involved in the report. While this destroyed her trust in Paul for some time, as time progressed Paul and others grew to respect ..., and eventually her name was included in the reports.

- *Katherine Goble Johnson*

7. All are true in regards to the changes you could see in the way the women were treated except?

- *No real transformation occurred*

8. The movie *Hidden Figures* detailed the previous untold story of the contextual experiences of three black women who were brilliant astrophysicists and deeply involved in the early days of NASA in the 1960s.
- *False*
9. All are examples of shame which were revealed in the movie except?
- *Having work double checked by male counterparts*
10. As the members of the NASA team continue to work at discovering how to bring the spaceship home safely without burning up in the atmosphere, you see ..., who successfully petitioned to be allowed to get her degree in an all-white school, was credited and applauded as the person who made this happen.
- *Mary Jackson*