

Katherine Johnson

Born 1918. Mathematician of the American space race.
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1, Introduction



Chapters 1 to 5 of this life story were archived in 2021, with acknowledgement and thanks, from Wikipedia.

Creola Katherine Johnson (née Coleman; August 26, 1918 – February 24, 2020) was an American mathematician whose calculations of orbital mechanics as a NASA (National Aeronautics and Space Agency) employee were critical to the success of the first and subsequent U.S. crewed spaceflights. During her 33-year career at NASA and its predecessor, she earned a reputation for mastering complex manual calculations and helped pioneer the use of computers to perform the tasks. The space agency noted her "historical role as one of the first African-American women to work as a NASA scientist".

Johnson's work included calculating trajectories, launch windows, and emergency return paths for Project Mercury spaceflights, including those for astronauts Alan Shepard, the first American in space, and John Glenn, the first American in orbit, and rendezvous paths for the Apollo Lunar Module and command module on flights to the Moon. Her calculations were also essential to the beginning of the Space Shuttle program, and she worked on plans for a mission to Mars.

In 2015, President Barack Obama awarded Johnson the Presidential Medal of Freedom. In 2016, she was presented with the Silver Snoopy Award by NASA astronaut Leland D. Melvin and a NASA Group Achievement Award. She was portrayed by Taraji P. Henson as a lead character in the 2016 film *Hidden Figures*. In 2019, Johnson was awarded the Congressional Gold Medal by the United States Congress. In 2021, she was inducted into the National Women's Hall of Fame.

2. Early Life



Katherine Johnson as a child.

Katherine Johnson was born as Creola Katherine Coleman on August 26, 1918, in White Sulphur Springs, West Virginia, to Joylette Roberta (née Lowe) and Joshua McKinley Coleman. She was the youngest of four children. Her mother was a teacher and her father was a lumberman, farmer, and handyman, and worked at the Greenbrier Hotel.

Johnson showed strong mathematical abilities from an early age. Because Greenbrier County did not offer public schooling for African-American students past the eighth grade, the Colemans arranged for their children to attend high school in Institute, West Virginia. This school was on the campus of West Virginia State College (WVSC). Johnson was enrolled when she was ten years old. The family split their time between Institute during the school year and White Sulphur Springs in the summer.

After graduating from high school at 14, Johnson enrolled at West Virginia State, a historically black college. As a student, she took every math course offered by the college. Multiple professors mentored her, including the chemist and mathematician Angie Turner King, who had mentored

Coleman throughout high school, and W. W. Schieffelin Claytor, the third African-American to receive a Ph.D. in mathematics. Claytor added new mathematics courses just for Johnson. She graduated summa cum laude in 1937, with degrees in mathematics and French, at age 18. Johnson was a member of Alpha Kappa Alpha. She took on a teaching job at a black public school in Marion, Virginia.

In 1939, after marrying her first husband, James Goble, she left her teaching job and enrolled in a graduate math program. She quit one year later after becoming pregnant and chose to focus on her family life. She was the first African-American woman to attend graduate school at West Virginia University in Morgantown, West Virginia. Through WVSC's president, Dr. John W. Davis, she became one of three African-American students, and the only woman, selected to integrate the graduate school after the 1938 United States Supreme Court ruling *Missouri ex rel. Gaines v. Canada*. The court ruled that states that provided public higher education to white students also had to provide it to black students, to be satisfied either by establishing black colleges and universities or by admitting black students to previously white-only universities.

3. Career

Johnson decided on a career as a research mathematician, although this was a difficult field for African Americans and women to enter. The first jobs she found were in teaching. At a family gathering in 1952, a relative mentioned that the National Advisory Committee for Aeronautics (NACA) was hiring mathematicians. At the Langley Memorial Aeronautical Laboratory, based in Hampton, Virginia, near Langley Field, NACA hired African-American mathematicians as well as whites for their Guidance and Navigation Department. Johnson accepted a job offer from the agency in June 1953.

According to an oral history archived by the National Visionary Leadership Project:

At first she [Johnson] worked in a pool of women performing math calculations. Katherine has referred to the women in the pool as virtual "computers who wore skirts". Their main job was to read the data from the black boxes of planes and carry out other precise mathematical tasks. Then one day, Katherine (and a colleague) were temporarily assigned to help the all-male flight research team. Katherine's knowledge of analytic geometry helped make quick allies of male bosses and colleagues to the extent that, "they forgot to return me to the pool". While the racial and gender barriers were always there, Katherine says she ignored them. Katherine was assertive, asking to be included in editorial meetings (where no women had gone before). She simply told people she had done the work and that she belonged.



From 1953 to 1958, Johnson worked as a computer, analyzing topics such as gust alleviation for aircraft. Originally assigned to the West Area Computers section supervised by mathematician Dorothy Vaughan, Johnson was reassigned to the Guidance and Control Division of Langley's Flight Research Division. It was staffed by white male engineers. In keeping with state racial segregation laws, and federal workplace segregation introduced under President Woodrow Wilson in the early 20th century, Johnson and the other African-American women in the computing pool were required to work, eat, and use restrooms that were separate from those of their white peers. Their office was labeled as "Colored Computers". In an interview with WHRO-TV, Johnson stated that she "didn't feel the segregation at NASA, because everybody there was doing research. You had a mission and you worked on it, and it was important to you to do your job ... and play bridge at lunch." She added: "I didn't feel any segregation. I knew it was there, but I didn't feel it."

NACA disbanded the colored computing pool in 1958 when the agency was superseded by NASA, which adopted digital computers. Although the installation was desegregated, forms of discrimination were still pervasive. Johnson recalled that era:

We needed to be assertive as women in those days – assertive and aggressive – and the degree to which we had to be that way depended on where you were. I had to be. In the early days of NASA women were not allowed to put their names on the reports – no woman in my division had had her name on a report. I was working with Ted Skopinski and he wanted to leave and go to Houston ... but Henry Pearson, our supervisor – he was not a fan of women – kept pushing him to finish the report we were working on. Finally, Ted told him, "Katherine should finish the report, she's done most of the work anyway." So Ted left Pearson with no choice; I finished the report and my name went on it, and that was the first time a woman in our division had her name on something.

From 1958 until her retirement in 1986, Johnson worked as an aerospace technologist, moving during her career to the Spacecraft Controls Branch. She calculated the trajectory for the May 5, 1961 space flight of Alan Shepard, the first American in space. She also calculated the launch window for his 1961 Mercury mission. She plotted backup navigation charts for astronauts in case of electronic failures.

When NASA used electronic computers for the first time to calculate John Glenn's orbit around Earth, officials called on Johnson to verify the computer's numbers; Glenn had asked for her specifically and had refused to fly unless Johnson verified the calculations. Biography.com states these were "far more difficult calculations, to account for the gravitational pulls

of celestial bodies". Author Margot Lee Shetterly stated, "So the astronaut who became a hero, looked to this black woman in the still-segregated South at the time as one of the key parts of making sure his mission would be a success." She added that, in a time where computing was "women's work" and engineering was left to men, "it really does have to do with us over the course of time sort of not valuing that work that was done by women, however necessary, as much as we might. And it has taken history to get a perspective on that."

Johnson later worked directly with digital computers. Her ability and reputation for accuracy helped to establish confidence in the new technology. In 1961, her work helped to ensure that Alan Shepard's Freedom 7 Mercury capsule would be found quickly after landing, using the accurate trajectory that had been established.



The Apollo 11 flight to the moon.

She also helped to calculate the trajectory for the 1969 Apollo 11 flight to the Moon. During the Moon landing, Johnson was at a meeting in the Pocono Mountains. She and a few others crowded around a small television screen watching the first steps on the Moon. In 1970, Johnson worked on the Apollo 13 Moon mission.

When the mission was aborted, her work on backup procedures and charts helped set a safe path for the crew's return to Earth, creating a one-star observation system that would allow astronauts to determine their location with accuracy. In a 2010 interview, Johnson recalled, "Everybody was

concerned about them getting there. We were concerned about them getting back. Later in her career, Johnson worked on the Space Shuttle program, the Earth Resources Satellite, and on plans for a mission to Mars.

Johnson spent her later years encouraging students to enter the fields of science, technology, engineering, and mathematics (STEM).



The space shuttle blasting off.

4. Personal Life and Death



Katherine Johnson with her three daughters.

Katherine and James Francis Goble had three daughters: Constance, Joylette, and Katherine. The family lived in Newport News, Virginia, from 1953. James died of an inoperable brain tumor in 1956 and, three years later, Katherine married James A. "Jim" Johnson, a United States Army officer and veteran of the Korean War; the pair were married for 60 years until his death in March 2019 at the age of 93. Johnson, who had six grandchildren and 11 great-grandchildren, lived in Hampton, Virginia. She encouraged her grandchildren and students to pursue careers in science and technology.

She was a member of Carver Memorial Presbyterian Church for 50 years, where she sang as part of the choir. She was also a member of the Alpha Kappa Alpha Sorority.

Johnson died at a retirement home in Newport News on February 24, 2020, at age 101. Following her death, Jim Bridenstine, NASA's administrator, described her as "an American hero" and stated that "her pioneering legacy will never be forgotten."

5. Legacy and Honors

Johnson co-authored 26 scientific papers. Her social influence as a pioneer in space science and computing is demonstrated by the honors she received and her status as a role model for a life in science. Johnson was named West Virginia State College Outstanding Alumnus of the Year in 1999. President Barack Obama presented her with the Presidential Medal of Freedom, one of 17 Americans so honored on November 24, 2015. She was cited as a pioneering example of African-American women in STEM. President Obama said at the time, "Katherine G. Johnson refused to be limited by society's expectations of her gender and race while expanding the boundaries of humanity's reach." NASA noted her "historical role as one of the first African-American women to work as a NASA scientist."



Johnson seated in 2017 on a bench beside the sign in front of the Katherine G. Johnson Computational Research Facility.

Two NASA facilities have been named in her honor. On May 5, 2016, a new 40,000-square-foot (3,700 m²) building was named the "Katherine G. Johnson Computational Research Facility" and formally dedicated at the agency's Langley Research Center in Hampton, Virginia. The facility officially opened its doors on September 22, 2017. Johnson attended this event, which also marked the 55th anniversary of astronaut Alan Shepard's historic rocket launch and splashdown, a success Johnson helped achieve. At the ceremony, deputy director Lewin said this about Johnson: "Millions of people around the world watched Shepard's flight, but what they didn't know at the time was that the calculations that got him into space and

safely home were done by today's guest of honor, Katherine Johnson". During the event, Johnson also received a Silver Snoopy award; often called the astronaut's award, NASA stated it is given to those "who have made outstanding contributions to flight safety and mission success". NASA renamed the Independent Verification and Validation Facility, in Fairmont, West Virginia, to the Katherine Johnson Independent Verification and Validation Facility on February 22, 2019.

Johnson was included on the BBC's list of 100 Women of influence worldwide in 2016. In a 2016 video NASA stated, "Her calculations proved as critical to the success of the Apollo Moon landing program and the start of the Space Shuttle program, as they did to those first steps on the country's journey into space."



The highly acclaimed film *Hidden Figures*, released in December 2016, was based on the non-fiction book of the same title by Margot Lee Shetterly, which was published earlier that year. It follows Johnson and other female African-American mathematicians (Mary Jackson and Dorothy Vaughan) who worked at NASA. Taraji P. Henson plays Johnson in the film. Appearing alongside Henson at the 89th Academy Awards, Johnson received a standing ovation from the audience. In an earlier interview, Johnson offered the following comment about the movie: "It was well-done. The three leading ladies did an excellent job portraying us." In a 2016 episode of the NBC series *Timeless*, titled "Space Race", the mathematician is portrayed by Nadine Ellis.

Science writer Maia Weinstock developed a prototype Lego for Women of NASA in 2016 and included Johnson; she declined to have her likeness printed on the final product. On May 12, 2018, she was awarded an honorary doctorate by the College of William & Mary. In August 2018, West Virginia State University established a STEM scholarship in honor of

Johnson and erected a life-size statue of her on campus. Mattel announced a Barbie doll in Johnson's likeness with a NASA identity badge in 2018. In 2019, Johnson was announced as one of the members of the inaugural class of Government Executive's Government Hall of Fame.

In June 2019, George Mason University named the largest building on their SciTech campus, the Katherine G. Johnson Hall.

In 2020, Bethel School District, Washington, named its newest school the Katherine G. Johnson Elementary.

On November 6, 2020, a satellite named after her (ÑuSat 15 or "Katherine", COSPAR 2020-079G) was launched into space. In February 2021, Northrop Grumman named its Cygnus NG-15 spacecraft to supply the International Space Station the SS Katherine Johnson in her honor.

6. Inspirational Quotes



This chapter was archived in 2021, with acknowledgement and thanks, from the We Are Tech Women website at www.wearetechwomen.com.

Below, we take a look at some of Katherine Johnson’s most inspirational quotes:

“Girls are capable of doing everything men are capable of doing. Sometimes they have more imagination than men.”

“I don’t have a feeling of inferiority. Never had. I’m as good as anybody, but no better.”

“Like what you do, and then you will do your best.”

“We will always have STEM with us. Some things will drop out of the public eye and will go away, but there will always be science, engineering, and technology. And there will always, always be mathematics.”

“We needed to be assertive as women in those days – assertive and aggressive – and the degree to which we had to be that way depended on where you were. I had to be.”

“I like to learn. That’s an art and a science.”

“In math, you’re either right or you’re wrong.”

“I counted everything. I counted the steps to the road, the steps up to church, the number of dishes and silverware I washed ... anything that could be counted, I did.”

“The women did what they were told to do. They didn’t ask questions or take the task any further. I asked questions; I wanted to know why. They got used to me asking questions and being the only woman there.”

“You are no better than anyone else, and no one is better than you.”

“Take all the courses in your curriculum. Do the research. Ask questions. Find someone doing what you are interested in! Be curious!”

“I see a picture right now that’s not parallel, so I’m going to go straighten it. Things must be in order.”

“Everything was so new – the whole idea of going into space was new and daring. There were no textbooks, so we had to write them.”

“Let me do it. You tell me when you want it and where you want it to land, and I’ll do it backwards and tell you when to take off.”

7. Review of Autobiography



The following review was archived in 2021, with acknowledgement and thanks, from the Nature website at www.nature.com. It was written by Ainissa Ramirez, and was published in June 2021.

My Remarkable Journey: A Memoir Katherine Johnson, Joylette Hylick & Katherine Moore, with Lisa Frazier Page Amistad (2021).

When Star Trek first aired in the 1960s, communications officer Uhura (Nichelle Nichols) seemed to be the only Black woman affiliated with space travel. Little did society know that, as mathematicians, Black women such as Katherine Johnson actually made space flight possible. Johnson, who was highlighted in the 2016 blockbuster movie *Hidden Figures*, died last year, aged 101. She left readers a gift. *My Remarkable Journey* is a masterful memoir of a life well lived. Written with her daughters and an award-winning journalist, it captures Johnson's story against the backdrop of a dramatic century of US history.

It begins with exuberance, describing how public recognition changed her final years, from attending the Oscars in 2017 to being honoured with the Presidential Medal of Freedom in 2015 — and getting a kiss from president Barack Obama. After that, Johnson unfolds how a mathematics prodigy from White Sulphur Springs, West Virginia, became a ‘human computer’ for some of the most watched rocket launches in history. At NASA, she calculated trajectories and launch windows for the Project Mercury human space-flight programme. Meanwhile, she had to navigate her own path in an age when segregation and disenfranchisement were legal in the United States.

She entitles her chapters with life lessons — ‘Education Matters’, ‘Ask Brave Questions’, ‘Shoot for the Moon’. Johnson recognizes that she is a role model, and that few women and people of colour see their reflections in the sciences. I felt like I was sitting at the knee of a griot — a historian and storyteller — gaining years of insight into how to use idle times to prepare, to keep moving forwards when life hurts. Her down-home way of explaining science is enjoyable, too. Comparing orbital prediction with hunting, she writes: “You aim where you think the rabbit will be.”

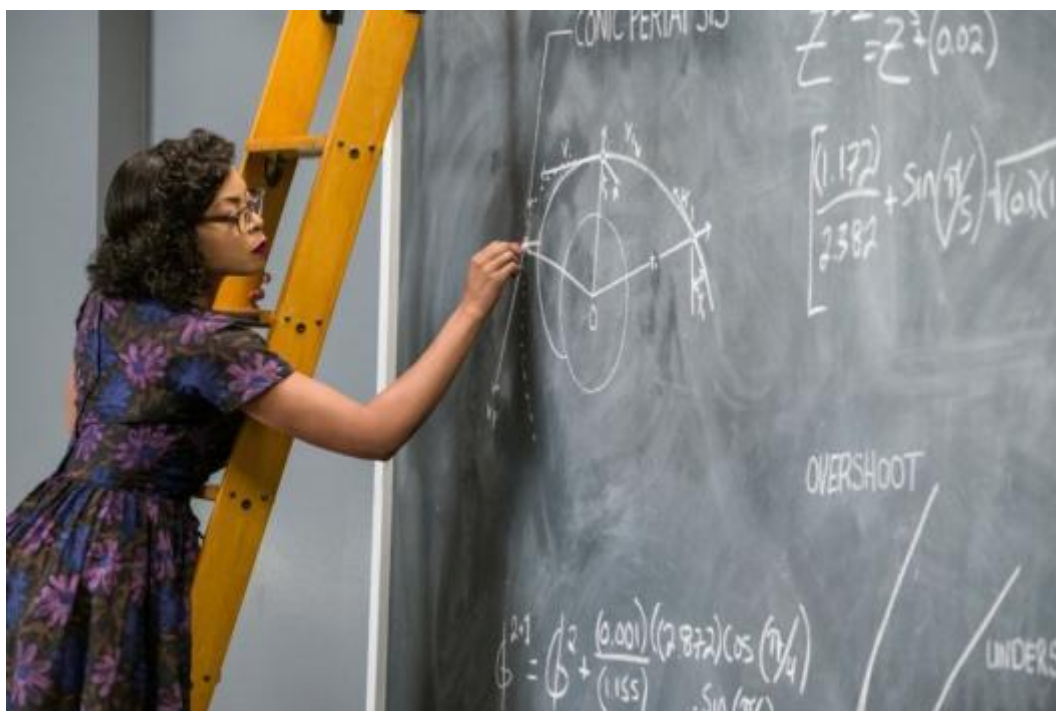
Just as a rocket thrusts a space capsule upwards, Johnson benefited from the sacrifices of her parents. She and her three siblings moved 190 kilometres to Institute, West Virginia, to attend a school for Black pupils that went beyond primary grades. Her father, who had his own gift for numbers, taught her that she was “equal to anyone, no matter what the laws or traditions said”. This lesson stabilized her trajectory.

At 14, she entered West Virginia State College (now West Virginia State University) in Institute. There, her professor gave her a mission — to become a research mathematician. William Waldron Schieffelin Claytor was a gifted topologist whose own career was later stymied by academic racism. He prepared his protégé for her window of opportunity with one-on-one instruction in analytic geometry of space. Unknowingly, he furnished her with the boost she needed years later. Claytor exemplified the African American adage “lift as we climb”.

Born in 1918, Johnson sat ringside to the Great Depression, the cold war and the US civil-rights movement, as well as the space race. Her life weaves through this greater tapestry, providing a deeper understanding of the past century. Johnson joined the precursor to NASA — the National Advisory Committee for Aeronautics — in the summer of 1953. Even before that, she shaped history. In 1939, she and two other Black students were selected by the president of West Virginia State College, a historically Black institution, to attend the previously all-white West Virginia University in Morgantown, desegregating it nearly two decades before the

Little Rock Nine did the same for a high school in Arkansas in 1957. Johnson's path to NASA was as significant as the work she did there.

The pinnacle of the book is a story that appeared on the big screen — but Johnson's account is more gripping. She was indeed “the girl” on whom astronaut John Glenn called to hand-check the computer's plan for his 1962 orbit of Earth, the first by an American. Hollywood embellished the scene; Johnson doesn't need to. A depiction of performing calculations has never been so engrossing. “I was the error checker, the last stop,” she writes. Although we know the outcome, there's relief when the numbers agree. For one moment, a launch — and a nation — relied on Johnson's mighty pencil.



A still from the 2016 film Hidden Figures. Katherine Johnson (acted by Taraji Henson) does blackboard calculations at the Langley Research Center. The film was directed by Theodore Melfi and was based on the 2016 non-fiction book of the same name by Margot Lee Shetterly.

She also celebrates a world rarely seen in science-history books — that of working- to middle-class southern African Americans of the mid-twentieth century. Of course, Johnson did not live unscathed by the realities of the Jim Crow laws: she describes incidents such as her daughter being refused admission to a segregated hospital. And she experienced microaggressions intended to ‘keep her in her place’. When her white adviser at West Virginia University asks, “What are you going to do with this advanced degree?” he is enraged by what he considers an audacious comparison to himself when she says she will do the same thing as him. She recalls: “I hadn't intended to insult him, but it did not bother me either.”

She created a full life of friends and family. She leant on her community during hardships, such as a house fire and her first husband's death. She cultivated camaraderie with other educated Black women in her university sorority, Alpha Kappa Alpha. And she was nurtured by Black colleges. Much achievement has been forged in these key institutions, as evidenced by US vice-president Kamala Harris, who studied at the historically Black Howard University in Washington DC. Johnson illuminates this inspiring world, long overlooked by dominant narratives. Yes, she writes about the space race — but she also writes about spaces where others enabled her to thrive, and about race.

My Remarkable Journey keenly shows how Johnson overcame the gravitational pulls of gender and racial discrimination. Decades ago, after she completed her calculations for the rendezvous between the lunar and command module for the eventual Apollo mission to the Moon, she said “my part was done”. With this final, beautiful opus, it is, indeed.
