

BASED ON THE UNTOLD TRUE STORY

MEET THE WOMEN YOU DON'T KNOW,
BEHIND THE MISSION YOU DO.

HIDDEN FIGURES



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The Numbers Don't Lie

The story of the Black women who became “human computers,” mathematicians, and engineers for NASA is the true story behind the film *Hidden Figures*. More than 50 years ago, they confronted employers who hired them only reluctantly. They worked in a southern state that was determined to oppose federal civil rights laws and to hold on to segregation, and in an age when women were generally encouraged to become housewives, nurses, teachers, or secretaries.

How they persisted, how they achieved their goals in spite of the many obstacles in their paths, how they convinced others who doubted them of their value as employees and even leaders—these are the lessons of *Hidden Figures* that are important for all students to learn today. Together, these women were able to accomplish more than they ever could have as individuals; they strengthened each other's determination, encouraged each other in dark times, and worked to assure the success of their whole team.

Let's look at some statistics for 2012 from the United States Department of Labor (below): Why is there such a difference between each group's size

in the total population and its representation in computing jobs? How many possible explanations can you think of? Are these numbers the result of personal choices, discrimination in hiring, diverse educational experiences, or something else? How much change has there really been from the time referenced in *Hidden Figures* to the statistics in 2012, and from 2012 to today?

As you think about careers today, think about the education you are engaged in right now. As a student, have you been encouraged to pursue courses in science, technology, mathematics, and engineering? How many such courses are offered at your school? Are there after-school activities you can join that will increase your ability to use computers and solve problems? Do you have some role models or mentors who can help you learn about these subjects?

And what about the future? What will job prospects be like for you as you graduate? Will you find a career that not only supports you financially, but that you can feel passionate about? One in which you can take pride? Now is the time to start planning that future. As you consider your own goals, think about your own strengths and the determination you have to overcome any obstacles you might face, and then plan a path that will really help you achieve, just as Katherine, Dorothy, and Mary did.

Women hold 57% of professional jobs in the U.S., but just 26% of technology jobs and 19% of software development positions. Women hold just 5% of leadership positions in technology.

Black and Hispanic people make up 30% of the U.S. population (12% Black and 18% Hispanic).

Black and Hispanic men hold 9% of U.S. computing jobs. (Black men hold 4% of these jobs and Hispanic men hold 5%.)

Black and Hispanic women hold 4% of U.S. computing jobs. (Black women hold 3% and Hispanic women hold 1%.)

Introduction to *Hidden Figures*

As NASA begins preparations for the first landing of humans on Mars in the 2030s, the excitement and challenge of the early years of manned space exploration will once again capture the world's imagination. What better time to re-examine the early years of the space race and, in particular, the efforts of the people whose work behind the scenes made those first epic voyages possible?

In Hampton, Virginia, in 1961, segregation still ruled, in spite of court orders and civil rights protesters. Workplaces, and especially workplaces in the sciences, were dominated by men. But at Langley Research Center, a remarkable group of women, the so-called “human computers,” were solving equations, calculating orbits, and laying the groundwork for the first successful flights by the team of astronauts known as the Mercury 7.

Katherine Johnson (played in the film by Taraji P. Henson), Mary Jackson (played by Janelle Monáe) and Dorothy Vaughan (played by Octavia Spencer) were among those women. As a girl growing up in West Virginia, Johnson had been passionate about mathematics; pulled from the computer pool at Langley, she became part of the team that calculated the trajectories for Alan Shepard and John Glenn. Eventually she worked on the team that accomplished the moon landing in 1969. In 2015 she was awarded the Presidential Medal of Freedom for her 33 years of work at NASA.

Dorothy Vaughn, a graduate of Wilberforce University, spent 28 years at NASA. First hired as a “human computer” to make up for the shortage of manpower during World War II, she used her mathematics skills to improve the speed and power of U.S. military aircraft. When computers were introduced, she learned FORTRAN and became a pioneer in computer programming.



Mary Jackson also began in the computer pool, and became NASA's first Black female engineer in 1958, after persuading a judge to allow her to take training courses at an all-white high school. She worked for many years writing and co-writing engineering studies; she then began a second career at NASA, becoming Langley's Federal Women's Program Manager in order to boost the careers of other women in science, math, and engineering.

Their stories are told in the film *Hidden Figures*, based on the book of the same title by Margot Lee Shetterly. This discussion guide covers the film itself, background context to help you understand the society in which these women made such strides, and a look to the future of women in STEM (Science, Technology, Engineering, and Mathematics) fields. This film helps to ensure that these brilliant and hardworking women will no longer be “hidden figures.”

Exploring the Film: *Hidden Figures*



1. At the beginning of the film, Katherine appears in a flashback at school; she is several years younger than her classmates and is asked to demonstrate the answer to a math question at the chalkboard.
 - What does this scene say about her early ability and character?
 - How did her parents and teachers support her continuing education?
 - Why did her family have to move for her to go to high school?
 - When does this image of a chalkboard reappear in the film? Why does the filmmaker choose to repeat it?
2. When Katherine first appears in her new workroom after leaving West Computing, she is mistaken for the custodian. What information does this brief but significant incident convey? How is she treated by her male co-workers? By Paul Stafford (played by Jim Parsons)? By Karl Zielinski (played by Olek Krupa), the self-identified “Polish Jew”?
 3. A major change at NASA occurs when the space agency purchases an IBM computer.
 - How does this computer compare with a typical computer today?
 - What difficulties do the engineers have installing the computer and making it operational? Why do the difficulties arise?
 - How does Dorothy learn enough to be able to operate the computer?
 - Compare Dorothy’s attitude toward her subordinates with that of Mrs. Vivian Mitchell (played by Kirsten Dunst). How does Dorothy help her colleagues succeed after the IBM computer is installed?

- Do Dorothy's attitude and actions have any implications for today's workforce in an era of ever-increasing technological sophistication?
4. The Mercury 7 astronauts came to Langley for training.
- What kind of reception did they receive? Describe John Glenn's first interaction with the women of West Computing. What is the filmmaker trying to show in this scene?
 - Why does Glenn want Katherine to check the mathematics behind his planned launch?
5. Symbols are often used to make significant points in a film. How do the following repeated symbols help to tell the story?
- Coffee:
 - The placement of an extra coffee pot in Katherine's work area
 - Katherine's reaction to the coffee pot
 - Stafford's offering her a cup of coffee at the end of the film
 - The restroom
 - The existence of a "colored" restroom in another building a half mile away
 - Katherine's need to run the distance
 - removal of the sign by Al Harrison (played by Kevin Costner)
 - The pearls
 - The dress code for women at NASA
 - Katherine's outburst when she says she can't afford pearls
 - The gift of a pearl necklace from Katherine's co-workers
6. The way that people address one another says a great deal about relative position. In most areas of the South during the period before the Civil War, slaves had no last names. Even after 1865, when freedmen chose last names for themselves, whites generally called them only by first names. Richard Wright, in his memoir, *Black Boy*, wrote of how important it was to Black adults to be called by "Mr." or "Mrs." and the last name.
- How do Stafford, Mitchell, and Harrison regularly address the women of West Computing in the film? What does this say about the working relationship of these supervisors and these workers?
 - What is the significance of Mrs. Mitchell addressing Dorothy as "Mrs. Vaughan" at the end of the film?
7. Katherine is regularly excluded from key meetings because there is no protocol for a woman to attend.
- Why is it important for her to attend?
 - How does she prove to the men in the room that it is to their advantage for her to be present?
 - Why does Harrison invite her into the room where men are tracking John Glenn's flight and making decisions about what should be done to bring him back safely?
8. In the climactic scene when John Glenn is about to re-enter Earth's atmosphere, how does the filmmaker create suspense?
9. Mary Jackson, Dorothy Vaughan, and Katherine Johnson certainly deserve recognition as major figures in the history of space science. Do their stories still carry meaning for today's young women? Can they help today's young women as exemplars and role models? What can they teach us now?

The Jim Crow South

Right after the Civil War, freed slaves and other U.S. residents of African ancestry hoped that they would have full rights as citizens. But after Union troops in the South withdrew, southern state governments passed laws that restricted the rights of Black people. The laws were called “Jim Crow” laws after a character in a minstrel show, and they lasted from 1877 to the mid-1960s. They made it very difficult for Black people to vote; they also made it illegal for them to use the same restaurants, hotels, restrooms, and even water fountains as whites. [This set of laws is an example of *de jure* segregation, separation of the races by law. There was also *de facto* segregation, separation by facts, such as where people settled; this type of segregation was common in the North as well.]

In 1896, in the case of *Plessy v. Ferguson*, the Supreme Court heard arguments about laws segregating people of different races in railroad cars; the Court declared that laws requiring “separate but equal” facilities were constitutional. This ruling was not overturned until more than half a century later, when the decision in *Brown v. Board of Education* outlawed *de jure* segregation in schools and paved the way for other types of desegregation.

1. Consider the scene early in the film when Dorothy is trying to restart the stalled car and a police officer drives up.
 - What is the women’s reaction to the arrival of the officer? Why?
 - Why does he initially doubt their identities—because of their race or their gender?
 - Why does he eventually give them an escort to Langley?
 - Why does this scene have particular resonance today?
2. When one of the engineers suggests that Mary might want to be certified as an engineer, she learns that she must take night courses held at the white high school in order to do so.
 - The Supreme Court case of *Brown v. Board of Education* had declared that separate but unequal school facilities were inherently unequal. Why does Mary still have to go to court to be admitted to her classes?
 - How does she present her case to the judge? Why does he decide in her favor?
 - How do her classmates and teacher react to her entrance?



‘Eyes on the Prize’: The Civil Rights Movement in the ’50s and ’60s

Rosa Parks’s refusal to yield her seat on a bus to a white passenger in 1955 is often seen as the start of the modern civil rights movement. The year-long bus boycott that followed showed the power of nonviolent protest and brought the Reverend Martin Luther King, Jr., to national attention. Marches and protests throughout the South followed over the next decade. In Greensboro, North Carolina, four Black students sat at a Woolworth’s lunch counter to protest segregation and were soon arrested, but were followed by dozens who took their place, and eventually hundreds of student protesters joined the movement. Black and white “Freedom Riders” rode together on buses along southern highways. Voter registration drives and “Freedom Summer” teach-ins continued.

After a decade of civil disobedience in the name of basic civil rights, Congress passed and President Lyndon B. Johnson signed the Civil Rights Act of 1964 and the Voting Rights Act of 1965. The first outlawed discrimination based on race, color, religion, sex, or national origin. The second protected the right of all adult citizens to vote; although guaranteed by the 15th Amendment, the rights of Black people in the South had been denied by poll taxes, discriminatory literacy tests, and outright intimidation and violence. These laws did not end all forms of discrimination, but the federal government was now clearly committed to the enforcement of civil rights.

1. How do the protests and marches of civil rights activists occurring elsewhere in the South, and the corresponding segregationist response, influence the lives of the women at Langley and their families?



2. Dorothy stole a FORTRAN manual from the public library.
 - a. Why did she do this? Was it necessary?
 - b. How did she explain this decision to herself and to her children?
 - c. Was this an act of resistance or was it simple theft?
3. How do the women of color at Langley fight for their rightful place? How successful are they? How does their experience compare with the methods and achievements of others in the civil rights movement?

A Woman's Place...

Women in the United States had historically lagged behind men in economic and political power. While the 15th Amendment stated that a state or the federal government could not deny the right to vote to any citizen because of “race, color, or previous condition of servitude,” it said nothing about denying the vote based on gender. Only in 1920 was universal women’s suffrage brought about by the 19th Amendment. Women’s right to vote, important as it was, was not reflected in political office-holding, however. In 2016, women held less than 20 percent of Congressional seats and no woman had ever been elected president.¹

The economic power of women also suffered in comparison with men. In *Hidden Figures*, NASA was ahead of other parts of government or business in seeking out talented women. In other parts of the business world, women’s traditional occupations were often limited to secretary, teacher, or nurse. Medical and law schools, as well as other graduate schools, were often reluctant to admit women. Pay for women was (and still is, in many cases) less than that of men for the same job; the pay gap for women of color is even larger than the average.²

1. Many women who worked in West Computing had started out as teachers in segregated schools; working for NASA gave them a big pay raise in spite of the fact that they were paid less than the white women working there.
 - How did their backgrounds as teachers help them in their work?
 - Why was the extra pay important to these women?
 - What obstacles did they encounter on a daily basis simply because of their gender?
2. After the labor shortage of World War II, many women who had worked in war industries returned to domestic life, as men returned from overseas. That assignment of women to the domestic sphere was still considered ideal in the 1950s. Instead of returning to family life like many others, the “human computers” of NASA continued to work long hours at Langley in addition to caring for their families.
 - How does working at NASA affect Katherine’s family life?
 - How well do her children seem to adjust?
 - What support does she have in raising her family?
 - Why does Levi Jackson (played by Aldis Hodge) oppose Mary’s efforts to take classes to become an engineer?

¹ <http://www.cawp.rutgers.edu/current-numbers>

² <http://www.aauw.org/research/the-simple-truth-about-the-gender-pay-gap/>

The Women of West Computing

Many women were recruited to work as “human computers,” first at NACA (the National Advisory Committee for Aeronautics) and then at NASA (the National Aeronautics and Space Administration). The film *Hidden Figures* highlights three of the most prominent Black women, whose brilliance in mathematics helped to propel John Glenn into orbit. Because of their race, however, they were placed in a special unit called West Computing, and located at a distance from the other women who were doing the same type of work.

Read the biographies of each of these remarkable women at the NASA website:



Katherine Johnson
<https://www.nasa.gov/content/katherine-johnson-biography>



Mary Jackson
<https://www.nasa.gov/content/mary-jackson-biography>



Dorothy Vaughan (left) with other human computers Leslie Hunter (middle) and Vivian Adair
<https://www.nasa.gov/content/dorothy-vaughan-biography>

1. Although the film starts in 1961, the history of women who worked as “human computers” at Langley goes back to the days of World War II. A severe shortage of skilled mathematicians led to the hiring of women to supplement the male engineering force working on improving military aircraft. Do you know of any other instances when a national emergency has led to increased opportunities for women?
2. Why were the Black computer experts segregated from the white specialists?
3. What was the attitude of Mrs. Mitchell to the women of West Computing in general and to Dorothy Vaughan in particular? How did Mrs. Mitchell demonstrate this attitude? Did it eventually change? If so, how—and why?
4. Mr. Stafford, the engineer, repeatedly has Mary Jackson remove her name from reports and tells her “Computers don’t author reports.” Why was he unwilling to let her share the byline? Should her name have been on the reports? Why, or why not?

The Cold War and the Space Race

Langley Field, near Hampton, Virginia, was founded in 1917, during World War I, as part of the United States war effort, when airplanes were just coming into use as weapons of war. During World War II, Langley's wind tunnels and engineering facilities helped to make American aircraft a pre-eminent factor in winning that war.

By the late 1940s the United States and its wartime ally the Soviet Union had become enemies again, competing for prestige and for influence over the rest of the world. By 1949 the Soviet nuclear development program had been successful in building their own atomic bomb, and within a few years both nations had developed even more powerful hydrogen bombs. The "arms race" to stockpile ever more dangerous weapons was on. When the Russians launched the first satellite to orbit the Earth in 1957, U.S. citizens were shocked and horrified. Fear that the Soviets could launch an attack from space led to a massive campaign to catch up, and the National Aeronautics and Space Administration (NASA) was organized. Many engineers and mathematicians from Langley became part of this effort.



3 Janelle Monáe, who plays Mary Jackson in *Hidden Figures*, released the song "Sally Ride" in 2013.

1. The Soviets, having achieved the atomic bomb in 1949 and the more powerful hydrogen bomb in 1955, now turned to space.
 - What achievements by the Soviets led to increased urgency in the United States space program?
 - Were Americans being paranoid or did they have a legitimate reason for fearing Soviet accomplishments?
 - How does Harrison respond to the increased pressure? Are the demands he places on his team reasonable? How do they respond?
2. John Glenn was not the first American into space. He was preceded by Alan Shepard and Virgil "Gus" Grissom.
 - Why was John Glenn's flight so important to the American public?
 - There were no Black astronauts among the Mercury 7. The first Black astronaut was Guion "Guy" Bluford, who was aboard the *Challenger* space shuttle in 1983. The first American female astronaut, Sally Ride,³ flew in the same year, a full 20 years after her Soviet counterpart. Why did it take so long for the ranks of astronauts to open to Black and female candidates?
3. How did the fact that television news coverage was live influence the public's response to Glenn's flight? How did it complicate the work of NASA?
4. Read about John Kennedy's call for Americans to go to the moon at <http://history.nasa.gov/moondec.html>. (You can also listen to his speech at this site.) How did Kennedy's goal inspire Americans and affect the lives of NASA workers?

Looking at the Future: Career Choices in Science, Technology, Engineering, and Math (STEM)

1. Who are the women of NASA today? Read about some of the women currently working for NASA at <https://women.nasa.gov/>. How did they become interested in working for the space agency? What education and experience did they need to qualify for their jobs? Were the requirements any different from those men had to meet?
2. What kinds of exploration and research is NASA working on right now? Would you be interested in working for NASA? Why, or why not?
3. On a webpage about Katherine Johnson in STEM (<https://www.nasa.gov/audience/foreducators/a-lifetime-of-stem.html>), NASA suggests some lessons to learn from her life:
 - Love learning.
 - Follow your passion.
 - Accept the help you're given, and help others when you can.
 - Follow new leads and don't give up. Keep trying.
 - Go beyond the task at hand; ask questions; be inquisitive. Let yourself be heard.
 - Do what you love, and love what you do.
 - You are as good as anyone in this town, but you are no better than any of them.

What are three ways that you could apply these lessons to your own life right now?



4. Besides aerospace science, what other kinds of STEM careers might you be interested in? What kind of education do they require? Are you on the path to earn the requisite degree(s) for your career path?
5. As the story of the women in *Hidden Figures* makes clear, having a mentor in one's career can be helpful.
 - What are the qualities you would like to have in a good mentor?
 - Who has been a mentor for you in your educational and career path so far? How did he or she help you?
 - Are you mentoring anyone younger or less experienced than you now? If so, what can you pass along that would be helpful to that person?

Additional Reading and Resources

Print

Shetterly, Margot Lee. *Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race*. New York: William Morrow, 2016.

Sobel, Dava. *The Glass Universe: How the Ladies of the Harvard Observatory Took the Measure of the Stars*. New York: Viking, 2016.

Holt, Nathalia. *Rise of the Rocket Girls: The Women Who Propelled Us, From Missiles to the Moon to Mars*. New York: Little, Brown and Co., 2016.

Online

Wei-Haas, Maya. "The Forgotten Black Women Mathematicians Who Helped Send Astronauts to Space"
<http://www.smithsonianmag.com/history/forgotten-black-women-mathematicians-who-helped-win-wars-and-send-astronauts-space-180960393/>

Official site of Women@NASA
<https://women.nasa.gov/>

NASA's website on John Glenn
<https://www.nasa.gov/johnglenn>

A history of early computers
<http://www.computerhistory.org/timeline/computers/>

The U.S. Department of Education website for STEM (Science, Technology, Engineering, and Mathematics) education
<http://www.ed.gov/stem>

The White House report on STEM
<https://www.whitehouse.gov/administration/eop/ostp/women>

Recent statistics about women in STEM
<https://ngcproject.org/statistics>



Film credits

DIRECTOR: Theodore Melfi

SCREENPLAY: Allison Schroeder and Theodore Melfi, based on the book by Margot Lee Shetterly

PRODUCERS: Donna Gigliotti, Peter Chernin, Jenno Topping, Pharrell Williams, Theodore Melfi

ACTORS: Taraji P. Henson, Octavia Spencer, Janelle Monáe, Kirsten Dunst, Jim Parsons, Mahershala Ali, Aldis Hodge, Glen Powell, Kimberly Quinn, Kevin Costner, Olek Krupa

Image credits

P. 9: NASA

All other photos courtesy of 20th Century Fox

This discussion guide for the film *Hidden Figures* was written by Eileen Mattingly, Director of Education at Journeys in Film. For additional free materials to bring the world to your classroom, see <http://journeysinfilm.org>.



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