

math in hidden figures

math in hidden figures plays a pivotal role in unveiling the remarkable contributions of African American women mathematicians during the early years of NASA's space program. This article explores the intricate mathematical concepts and calculations that were essential in the success of space missions, as depicted in the story of "Hidden Figures." The narrative highlights how these women used advanced mathematics, including algebra, calculus, and analytic geometry, to solve complex problems in aerodynamics and orbital mechanics. Understanding math in hidden figures not only celebrates their intellectual achievements but also underscores the importance of mathematics in engineering breakthroughs. This article will delve into the historical context, the specific mathematical techniques applied, and the impact of these contributions on modern science and technology. Readers will gain insight into the mathematical challenges faced and overcome by these pioneering women, illustrating the profound connection between math and space exploration.

- Historical Context of Math in Hidden Figures
- Mathematical Techniques Used in Hidden Figures
- Role of Mathematics in NASA's Space Missions
- Impact of Hidden Figures on Modern STEM Fields

Historical Context of Math in Hidden Figures

The story of math in hidden figures is set against the backdrop of the 1940s through the 1960s, a period marked by rapid advancements in aerospace technology and the burgeoning space race between the United States and the Soviet Union. During this era, African American women

mathematicians at NASA—then known as NACA (National Advisory Committee for Aeronautics)—performed critical calculations that enabled successful space missions. Despite facing segregation and gender discrimination, these women excelled in mathematical fields that were crucial for aeronautical engineering and astronautics. Their work was integral to the United States' efforts in achieving milestones such as John Glenn's orbital flight. This historical context emphasizes the intersection of social challenges and scientific progress, highlighting how math in hidden figures was a tool for both empowerment and innovation.

The Social and Scientific Landscape

During the mid-20th century, racial segregation laws and gender biases limited opportunities for African American women in science and engineering. However, NASA's need for accurate and reliable mathematical computations created a demand for skilled mathematicians. The women featured in hidden figures broke barriers by mastering complex mathematical concepts and applying them to real-world problems in aerodynamics and spaceflight. Their expertise challenged prevailing stereotypes and contributed significantly to the success of missions during the space race.

The Role of Human Computers

Before the advent of electronic computers, NASA employed "human computers" to perform extensive calculations by hand or with mechanical calculators. These human computers, many of whom were African American women, used advanced mathematical techniques to process data essential for flight trajectories, speed, and fuel efficiency. The precision and accuracy of their work ensured the reliability of NASA's missions, demonstrating how foundational math was to early space exploration efforts.

Mathematical Techniques Used in Hidden Figures

The math in hidden figures encompasses a range of mathematical disciplines, including algebra, analytic geometry, calculus, and numerical methods. These techniques were applied to solve complex

problems related to aerodynamics, orbital mechanics, and flight trajectories. The women mathematicians' expertise allowed them to perform calculations that were critical for determining spacecraft launch windows, re-entry paths, and orbital insertions.

Algebra and Analytic Geometry

Algebraic equations and analytic geometry were fundamental tools for plotting flight paths and calculating trajectories. By using coordinate systems and equations of conic sections, mathematicians could model the spacecraft's orbit and predict its position at various points in time. These calculations ensured that spacecraft would maintain stable orbits and safely return to Earth, minimizing risks during missions.

Calculus and Differential Equations

Calculus played a vital role in understanding changes in velocity, acceleration, and forces acting on spacecraft. Differential equations helped model the dynamics of flight, including the effects of gravity, atmospheric drag, and thrust. Mastery of these mathematical concepts was essential for predicting the spacecraft's behavior under various conditions and making necessary adjustments to flight plans.

Numerical Methods and Computational Techniques

Since electronic computers were in their infancy, numerical methods were employed to approximate solutions to complex equations that could not be solved analytically. Techniques such as iterative methods and interpolation were used to refine calculations and improve accuracy. The mathematicians' ability to perform these computations manually or with mechanical aids was crucial to the success of early space missions.

Role of Mathematics in NASA's Space Missions

Mathematics was the backbone of NASA's space missions, enabling engineers and scientists to design spacecraft, plan trajectories, and ensure astronaut safety. The math in hidden figures highlights the indispensable contributions of mathematicians who provided the numerical foundation for mission planning and execution.

Trajectory Calculations and Orbital Mechanics

One of the most critical applications of math in hidden figures was calculating the precise trajectories needed for spacecraft to enter and maintain orbit around Earth. These calculations involved understanding gravitational forces, velocity requirements, and timing for orbital insertion. Accurate trajectory planning was essential for missions such as John Glenn's Friendship 7 flight, where human computers verified and validated electronic computer results.

Re-entry and Landing Computations

Another significant challenge was determining safe re-entry paths to ensure that spacecraft could return to Earth without burning up or crashing. Mathematical models accounted for atmospheric friction, heat dissipation, and landing coordinates. These computations required high precision and were often verified multiple times by mathematicians to guarantee mission success.

Optimization of Flight Parameters

Mathematics also enabled the optimization of flight parameters such as fuel consumption, thrust, and timing. By applying mathematical models, engineers could maximize efficiency and minimize risks. The contributions of mathematicians in refining these parameters underscored the critical role of math in mission planning and execution.

Impact of Hidden Figures on Modern STEM Fields

The legacy of math in hidden figures extends beyond NASA and space exploration, influencing modern STEM fields and promoting diversity in science, technology, engineering, and mathematics. The achievements of these mathematicians serve as a powerful example of overcoming barriers through expertise in mathematics.

Inspiration for Diversity and Inclusion

The story of hidden figures has inspired efforts to increase diversity and inclusion within STEM careers. Recognizing the mathematical brilliance of African American women mathematicians has helped challenge stereotypes and encourage underrepresented groups to pursue careers in science and engineering. Their legacy highlights the importance of equal opportunities and representation in advancing scientific progress.

Advancements in Computational Mathematics

The early work of human computers laid the groundwork for the development of modern computational mathematics and computer science. Techniques developed during that era have evolved into sophisticated algorithms and software used today in aerospace engineering, data analysis, and simulation. The foundational math in hidden figures remains relevant in contemporary technological applications.

Educational Influence

The narrative of math in hidden figures has influenced educational curricula, encouraging the integration of history, mathematics, and social studies to provide a holistic understanding of scientific achievements. This multidisciplinary approach enriches students' learning experiences and fosters appreciation for the societal impact of mathematics.

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Frequently Asked Questions

What role does math play in the movie 'Hidden Figures'?

Math is central to 'Hidden Figures' as it highlights the crucial contributions of African-American female mathematicians who performed complex calculations essential for NASA's space missions.

Who are the main mathematicians featured in 'Hidden Figures' and what were their contributions?

The main mathematicians are Katherine Johnson, Dorothy Vaughan, and Mary Jackson. Katherine Johnson calculated flight trajectories, Dorothy Vaughan specialized in programming early computers, and Mary Jackson worked on engineering and aerodynamic calculations.

How did Katherine Johnson's mathematical skills impact the success of John Glenn's orbital mission?

Katherine Johnson verified the computer-generated trajectories and calculations for John Glenn's mission, ensuring the accuracy and safety of the spacecraft's orbit and re-entry, which was critical for the mission's success.

What types of mathematical concepts are demonstrated in 'Hidden Figures'?

The film demonstrates concepts such as orbital mechanics, trajectory analysis, calculus, algebra, and numerical methods used in aerospace engineering and computer programming.

How did the use of computers change the role of mathematicians at NASA as depicted in 'Hidden Figures'?

Computers began automating complex calculations, but mathematicians like Dorothy Vaughan transitioned to programming and supervising computer operations, blending traditional math skills with emerging technology.

Why is 'Hidden Figures' significant for promoting the importance of mathematics in STEM fields?

'Hidden Figures' showcases how mathematical expertise is vital in solving real-world problems, breaking racial and gender barriers, and inspiring future generations to pursue careers in STEM.

Additional Resources

1. *Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race*

This groundbreaking book by Margot Lee Shetterly tells the inspiring true story of African-American women mathematicians at NASA. The narrative highlights their crucial contributions to the Space Race during the 1940s through the 1960s. It reveals how these women overcame racial and gender barriers to shape history in science and mathematics.

2. *The Mathematics of Hidden Figures: The Calculations that Launched a Space Race*

This book delves into the specific mathematical techniques and calculations used by the

mathematicians featured in *Hidden Figures*. It explains concepts like orbital mechanics, trajectory analysis, and numerical methods in an accessible way. Readers gain insight into the practical applications of math in space exploration.

3. Code Breakers and Number Crunchers: The Math Behind Hidden Figures

Focusing on the computational aspects, this book explores the role of human computers before the age of digital machines. It highlights how women mathematicians performed complex calculations by hand to solve critical engineering problems. The text also covers the transition from manual to electronic computing.

4. Women in Mathematics: From Hidden Figures to Modern Innovators

This inspiring volume traces the history of women mathematicians from the era depicted in *Hidden Figures* to present-day pioneers. It discusses challenges faced and breakthroughs achieved by women in the field of mathematics. The book encourages young readers to pursue STEM careers by showcasing diverse role models.

5. Mathematical Pioneers: Stories of Black Women in STEM

This collection of biographies focuses on Black women mathematicians and scientists beyond those featured in *Hidden Figures*. It emphasizes their contributions to mathematics, physics, and engineering. Each story highlights perseverance, innovation, and the impact of their work on society.

6. The Geometry of Space: Understanding the Mathematics Behind Hidden Figures

This educational book explains the geometric principles essential to space flight, such as conic sections and coordinate transformations. By connecting these ideas to the work of NASA's mathematicians, it provides a deeper appreciation of the math involved. The book includes diagrams and exercises for learners.

7. From Calculations to Computers: The Evolution of Mathematical Tools in Hidden Figures

Detailing the technological advancements during the mid-20th century, this book covers the shift from slide rules and hand calculations to early computers. It explores how this evolution impacted the work of the mathematicians at NASA. The narrative combines historical context with technical explanations.

8. *NASA's Secret Mathematicians: Unsung Heroes of the Space Age*

This book uncovers lesser-known stories of the mathematicians who contributed to NASA's success. It highlights their mathematical expertise, problem-solving skills, and determination. Readers learn about the collaborative environment and groundbreaking projects behind the scenes.

9. *Calculus and Cosmic Journeys: The Math that Propelled Hidden Figures*

This title focuses on the role of calculus in solving real-world problems faced during the Space Race. It breaks down how derivatives and integrals were applied to trajectory calculations and velocity analysis. The book aims to make advanced mathematics accessible through historical examples.

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