



Katherine Johnson: Hidden Figure

Objectives:

By the end of the lesson, students will be able to:

1. Know that Katherine Johnson:
 - a) Possessed good character traits that helped her achieve a successful career at NASA.
 - b) Calculated the path to land Alan Shepard's May 1961 mission Freedom 7, the first human spaceflight.
 - c) Verified the electronic computer calculation, at the request of John Glenn who became the first U.S. astronaut to orbit Earth.
 - d) A part of the team that sent the first three men to the Moon.
2. Recognize that math is used in everyday life and is also useful for performing complex calculations to achieve space flights and build structures.

Materials Needed:

1. Famous Structures of the World worksheet (Provided):
<https://technologystudent.com/PDF3/struck1.pdf>
2. A reward

Vocabulary

- National Advisory Committee for Aeronautics (NACA)
- West Area Computing
- Segregated
- Character

Subject Area: Black History, Social Studies, Women's History, World History, Career Exploration

Bloom Taxonomy	Affective Domain	Gardner's Multiple Intelligences
<ul style="list-style-type: none"> • Knowledge • Understanding • Application • Analysis 	<ul style="list-style-type: none"> • Receiving • Responding • Valuing • Organizing 	<ul style="list-style-type: none"> • Audio • Linguistic • Interpersonal

Background on Katherine Johnson

- Katherine Johnson was born on August 26, 1918, in White Sulphur Springs, West Virginia, U.S.
- Katherine was an extremely gifted child. When **she was just 10 years old, she attended high school.**
- **By the age of 18, Katherine graduated with the highest honors from West Virginia State College** (now West Virginia State University), with bachelor's degrees in mathematics and French.
- **Katherine enrolled in a graduate program at West Virginia University** in 1939 making her one of the first three Black students to enroll. There, she studied math but decided to leave to marry James Goble and to start a family. In 1956, James Goble died of cancer and she later married James Johnson.
- Katherine began working at the **National Advisory Committee for Aeronautics (NACA)'s West Area Computing** unit in 1953.
- **The National Advisory Committee for Aeronautics (NACA)** and the **West Area Computers** were segregated which mandated the Black women to use separate bathrooms and dining facilities.
- **Katherine also became a member of the Space Task Group** and as a result, **she authored or coauthored 26 research reports** during her career which was the **first time a member of the West Area Computers received credit as an author of the research report.**
- In 1961, **Katherine calculated the path to land Alan B. Shepard, the first U.S. astronaut in space, on board the Freedom 7 spacecraft.**
- In 1962, **Katherine verified the electronic computer calculation, at the request of John Glenn** who became the first U.S. astronaut to orbit Earth.
- 1969, **Katherine was also part of the team that calculated where and when to launch the rocket for the Apollo 11, a mission that sent the first three men to the Moon.**
- Katherine retired from NASA in 1986 and died on February 24, 2020.

Source: <https://www.britannica.com/biography/Katherine-Johnson-mathematician>

Background on National Advisory Committee for Aeronautics (NACA)

- National Advisory Committee for Aeronautics (NACA) was established in 1915, 43 years before NASA.
- The role of NACA was to conduct aeronautics research, conduct experiments, and perform flight tests and simulations which led to major efforts and contributions in both World War I and World War II.

Source: <https://www.nasa.gov/ames/the-national-advisory-committee-for-aeronautics>

West Area Computers

- The **West Area Computing unit** was a group of Black women who manually performed complex mathematical calculations for the program's engineers.
- These Black women were known as West Computers. **These women analyzed test data and provided mathematical computations that were extremely necessary for the early U.S. space program.**

Source: <https://www.britannica.com/biography/Katherine-Johnson-mathematician>

The Great Pyramids of Giza

- The Great Pyramids of Giza are **located on the plateau on the west bank of the Nile River**, on the outskirts of modern-day Cairo.
- The oldest and largest of the three pyramids at Giza are known as **the Great Pyramids which is the only surviving structure** out of the famed Seven Wonders of the Ancient World.
- The Great Pyramids **were built for Pharaoh Khufu (Cheops, in Greek) Sneferu's successor** and the second of the eight kings of the fourth dynasty.
- The sides of the **pyramid's base average 755.75 feet (230 meters) and the original height was 481.4 feet** making it **the largest pyramid in the world.**

Source: <https://www.history.com/topics/ancient-history/the-egyptian-pyramids>

Introduction/Motivation:

- Say to students, “Math is everywhere! For the next 5-10 minutes I want you to describe ways that math is used daily.” Students can work individually or work in groups.
- After 5-10 minutes discuss as a class.
- Chart the information to describe how many students thought of similar ways math is used every day. For example:

Money	Cooking	Sports	Building	Shopping	Travel	Time	Fashion
Budget	Measuring	Scores	Renovation		Maps	Dates	Design
Stats		Exercising	Technology		Driving		Music
			Computers		Forecast		Dance

- Share with students that math is also used to calculate space flights.
- Share with students in the 1950s, the **National Advisory Committee for Aeronautics (NACA)** used mathematics to conduct space flights.
- Discuss **NACA** and the **West Area Computer**.
- Share with students, “Today we are going to learn about a woman who worked at the West Area Computers department of the National Advisory Committee for Aeronautics (NACA) and used complex mathematic calculations to achieve space flight. This woman’s name is **Katherine Johnson**.”

Introduction for Older Students:

- Print/Share **Famous Structures of the World** worksheet:
- <https://technologystudent.com/PDF3/struck1.pdf>
- <https://technologystudent.com/struct1/wlrdr1.htm>
- Tell students, “You have 2-3 minute to complete the **Famous Structures of the World** worksheet. The person who answers the most questions correctly wins a prize (teacher’s choice)”

Once the 2-3 minutes are up, review the correct answers and decide who earned the prize.

- Focus student’s attention on The Great Pyramids of Giza, number 4 on the Famous Structures of the World worksheet. Describe the background of the Great Pyramids.

- Ask students, “How were the Great Pyramids built?”
- Entertain all student’s response and say to them , “The **designers of the pyramids used math** to construct the correct height, width and size of the stones and material.
- Share with students **that modern-day architects use math** to:
 - Design images on drawing that can be used in construction to build that image for everyone to see
 - Analyze and calculate structural problem so that the structure will remain stable
 - Describe sizes and shapes of pieces of the design
- Share with students, “**Math is also used to calculate complex calculations to achieve space flights and today we’re going to learn about a woman who:**
 - Manually calculated the path to land Alan B. Shepard, the first U.S. astronaut in space, on board the Freedom 7 spacecraft
 - Verified the electronic computer calculation, at the request of John Glenn who became the first U.S. astronaut to orbit Earth.
- Share with students, that the women we are going to learn about is **Katherine Johnson**.

Body

- Review the **National Advisory Committee for Aeronautics (NACA)**.
- Review the **West Area Computers**, a unit was a group of Black women who manually performed complex mathematical calculations for the program’s engineers.

Activity 1# Your Good Character Means Everything!

Part 1#

- Introduce students to the word, “**character**” by first asking a few students to name their favorite superhero.
- Afterwards, have students describe him/her. Make a list of behaviors and/or traits.
- Share, “... a person’s character is shown by how they act, think, and feel in life. Character isn't one thing; it's the sum of how someone usually interacts with others and how they treat themselves.” (Takingtreebooks)
- For additional visual/video, watch, “**What is character?**” with students.
<https://www.youtube.com/watch?v=G1YeaOh4gHQ>

Part 2#

- Show movie clip of Hidden Figures to introduce students to **Katherine Johnson**:
<https://www.youtube.com/watch?v=1dO8pvpWTaY>
 - Describe Katherine Johnson character with students. Does she seem angry, shy, scared, brave, or confident? If students are unfamiliar with confident, define it for them.
 - Make a list of Katherine Johnson's character
- Share with students that Katherine Johnson's good character helped to:
 - Calculate the path to land Alan B. Shepard, the first U.S.
 - Verify the electronic computer calculation, at the request of John Glenn who became the first U.S. astronaut to orbit Earth.

Part 3# Art Project

- Ask students, "What kind of job do you want when you grow up?" Describe the **character** you will need to keep the job. For example, "If you want to be a doctor, what kind of character should you have?"
- Show students the **Character Development Table (provided)**.
- For younger students, review the list of word on the **Character Development Table** and give examples
- Have students find a picture of the career, the dream job, or profession they want when they grow up. They can use the internet, search through a book or a magazine. **An example is provided.**
- Students should list or describe the character they think is needed for the job.

Career Exploration

- For older students, share with them your journey to become an educator. Your journey should include **experiences** and **character traits** that led you to become an educator.
- Using the **Career Exploration Interview page provided**, have students conduct an interview with someone who is working in their dream job or career they would like to have.
- The details of the interview should be presented through a visual aid in front of the class.

Links:

Egyptian Pyramids <https://www.history.com/topics/ancient-history/the-egyptian-pyramids>

How to Build a Pyramid <http://www.ldolphin.org/pyramid.html>

Math Matters: Ways math is used everyday <https://www.niu.edu/mathmatters/everyday-life/index.shtml#:~:text=People%20use%20math%20knowledge%20when,2%2F3%20of%20a%20cup>.

Ways math is used every day: <https://www.imaginelearning.com/blog/2017/04/math-real-life-examples>

What is good character? <https://talkingtreebooks.com/teaching-resources-catalog/definitions/what-is-character-definition.html>

Ways math is used every day: <https://studiousguy.com/examples-of-mathematics/>

Character Development Table	
Good	Bad
Courteous	Impolite
Determined	Unsure
Friendly	Unfriendly
Hard-working	Lazy
Humble	Proud
Generous	Selfish
Punctual	Late
Respectful	Rude
Brave	Coward
Loyal	Rebellious
Perseveres	Gives up easily
Considerate	Inconsiderate
Honest	Dishonest
Kind	Mean
Sincere	Insincere

Source <https://www.pinterest.com/pin/69172544252713762/>

3# Art Project Example



If I want to be a successful doctor, I must be...

Career Exploration Interview

Directions: Think about the career you would like to have or the job you would like to have when you get older. Interview someone in that career or job you would like to have. You must present the results of the interview in front of the class through a visual aid of your choosing.

Interview Questions

- The questions should include but are not limited to the following:
 - Tell me about your job.
 - This should include the interviewee's job title and company.
 - How long have you been at your job and in that career?
 - Did you go to college? If so, what did you study? If not, why not?
 - What type of good character traits do you need to be successful at your job or career?
 - How does having a good character affect your job? Can you give an example?
 - How would a bad character affect your job?
 - What advice would you have for someone who is interested in working at your job/in your career?



Answer the reflection questions in your presentation:

- What did you learn about the job or the career?
- After the interview, are you more interested in the job or career or less interested?