Name: _____ Date: _____

Vocabulary: The Language of Space

Katherine Johnson loved numbers. As a child she counted everything around her, and she was so far ahead in math that she skipped several grades. She grew up to do the math that sent astronauts into space. The six words below will help you understand her story in *A Computer Called Katherine*.

Six Words for Katherine's Story		
Word	**What it means**	**How it connects to Katherine**
computer (human)	A person whose job is to solve math problems by hand, quickly and correctly.	Katherine was hired as a human computer at Langley, where she worked through long calculations all day.
mathematician	A person who is an expert in math and uses math in their work.	Katherine was such a strong mathematician that she skipped several grades and started high school at age 10.
trajectory	The path an object travels through space.	Katherine calculated the trajectory for Alan Shepard's 1961 flight so his capsule would follow the right path and come home safely.
orbit	To travel in a curved path around a planet or another object in space.	In 1962 John Glenn asked Katherine to check the numbers before he became the first American to orbit Earth.
NASA	The United States agency that runs the country's space program.	Katherine worked at NASA, where she did math for missions including the Apollo 11 landing on the Moon.
segregation	The practice of keeping people of different races apart in schools, buses, and workplaces.	Because of segregation, Katherine first worked in a separate computing unit at Langley.

Check for Understanding

Draw a line from each word on the left to the picture or situation it describes on the right.

Word	Picture or Situation
computer (human)	A drawing of a small arrow curving all the way around a globe and coming back to where it started.
mathematician	A sign on a building that reads "Space Program Headquarters, United States."
trajectory	A person at a desk with a stack of paper, solving long problems by hand before any machine does.
orbit	A dotted line rising from a launch pad, arcing through the sky, and landing in the ocean.
NASA	Two water fountains side by side, with a sign saying who may use each one.
segregation	A person who works with numbers every day and is an expert in math.

1. At Langley, Katherine solved long math problems by hand, all day, before electronic machines did the work. Which word from the table names the job she was hired to do?

A) segregation
B) trajectory
C) computer (human)
D) mathematician

2. Choose two words from the table. Write one sentence that uses both words to tell about Katherine's life.

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Study Guide: Katherine's Calculations

Katherine Johnson grew up loving numbers. She counted everything around her and solved problems faster than most adults. In *A Computer Called Katherine* by Suzanne Slade, you read how that love of numbers took her from a small town in West Virginia to NASA, where her math helped send astronauts into space and bring them safely home. Use the questions below to think back over her life and work.

Words to Know

human computer — a person whose job was to solve math problems by hand, before machines did the work.
trajectory — the path an object takes as it moves through space.
orbit — the curved path one object follows as it travels around a larger object, like a spacecraft going around Earth.
NASA — the United States agency that runs the country's space program.
segregation — the practice of keeping people of different races apart in schools, jobs, and public places.

Part 1: Katherine's Life and Work

Answer each question in complete sentences. Go back to the book if you need to check a detail.

1. Katherine's family moved from White Sulphur Springs to Institute, West Virginia. Why did her parents make that move?

2. Why was Katherine called a "human computer"?

3. Before John Glenn's 1962 flight, he asked Katherine to check the computer's numbers by hand. What did he say about her work, and what does that tell you about how much people trusted her?

4. Katherine faced barriers because of her race and because she was a woman. Describe two of those barriers and explain how she kept going anyway.

5. Besides John Glenn's flight, name two other space projects Katherine worked on.

Part 2: Math in Action — What Is a Trajectory?

A **trajectory** is the path an object takes as it moves through space. You already know about trajectories. Toss a ball to a friend and watch it: it rises, curves, and comes down in an arc. That arc is the ball's trajectory.

A spacecraft's path works the same way, but the numbers matter far more. Before a rocket ever leaves the ground, mathematicians plan its whole path. They figure out how fast it must go, which way it must tilt, and exactly when it must fire its engines to come back down in the right place. If the numbers are a little off, the spacecraft can miss its landing spot by hundreds of miles — or worse.

Katherine Johnson worked out these paths by hand, and she checked the paths that machines worked out. When John Glenn was about to orbit Earth, he wanted her to check the numbers before he would fly. Her math helped astronauts leave Earth and, just as important, come home again.

6. In your own words, what is a trajectory? Use the ball or the spacecraft in your explanation.

7. Why did Katherine's math have to be perfect for the astronauts to come home safely? Use the idea of a trajectory in your answer.

8. Computers could already do math when John Glenn flew. Why do you think Glenn still wanted a person to check the machine's numbers? Explain your thinking.

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Answer Key

This key covers both activities in the packet: **Vocabulary: The Language of Space** and **Study Guide: Katherine's Calculations**. Items are numbered exactly as students see them.

Vocabulary: The Language of Space

Part A — Six Words for Katherine's Story (table)

1. **computer (human)** — A person whose job is to solve math problems by hand, quickly and correctly. *Connection:* Katherine was hired as a human computer at Langley, where she worked through long calculations all day.
2. **mathematician** — A person who is an expert in math and uses math in their work. *Connection:* Katherine was such a strong mathematician that she skipped several grades and started high school at age 10.
3. **trajectory** — The path an object travels through space. *Connection:* Katherine calculated the trajectory for Alan Shepard's 1961 flight so his capsule would follow the right path and come home safely.
4. **orbit** — To travel in a curved path around a planet or another object in space. *Connection:* In 1962 John Glenn asked Katherine to check the numbers before he became the first American to orbit Earth.
5. **NASA** — The United States agency that runs the country's space program. *Connection:* Katherine worked at NASA, where she did math for missions including the Apollo 11 landing on the Moon.
6. **segregation** — The practice of keeping people of different races apart in schools, buses, and workplaces. *Connection:* Because of segregation, Katherine first worked in a separate computing unit at Langley.

Part B — Check for Understanding: Matching

1. **orbit** → A drawing of a small arrow curving all the way around a globe and coming back to where it started.
2. **NASA** → A sign on a building that reads "Space Program Headquarters, United States."
3. **computer (human)** → A person at a desk with a stack of paper, solving long problems by hand before any machine does.
4. **trajectory** → A dotted line rising from a launch pad, arcing through the sky, and landing in the ocean.
5. **segregation** → Two water fountains side by side, with a sign saying who may use each one.
6. **mathematician** → A person who works with numbers every day and is an expert in math.

Common error: Students often pair **trajectory** with the globe picture because both involve a path. Remind them that *orbit* is the closed loop all the way around a planet, while *trajectory* is the launch-to-landing arc.

Part C — Multiple Choice and Sentence Writing

1. C. computer (human) — The question asks for the *job* Katherine was hired to do: solving long calculations by hand before machines did the work.

- A (*segregation*) names the practice of keeping races apart, not a kind of work.
- B (*trajectory*) names the path a spacecraft travels, not a person's job.
- D (*mathematician*) describes a person who is an expert in math, but it does not name the job of solving calculations by hand.

2. Answers will vary. The sentence must use **two** words from the table correctly. Sample: *Because of segregation, Katherine first worked in a separate unit at NASA, but her work as a mathematician soon earned her a place on mission teams.*

Look for: both words used with their correct meaning, and a fact about Katherine's life that matches the table.

Study Guide: Katherine's Calculations

Part 1 — Katherine's Life and Work

1. Her parents moved the family to Institute, West Virginia, so their children could attend better schools. Schools for African American children in the segregated South were often underfunded and offered few opportunities, so the move gave Katherine the chance to keep learning. In Institute she thrived, skipped several grades, and started high school at age 10.

2. Before electronic computers did the work, people were hired to solve long math problems by hand. Katherine was hired at Langley as a human computer, and she was known for calculations that were fast, precise, and reliable — so accurate that astronauts trusted her numbers over the machine's.

3. Glenn said, **"If she says they're good, then I'm ready to go."** He asked Katherine to personally recheck the computer's calculations before his 1962 orbital flight, and she manually checked the orbital equations. This shows how much trust and confidence Glenn and her colleagues had in her — he was willing to launch based on her word.

4. Answers will vary in wording; accept any **two** barriers, such as:

- **Segregation:** she worked in the segregated West Area Computing unit, separated from her white colleagues.
- **Gender:** she entered a field that was predominantly male and hesitant to accept her.
- **Unequal schooling:** schools for African American children were underfunded, and few universities accepted African American students.
  She kept going through her own determination and love of learning, her family's support (including the move to Institute), and mentors such as Dr. William W. Schieffelin Claytor, who encouraged her to pursue higher mathematics. Her precise work eventually earned her the respect of her peers and pushed her into more collaborative roles.

5. Any **two** of: Alan Shepard's 1961 Mercury flight (*Freedom 7*), the Apollo 11 mission that landed the first humans on the Moon in 1969, planning for the Space Shuttle program, and the Earth Resources Technology Satellite (later renamed Landsat).

Common error: Students sometimes name John Glenn's 1962 flight here. The question says *besides* Glenn's flight, so that answer does not count.

Part 2 — Math in Action: What Is a Trajectory?

6. Answers will vary. Sample: *A trajectory is the path an object takes as it moves through space. When you toss a ball to a friend, it rises, curves, and comes down in an arc — that arc is the ball's trajectory. A spacecraft's path is also a trajectory, but mathematicians plan it ahead of time by working out how fast it must go, which way it must tilt, and when to fire its engines.*

Look for: the idea of a **path** through space, plus the ball or the spacecraft used as the example.

7. Answers will vary. Sample: *Katherine's math had to be perfect because the trajectory decides exactly where and when the spacecraft comes down. If the numbers are off even a little, the spacecraft can miss its landing spot by hundreds of miles — or worse — and the astronauts might not come home safely. Her calculations were the plan for the whole path, so an error in the math was an error in the path.*

Look for: a link between the accuracy of the numbers and the safe return along the trajectory.

8. Answers will vary. Sample: *Glenn trusted Katherine more than the machine. Computers can make mistakes, and a person who checks the numbers by hand can catch an error before it matters. Glenn said, "If she says they're good, then I'm ready to go," which shows he wanted a careful person to confirm the numbers before he would fly.*

Look for: a reason connected to trust in her accuracy or to catching a machine's error.