

Sputnik and the Origins of the Space Race

BASED ON THE UNTOLD TRUE STORY

HIDDEN FIGURES



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



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About *Journeys in Film*

Founded in 2003, *Journeys in Film* operates on the belief that teaching with film has the power to prepare students to live and work more successfully in the 21st century as informed and globally competent citizens. Its core mission is to advance global understanding among youth through the combination of age-appropriate films from around the world, interdisciplinary classroom materials coordinated with the films, and teachers' professional-development offerings. This comprehensive curriculum model promotes widespread use of film as a window to the world to help students to mitigate existing attitudes of cultural bias, cultivate empathy, develop a richer understanding of global issues, and prepare for effective participation in an increasingly interdependent world. Our standards-based lesson plans support various learning styles, promote literacy, transport students around the globe, and foster learning that meets core academic objectives.

Selected films act as springboards for lesson plans in subjects ranging from math, science, language arts, and social studies to other topics that have become critical for students, including environmental sustainability, poverty and hunger, global health, diversity, and immigration. Prominent educators on our team consult with filmmakers and cultural specialists in the development of curriculum guides, each one dedicated to an in-depth exploration of the culture and issues depicted in a specific film. The guides merge effectively into teachers' existing lesson plans and mandated curricular requirements, providing teachers with an innovative way to fulfill their school districts' standards-based goals.

Why use this program?

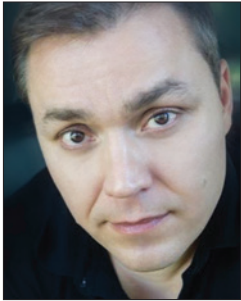
To be prepared to participate in tomorrow's global arena, students need to gain an understanding of the world beyond their own borders. *Journeys in Film* offers innovative and engaging tools to explore other cultures and social issues, beyond the often negative images seen in print, television, and film media.

For today's media-centric youth, film is an appropriate and effective teaching tool. *Journeys in Film* has carefully selected quality films that tell the stories of young people living in locations that may otherwise never be experienced by your students. Students travel through these characters and their stories: They drink tea with an Iranian family in *Children of Heaven*, play soccer in a Tibetan monastery in *The Cup*, find themselves in the conflict between urban grandson and rural grandmother in South Korea in *The Way Home*, watch the ways modernity challenges Maori traditions in New Zealand in *Whale Rider*, tour an African school with a Nobel Prize-winning teenager in *He Named Me Malala*, or experience the transformative power of music in *The Music of Strangers: Yo-Yo Ma & the Silk Road Ensemble*.

In addition to our ongoing development of teaching guides for culturally sensitive foreign films, *Journeys in Film* brings outstanding documentary films to the classroom. *Journeys in Film* has identified exceptional narrative and documentary films that teach about a broad range of social issues in real-life settings such as famine-stricken and war-torn Somalia, a maximum-security prison in Alabama, and a World War II concentration camp near Prague. *Journeys in Film* guides help teachers integrate these films into their classrooms, examining complex issues, encouraging students to be active rather than passive viewers, and maximizing the power of film to enhance critical thinking skills and to meet the Common Core Standards.

Journeys in Film is a 501(c)(3) nonprofit organization.

A Letter From Theodore Melfi



When you find a career you love, fame is far from your mind. Passion, excitement, and challenging work are instead the driving factors that motivate on a daily basis. Such is the case for Katherine G. Johnson, Dorothy Vaughan, and Mary Jackson—the

brilliant trio of African-American women working at NASA in the early 1960s—who helped serve as the brains behind one of the greatest operations in history: the Mercury space missions, culminating in the launch of astronaut John Glenn into orbit.

For decades, until the publication of Margot Lee Shetterly's book *Hidden Figures*, the story of Johnson, Vaughan, and Jackson, NASA's so-called "human computers," went untold. But when their story crossed my path—a story that blurs gender, race, and professional lines—I knew this was a part of history that had to be told. Fifty-five years later, *Hidden Figures* is a rich and moving true story that deserves a spot in our collective consciousness.

The backdrop for the movie is one of the most defining, complex periods in American history: the high-stakes Cold War, the space race, the Jim Crow South and the birth of the civil rights movement. Exploring these historic events serves as a reminder that we must learn from our past experiences while continuing to catapult ourselves forward.

It was also important for me, as a son raised by a single mother and as the father of two daughters, to explore the importance of STEM as a compelling and viable career choice for young girls. The media, cinema, and other public discourse often do society a disservice by not presenting strong, independent women in the fields of science, technology, engineering and

math on a regular basis. Drawing attention to these figures, often hidden in plain sight, will hopefully help to chart a new course for female students and change the composition of these vital industries.

At its core, *Hidden Figures* is the story of three remarkable women who overcame every obstacle stacked against them, despite gender, race, and the political landscape of the time. Illuminating this universal experience for the next generation was critical. My goal was to showcase how skill and knowledge are equalizers, how hard work and determination are the cornerstones to every pursuit, and how uniting under a common goal is more powerful than staying divided.

Johnson, Vaughan, and Jackson were pioneers who broke down commonly held perceptions and achieved something phenomenal. Their legacy of persistence serves to empower people of all circumstances and teaches us, as NASA points out in its webpage on Katherine Johnson,

- To love learning.
- To follow your passion.
- To accept the help you're given, and help others when you can.
- To follow new leads and don't give up. Keep trying.
- To go beyond the task at hand; ask questions; be inquisitive. Let yourself be heard.
- To do what you love, and love what you do.

I hope that through the exploration of *Hidden Figures*—and your own passions—you, too, will achieve the seemingly impossible.

Theodore Melfi

Director, *Hidden Figures*

Introducing *Hidden Figures*

Space exploration in the modern age is entering a new phase, replete with private space companies, prospective lunar tourism, and even projected travel to Mars, the closest planet in our solar system. It is fitting, therefore, to pause to look back at the early years of the United States space program, and particularly the early efforts to launch astronauts into orbit, a preliminary step toward a moon landing.

Hidden Figures tells us about a generally unheralded group of women whose brilliance and dedication provided a foundation for the space program—the Black women known as “human computers” who worked at the NASA Center in Langley, Virginia. Faced with obstacles to their own education and to job prospects because of race and gender, these women succeeded in earning places and eventually respect in a workplace dominated by male supervisors and colleagues, many of whom were reluctant to hire women, and marked by segregated facilities, from office to restroom, that reflected the pre-civil rights era.

Katherine Johnson, physicist and mathematician, calculated the orbits, trajectories, and launch windows that would put John Glenn and others into space and bring them back safely. Dorothy Vaughan, another mathematician, became the first African-American supervisor at NASA, learning the computer language FORTRAN on her own and teaching it to her staff. Mary Jackson, an aerospace engineer as well as a mathematician, had to go to court to earn the right to take graduate-level courses at a previously all-white school; she eventually also served as a program officer helping other women succeed at NASA.

Their story is also the story of the world in which they lived and worked—the racism and segregation that made their lives more difficult; the beginnings of the civil rights movement in the South; the Cold War with Russia that gave such impetus to the drive for superiority in space; and the space race itself. The film weaves these events into the dramatic personal stories with skill and accuracy, making it an ideal film for the classroom. It is sure to serve as inspiration to many young women considering a career in science and mathematics.

Hidden Figures has been nominated for many awards, including the Academy Awards, BAFTA, the Golden Globes, the NAACP Image Awards, the Screen Actors Guild, and the African-American Film Critics Association.

Film credits

DIRECTOR: Theodore Melfi

SCREENPLAY: Allison Schroeder and Theodore Melfi, based on the book with the same title 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

Sputnik and the Origins of the Space Race

Enduring Understandings

- Both competition and cooperation can spur innovation in space exploration.
- The National Aeronautics and Space Administration (NASA) was founded largely as a response to the Russian launching of a space satellite called Sputnik.
- Beginning in the 1980s, competition in space gave way to cooperation, particularly with the International Space Station.

Essential Questions

- What are the advantages of competition when one is trying to achieve a goal? What are the advantages of cooperation?
- How did the United States respond to the launching of Sputnik I?
- Why and how has competition in space morphed into cooperation?

Notes to the Teacher

The film *Hidden Figures* takes place during a time when the United States was involved in a tense Cold War with the Soviet Union in the 1950s and 1960s. From July 1957 to December 1958, the scientific community tried to bring the post-WWII countries together in peace for the worldwide event known as the International Geophysical Year (IGY). During the IGY, the Soviets launched Sputnik, the first man-made satellite to orbit the Earth, on October 4, 1957. The success of Sputnik was widely hailed as a scientific achievement, but also feared as a demonstration of Soviet political strength. From these anxieties, the space race was born.

The initial reactions to Sputnik in the United States were complex. For example, many in the Eisenhower administration feared that the Soviets' ability to launch satellites meant that they were capable of launching nuclear missiles from Europe to the United States. However, some surveys showed that public concern over Sputnik's significance was not great.

World reactions to Sputnik were also mixed. In India, for example, many saw the Soviet Union as the definitive world scientific leader. In Europe, however, many felt that this was a temporary glitch and that, in general, American scientific technology was superior to the that of the Soviets.

By 1958, the United States had formed the National Aeronautics and Space Administration (NASA), with the goal of sending a human into space, orbiting the Earth, and eventually landing on the moon. Katherine Johnson and the other "human computers" featured in *Hidden Figures* played an integral part in NASA's success.

Relations between the United States and Russia have historically been very complex with the rise and fall of political tensions, however, cooperation with Russian scientists became a hallmark of the space program. The NASA website at https://www.nasa.gov/mission_pages/station/expeditions/index.html lists the current occupants of the International Space Station and provides details of past expeditions. Explore the ISO Standards website (<https://www.iso.org/home.html>) to help prepare for this discussion.

In this lesson, students begin with an exercise in competition and cooperation, with a small and appropriate prize to be awarded to the “winner.” Be sure you have enough small prizes on hand for all students, since eventually all players will win. This is followed by a guided reading on the International Geophysical Year, the launch of Sputnik, and the U.S. reaction. Students working in six “expert” teams then complete additional research on these and other topics in the early years of space research; they then share their research with others in a jigsaw exercise. Plan your “home” groups beforehand so that at least one member of each “expert” team will be present in each group. For more information about using jigsaws in the classroom, see “Using the Jigsaw Cooperative Learning Technique” at <http://www.readwritethink.org/professional-development/strategy-guides/using-jigsaw-cooperative-learning-30599.html>.

The lesson concludes with a discussion with students about how competition eventually gave way to collaboration and cooperation, using a NASA website about the current crew of the International Space Station. Explore the ISO Standards website (<https://www.iso.org/home.html>) to help prepare for this discussion.

Another helpful article for the discussion of advantages of such cooperation is “The Case for Managed International Cooperation in Space Exploration” at web.mit.edu/adamross/www/BRONIATOWSKI_ISUo7.pdf, which summarizes the arguments for cooperation neatly. You may wish to assign this article for your more advanced students.

Some suggested online resources for further research:

The Manuscript and Audiovisual Archives of the Eisenhower Presidential Library: https://www.eisenhower.archives.gov/research/online_documents.html

NASA History Program Office: <https://history.nasa.gov/>

COMMON CORE STANDARDS ADDRESSED BY THIS LESSON

ENGLISH LANGUAGE ARTS STANDARDS » HISTORY / SOCIAL STUDIES

CCSS.ELA-LITERACY.RH.11-12.2

Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas.

CCSS.ELA-LITERACY.RH.11-12.3

Evaluate various explanations for actions or events and determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain.

CCSS.ELA-LITERACY.RH.11-12.7

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.

CCSS.ELA-LITERACY.RH.11-12.9

Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.

COMMON CORE STANDARDS ADDRESSED BY THIS LESSON

ENGLISH LANGUAGE ARTS STANDARDS » WRITING

CCSS.ELA-LITERACY.WHST.11-12.1

Write arguments focused on discipline-specific content.

CCSS.ELA-LITERACY.WHST.11-12.1.A

Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.

CCSS.ELA-LITERACY.WHST.11-12.1.B

Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.

CCSS.ELA-LITERACY.WHST.11-12.1.c

Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

CCSS.ELA-LITERACY.WHST.11-12.4

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCSS.ELA-LITERACY.WHST.11-12.9

Draw evidence from informational texts to support analysis, reflection, and research.

Duration of the Lesson

Three or four class periods, plus time to research and to write the final essay

Assessment

Class discussions

Completion of **HANDOUT 1: THE LAUNCH OF SPUTNIK AND THE ORIGINS OF NASA**

Participation in “expert” and “home” group activity

Short essay

Materials

Trailer of film *Hidden Figures* at <http://www.foxmovies.com/movies/hidden-figures>

Photocopies of **HANDOUT 1: THE LAUNCH OF SPUTNIK AND THE ORIGINS OF NASA** for each student

Index cards

Student notebooks

Procedure

Part 1: Competition and Cooperation

1. Tell students to take out paper and a pen or pencil. Explain that they are going to brainstorm answers to a question and the person who has the most good answers will get a prize. Write this question on the board: “What are some of the ways that nations compete with each other?” Tell them to begin their lists. Allow a few minutes and then tell everyone time is up and that they should put their pens or pencils down. (Some possible answers: Wars, business contracts, the Olympics, international soccer matches, beauty pageants, military build-up, international scholastic competitions, influence at the United Nations, literary prizes, international music competitions, yacht races, tourist attractions, track and field events.)
2. Tell the students to draw a line across the paper right under the last item on their list. Have them count the items and conduct a sort of auction, “Does anyone have 5 items? 10 items?” Give a prize to the person with the highest number.
3. Announce that everyone will have a second chance to win a prize. Ask the first “winner” to read his or her list aloud. Tell the others that if they hear an item mentioned that is not on their own list, they may add it to their list below the line they have drawn. Tell them that if everyone in the class can reach [choose an appropriate number that seems reasonable to you] items, everyone will get a prize. Allow students to call out suggestions until the number is reached.

4. Conduct a discussion: Was competition a good way to generate ideas? Did the second stage of the activity, cooperating, produce any additional ideas? What are the advantages and disadvantages of competition? What are the advantages and disadvantages of competition? Which method of working was better in this case, or should both be used?
5. Finish the activity by distributing a prize to each student. (If you are planning to use this activity with another class later, you must swear them to secrecy at this point.)

Part 2: Competition in Space in the 1950s and 1960s

1. Tell students that they will be viewing *Hidden Figures*, a film that takes place during the space race. It is a biographical drama based not on the lives of the astronauts, but on the real lives of female African-American engineers and mathematicians at NASA in the early years of the space program. Show students the trailer to the film.
2. Explain that before seeing the film, they are going to learn a bit about the context of the world in which these women were working; their jobs were influenced by a competition known as the “space race” because the United States and the Soviet Union were competing to see who could be the first to launch space vehicles.
3. If your students are not familiar with the term “Cold War,” give them some background information using the Notes to the Teacher from Lesson 1 of this curriculum unit or from other sources.
4. Divide students into groups of three and distribute a copy of **HANDOUT 1** to each student. Ask students to read the selection and work together to answer the questions as fully as possible.

Suggested answers:

1. The IGY was actually an 18-month period in 1957–58, when an international effort was made to learn more about the Earth. One of the goals of the IGY was to launch satellites to help map the Earth.
2. Sputnik I was a basketball-size satellite launched by the Soviet Union in 1957. It was the first man-made object to orbit the Earth and is considered the beginning of the space age. Sputnik II was larger and carried a dog.
3. The United States government was shocked to learn about the Soviet launch. Also, there was fear that such a satellite could be used to drop bombs on the United States.
4. The United States military increased its efforts to develop better rockets and the Explorer project worked to develop satellites for launch.
5. After students have had adequate time to complete the handout, discuss the answers with the class. Then ask them to imagine how they would have felt as teenagers in 1957: Would they have been excited about Sputnik? Worried? Point out that after Sputnik, American schools drastically revised their approach to math, science, and engineering classes, including more hands-on laboratory work, increased funding for science equipment, more money for college scholarships, and reforms in methods of teaching science, technology, engineering, and mathematics (STEM subjects), all in the name of national defense.

6. After this introduction, divide students into six equal groups for a jigsaw activity. Explain that each group should become an “expert” group to research thoroughly one aspect of the early years of space exploration: The International Geophysical Year, the launching of Sputniks I and II, the birth of NASA, the 1961 flight of Yuri Gagarin, the 1961 flight of Alan Shepard, and the Mercury project. Tell each group to prepare a one-page briefing sheet with the most important information they find. Have them make six copies of each one to bring in to the next class.
7. The next day, have the students move into their “expert” groups again. Have them quickly review their research while you distribute numbered index cards assigning them to “home groups” or use another method you prefer. Indicate where each “home” group should gather to share information.
8. Have each student in turn teach the other members of the “home” group about the research done by his or her “expert” group while the other students in the “home” group take notes.
9. Conclude by asking students whether they think that the competition in the space race was helpful or harmful to innovation. Remind them that the Cold War was playing out in the space race at the time shown in the film *Hidden Figures*.

Part 3: Competition Leads to Cooperation

1. Begin this part of the lesson by projecting a photo of the current crew of the International Space Station, which can be found at https://www.nasa.gov/mission_pages/station/expeditions/index.html.
2. Click on each member of the crew in turn to find out what country he or she comes from. (Note that some of the biographical information may be written in other languages. Students can copy and paste text into Google.com/translate to see the copy in their primary language.) Ask students why and members from other countries would be on “our” space station. After they answer, point out that it is not “our” space station at all, but one that is a project run by many countries.
3. Now project the map of partner agencies available at https://www.nasa.gov/mission_pages/station/cooperation/index.html. Have students identify the countries that are actively working on the space station.
4. Using information from Notes to the Teacher, point out to students that Russian cosmonauts and American astronauts often find themselves working together on the International Space Station. Ask them to theorize about how that could be possible, given the competitive nature of the early space program and the current political tensions between the two nations.
5. Remind students of the activity at the beginning of the lesson, when they discussed the advantages and disadvantages of cooperation and competition. What are the advantages and disadvantages of cooperating on the International Space Station?

6. Ask students to consider the current political climate and make a prediction: Will these countries continue to cooperate on additional space projects? Can space be kept free from military uses?
7. For homework, have students write a 250-word essay about what they have learned from their study of the space race.
8. Now arrange for the students to watch the film *Hidden Figures*. Give them the following prompts before starting the video:
 - How did the views of the early space race in the film compare with your research?
 - What are the main themes of the space race portrayed in the film?
9. After the conclusion of the film, lead students in a discussion of the questions above. Ask students to describe any aspect of the film that surprised them and changed the way they thought about the early space program. What role did competition play in the timing and success of John Glenn's mission? What kind of cooperation made it possible?

Extension activity

1. For more mature students, or those with a particular interest in space exploration, you may wish to show or suggest the NASA 50th Anniversary documentary, which features images and interviews from the space race era. You can find it at <https://documentary.net/video/neil-armstrong-hosts-nasa-50th-anniversary-documentary/>. Ask students to compare the space race in the documentary with the way it is portrayed in the film.
2. Students might be interested in seeing some of the science fiction television programs that were popular while the space race was under way. You might wish to have them report on one of the following series, considering how the series reflected the broader culture of the times. Many episodes can still be found online on YouTube. Here is a partial list:
 - 1950s: *Captain Video*, *Space Patrol*, and *Tom Corbett, Space Cadet*
 - 1960s: *Twilight Zone*, *Lost in Space*, and *Star Trek*.

Handout 1 ► P. 1

The Launch of Sputnik and the Origins of NASA

Directions:

Read the text selection on the next page of this handout and then answer the following questions:

1. What was the International Geophysical Year? How is it connected with the launching of the Russian satellite known as Sputnik I?

2. What exactly was Sputnik I? Why was it so important? How was Sputnik II different?

3. What was the reaction of the United States government to the launch of Sputnik?

4. What changes were made in the U.S. space program as a result of Sputnik?



Handout 1 ▶ P. 2

Sputnik and the Dawn of the Space Age¹

History changed on October 4, 1957, when the Soviet Union successfully launched Sputnik I. The world's first artificial satellite was about the size of a beach ball (58 cm. or 22.8 inches in diameter), weighed only 83.6 kg. or 183.9 pounds, and took about 98 minutes to orbit the Earth on its elliptical path. That launch ushered in new political, military, technological, and scientific developments. While the Sputnik launch was a single event, it marked the start of the space age and the U.S.–U.S.S.R. space race.

The story begins in 1952, when the International Council of Scientific Unions decided to establish July 1, 1957, to December 31, 1958, as the International Geophysical Year (IGY) because the scientists knew that the cycles of solar activity would be at a high point then. In October 1954, the council adopted a resolution calling for artificial satellites to be launched during the IGY to map the Earth's surface.

In July 1955, the White House announced plans to launch an Earth-orbiting satellite for the IGY and solicited proposals from various government research agencies to undertake development. In September 1955, the Naval Research Laboratory's Vanguard proposal was chosen to represent the U.S. during the IGY.

The Sputnik launch changed everything. As a technical achievement, Sputnik caught the world's attention and the American public off-guard. Its size was more impressive than Vanguard's intended 3.5-pound payload. In addition, the public feared that the Soviets' ability to launch satellites also translated into the capability to launch ballistic missiles that could carry nuclear weapons from Europe to the U.S. Then the Soviets struck again; on November 3, Sputnik II was launched, carrying a much heavier payload, including a dog named Laika.

Immediately after the Sputnik I launch in October, the U.S. Defense Department responded to the political furor by approving funding for another U.S. satellite project. As a simultaneous alternative to Vanguard, Wernher von Braun and his team began work on the Explorer project.

On January 31, 1958, the tide changed, when the United States successfully launched Explorer I. This satellite carried a small scientific payload that eventually discovered the magnetic radiation belts around the Earth, named after principal investigator James Van Allen. The Explorer program continued as a successful ongoing series of lightweight, scientifically useful spacecraft.

¹ Excerpted from the NASA History Program website: <https://history.nasa.gov/sputnik/>



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