

The Journey to Mars: How Donna Shirley Broke Barriers
for Women in Space Engineering

Laurel Mossman, Kate Schein, and Amelia Peoples

Senior Division

Group Documentary

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Our group chose the topic, Donna Shirley and her Mars rover, because of our connections and our interest level in not only science but strong, determined women. One of our group member's mothers worked for a man under Ms. Shirley when she was developing the Mars rover. This provided us with a connection to Ms. Shirley, which then gave us the amazing opportunity to interview her. In addition, our group is interested in the philosophy of equality and we have continuously created documentaries that revolve around this idea. Every member of our group is a female, so we understand the struggles and discrimination that women face in an everyday setting and wanted to share the story of a female that faced these struggles but overcame them. Thus after conducting a great amount of research, we fell in love with Donna Shirley's story. Lastly, it was an added benefit that Ms. Shirley is from Oklahoma, making her story important to our state. All of these components made this topic extremely appealing to us.

We conducted our research using online articles, Donna Shirley's autobiography, "*Managing Martians*", news coverage from the launch day, and our interview with Donna Shirley. We started our research process by reading Shirley's autobiography. This gave us insight into her college life, her time working at the Jet Propulsion Laboratory, and what it was like being in charge of such a barrier-breaking mission. Our interview with Donna Shirley was easily the most important component of our research. We learned a lot about her personal experiences working at JPL and the struggles that came with being a project manager.

We selected our presentation category, group documentary, because of the success we have experienced in previous years. Our last two documentaries have allowed us to attend the national competition, further fueling our drive to create another project. We discovered that it is the best way for us to display our knowledge in an interesting, informative manner. By

producing a documentary, we can incorporate interview clips from living experts and videos taken during the time of the event. Documentaries have allowed us to improve our knowledge of computer softwares, specifically Apple's Imovie and Keynote. Over the years we have found a passion for documentary making and we believe it's the best way to tell an important story in a captivating manner.

Our topic relates to the theme, breaking barriers, in multiple ways. Donna Shirley broke a scientific barrier by being the first person to put a rover on Mars. This was a major breakthrough because the rover was able to analyze Mar's terrain for the first time in history. Shirley also broke a major gender barrier by being the first female project manager at JPL. Her inspirational career led to the creation of more rovers designed to explore Mars and gave women more opportunities in the engineering field. Donna Shirley did not follow stereotypes and labels, allowing her to flourish and break barriers in her career, inevitably bringing her great success.

Annotated Bibliography

Primary Sources

Photographs:

Barnacle Bill Images. Mars, 1998. March 3, 2020. This photo, taken by the Sojourner rover, depicts one of the rocks discovered on Mars. The rock, named after cartoon character Barnacle Bill, was analyzed by Sojourner's alpha proton X-Ray spectrometer which proved useful when trying to understand the thermal activity on the planet. This photo was necessary to help us further explain the work of Sojourner and the extent of its findings.

Barnacle Bill in Super Resolution from Insurance Panorama. Mars, 1998. April 6, 2020. This photo of the rock, Barnacle Bill, was taken by the Sojourner Rover at the beginning of the mission. The rover measured the amount of silica in the rock in order to uncover more data about the planet's past. This photo was an important visual aid in our discussion of the rover's findings and ability to take photographs.

Bill Ingalls-NASA / Staff. *Mars Pathfinder Project Manager Tony Spear Points*. Pasadena, CA, 4 July 1997. April 6, 2020. This photo shows project leader, Tony Spear, on the day of the landing. A monumental day for everyone around the world, the excitement shown in Spear was important in conveying how significant this moment in history truly was.

Donna Shirley with the Sojourner Rover. 20 Aug. 1998. March 16, 2020. This photograph shows Donna with her rover after it returned to the Jet Propulsion Laboratory. The mission ended in March of 1998, however the rover's impact continued even after returning to Earth.

Thus with the use of this image, we were able to more clearly demonstrate both the rover's legacy as well as Shirley's when concluding our documentary.

Dr. David R. Williams. *Close-up Image of Mermaid Dune Taken by the Rover*. 30 Dec. 1999.

April 8, 2020. This photo shows another picture taken by the Sojourner rover on the Pathfinder mission. This photo helped JPL have a better understanding of Mars' terrain and analyze the rocks on the planet.

Dr. David R. Williams. *A View from the Sojourner Rover on Sol 26*. 30 Dec. 1999. April 7, 2020.

This image was taken by the Sojourner rover looking away from the Mars Pathfinder lander. We see an up close view of two rocks that run across the center of the screen. From this photo, our group was able to show the viewer the accomplishments of Shirley's team.

Dr. David R. Williams. *Image Taken by Sojourner of Souffle*. 30 Dec. 1999. April 4, 2020. This

photo shows a picture that the Sojourner Rover took on Mars. Here, we see a wide angle shot of the newly discovered terrain which includes the newly discovered rocks and the overall landscape of the planet. We used this photograph to help our audience understand how the Sojourner rovers' capabilities aided JPL.

Dr. David R. Williams. *Image Taken by Sojourner Looking Back at Yogi* . 30 Dec. 1999. April 8

2020. This photo shows a picture that the Sojourner rover took on Mars. More specifically, we see newly discovered rock, Yogi, before the alpha proton X-ray spectrometer analyzed its elemental composition. The newly captured pictures of Mars allowed us to see the Sojourner rover's capabilities and to show the viewer how impressive this mission was.

Dr. David R. Williams. *Sojourner Rover on the Rock "Hassock"*. 30 Dec. 2004. March 30, 2020.

This photo was one of the many photos taken by the rover on the Pathfinder mission. April 8, 2020. This photo not only served the purpose of giving us a visual representation of what Mars looked like, but the website also provided us with history about the photo. This photo served an important role in our documentary, because it gave the viewer an example of the rover's abilities.

ESOC. *ESOC Main Control Room in the 1980s*. 1980. March 13, 2020. This photo shows a group of young workers at NASA, in the technology room. We wanted to add what life at NASA was like into our documentary. All in all, this photo gave us an inside look at NASA.

Gordon, Paula. *Creating Martians: Donna Shirley*. 1997. April 4, 2020. This photo depicts Donna Shirley smiling in the prime of the Sojourner rover's success and overall success. Along with this photo, an interview was conducted discussing the ambition behind the rover, which was useful to our group. This is a primary source as it was captured in the late 1990s.

Image courtesy of NASA. *Donna Shirley*. California, 1994. April 6, 2020. In this photo, Shirley is posing with the Sojourner rover. This was useful to add, and it shows Shirley posing with the Rover she worked endless hours on. All in all, this photo was useful for our documentary.

Image sensors from ON Semiconductor. *Sojourner Rover Photo*. 4 July 1997. February 21, 2020. This developed photo of the rover and shows the viewer the machine performing its

intended job. This is a primary source as it was taken while in 1997, during the mission's peak.

JPL. *Vallery Ambroise Visits the White House and Meets with Vice President Gore. Ms.*

Ambroise Named the Rover after Sojourner Truth. District of Columbia, 1997. March 7, 2020. In this photo, the rover naming essay contest winner is pictured. Vallery Ambroise wrote her essay about former slave and feminist, Sojourner Truth. Shirley loved her essay and chose Vallery to be the winner. This photo shows the important history of the rover.

JPL. *Rover Team.* Pasadena, CA, 1997. April 8, 2020. The Sojourner rover team is pictured in this photo. Including and showing the entire team was very important to our documentary. This photo also includes all the team's names at the bottom, making this photo an even more useful source.

Kansas Museum Sends Restored NASA Consoles Home to Texas. Houston, Texas, 1960. April 5, 2020. This photo shows the stress-filled environment that NASA truly was during the 1960s as the space race quickly escalated. This photo provided us with a lot of context on NASA goals in the late twentieth century.

KCS. *Pathfinder.* 1995. March 13, 2020. In this photo, the Pathfinder shuttle is shown. The Pathfinder Shuttle plays a huge role in Shirley's mission. It carried her rover all the way to Mars. This photo provided us with valuable information that helped us improve our documentary.

Koelle, Alice. *Speaking*. Aspen, Colorado, Sept. 1997. April 7, 2020. This photo depicts Donna Shirley and Charley Rose speaking at an executive workshop discussing The Sojourner rover and JPL's ongoing projects. This photo is important as it shows the work Donna Shirley put into making the rover well known and its importance nationally recognized.

Library of Congress. *Sojourner Truth, "I Sell the Shadow to Support the Substance"*. Library of Congress. 1810. March 13, 2020. This photo shows Sojourner Truth, a former slave, and author. Sojourner is what Shirley and JPL decided to name the rover after. It was important to talk about the history of the rover, and talking about this backstory was needed.

Mars, 4 Aug. 1997. April 4, 2020. This image was taken by the Sojourner Rover shortly after it began exploring the unknown terrain of Mars. The rover's photos were very useful for JPL as it gave them insight into what the environment was like on this foreign planet.

Mars Pathfinder: Sol 26-27. Mars, 31 July 1997. April 13, 2020. This photo is a wide-angle shot the Sojourner rover captured of the overall Mars terrain. It shows the audience the rover's capable cameras, and the images the rover can take. We gained a first hand view at what data the rover was collecting, helping us further expand our knowledge on the topic.

NASA/JPL. *Sojourner on Mars*. 22 July 1997. April 5, 2020. The robotic rover Sojourner adjacent to a large rock on Mars's Chryse Planitia, in a photograph taken by the Mars Pathfinder lander on July 22, 1997. The rover has deployed its alpha proton X-ray

spectrometer to determine the chemical composition of the rock, one of nine individual specimens that it investigated during its mission.

Nasa. *Launch of Galileo on STS-34 Atlantis*. 18 Oct. 1989. April 12, 2020. The launch of the Galileo was important to add because we wanted to give a brief history of NASA's past launches. The Galileo mission was very important to NASA because it was after the Cold War. We gained historical context from this image, as it helped explain the struggles NASA was facing at the time.

NASA. *Members of the Kennedy Space Center Team Rise from Their Consoles to Watch the Apollo 11 Liftoff*. 16 July 1969. March 5, 2020. This photo shows NASA scientists anxiously watching their mission up in space. This photo was taken during the Apollo mission, 1969. Even though this was not Shirley's mission, we thought it was important to add some important missions when talking about NASA and JPL.

NASA. *Welcome to JPL*. Dec. 1957. In this photo, the JPL sign from 1957 is shown. March 13, 2020. We thought it was important to add this to our documentary because it shows what JPL looked like in the past. We thought it was interesting how much JPL has evolved and changed into what it is today. We used this photograph when discussing Donna Shirley's start at JPL.

Photograph Number P-45061. *Mars Pathfinder Rover Team, 1994*. JPL, Dec. 1994. May 21, 2020. In December 1994, a group of Mars Pathfinder team members gathered for a photo with the Sojourner Rover model. They were working on rover technology development

efforts about two years before the anticipated launch date. This photo gave recognition to all of the members on the Mars Rover Team.

Sojourner Rover Image: Sol 18-19. Mars, 16 July 1997. April 13, 2020. This photo depicts a flat area of Ares Valles and the small rocks along the path the Sojourner Rover moved along. This is an important photo as it shows our viewing audience the full range of Sojourner's cameras.

Sojourner Rover: 3D Model. 4 July 1997. April 6, 2020. This photo of the rover was important to our group as it was a necessary part of a moving graphic we included in the documentary. This also displays all of the features of the Sojourner Rover. We gained data to use in our documentary from this graph, which ultimately helped us improve the quality of our documentary.

System Engineers--Lonne Lane and Bob Wilson. 1998. April 6, 2020. This photo depicts two important engineers at Jet Propulsion Laboratory during their weekly briefing sessions. The picture was taken when Donna Shirley and Tony Spear disliked one another, and Spear asked Lonne Lane to build a competing rover. This was important as it showed our audience more about Spear's hatred for Shirley.

Stone House Day: Sojourner Truth. District of Columbia, 1994. April 12, 2020. This picture depicts essay writing contest winner, Valerie Ambrose, with the newly named Sojourner Rover. She is standing with then vice president, Al Gore, and the rover being honored for her beautifully worded essay and overall interest in NASA's Pathfinder mission.

Super Resolution Stereo Pairs of "Twin Peaks" by Dr. Timothy Parker, JPL. Mars, July 1998.

April 5, 2020. This is one of the images that the Sojourner Rover captured during its time in use on Mars. It is important as it displays the "Twin Peaks" , a mountainous structure on the planet that was a new discovery because of the Pathfinder mission.

The Landing Celebration. Pasadena, California, 4 July 1997. April 8, 2020. This photo was

captured moments after the Delta II rocket successfully landed on Mars's surface. Donna Shirley's team is pictured cheering together and celebrating their hard work and success.

We used this photo to gain perspective on how Shirley's team felt after their monumental accomplishment.

The Mars Rover's "Mom" - NASA Aerospace Engineer Donna Shirley." Kelly O'Donnell,

correspondent. *NBC Nightly News*. NBCUniversal Media. 11 July 1997. *NBC Learn*. Web.

11 January 2020. May 21, 2020. Donna Shirley is pictured working on a model of her rover. The photo is a screenshot from NBC National News. Many major news outlets covered the rover, and Shirley's success.

The Rover Prototype. 1992. April 11, 2020. This photo shows a model of the Sojourner Rover in

the early stages of the development of the Pathfinder Mission. This gave our group a good amount of perspective on the hard work that went on during this stressful period. It also showed us how much time and thought went into the mission, as they used many prototypes before settling on the Sojourner model.

The Rover Team. 1992. April 10, 2020. This photo depicts just a fraction of Donna Shirley's

team that worked on the Sojourner Rover. The photo shows the group standing around their

proud accomplishment with a look of joy and satisfaction. It was important to add this image as we wanted to show our audience the emotions present the day of the rover landing.

The Tombs in Space. 12 Apr. 1961. April 11, 2020. This image shows a cartoon astronaut floating through space in a Soviet Union uniform. This photo is relevant as it depicts a deeper meaning, the space race during the Cold War. The space race was important to our documentary as it was a large part of our historical context.

Films:

“Donna Shirley, Retired Manager, Mars Exploration Program, 1997.” CNN, 4 July 1977. March 13, 2020. This news clip allowed our group to gain perspective on the chaos and excitement the day the rover landed successfully on Mars. This short video is a primary source as it was published in 1997. This source was also very beneficial as it added an interesting media element to our documentary.

Rose, Charlie, director. *DONNA SHIRLEY*. *Charlie Rose*, 7 Jan. 1998, charlierose.com/videos/5342. April 11, 2020. In this video, Shirley is talking about her newly published autobiography, "Managing Martians". This video helped us understand the writing process, why Shirley wrote a book, and the intentions she had with the book. This video gave us an inside view on Shirley's book, and helped us understand her goal with publishing an autobiography.

Running the Rover for a Space Fan. Dan Goldin, NASA's Administrator, Makes a Point to Vice President Al Gore at JPL in 1996. Ed Stone, the Director of JPL Is to the Right of Donna Shirley. 1996. February 21, 2020. In this photo, Donna Shirley is seen talking with NASA's administrator, Dan Goldin, and the vice president of the United States, Al Gore. This photo was very important to our documentary because it shows Shirley talking with people who held great power. She is talking about her mission and all her hard work in this photo, and it documented Shirley's journey with the rover.

Shirley, Ada Brooks. *Donna Shirley and Her Father at Her Grandmother's House, before Her Father, Shipped off for the Pacific.* Oklahoma, 1944. February 21, 2020. This photo captures a young Donna with her father. It was really important for our documentary to have pictures of Donna Shirley from her childhood. This picture was especially important because it shows Donna with her family.

“Sojourner Rover during Exploration.” NASA/JPL Caltech, July 1998. April 5, 2020. In this short video, the Sojourner rover drives around on the Martian surface and rolls one of its wheels on a rock. This added a fun, visually appealing element to our documentary, drawing our viewers into the compelling story even further.

Books:

Shirley, Donna, and Danielle Morton. *Managing Martians.* Bantam, 2000. April 10, 2020. This was one of the most helpful sources when creating our project. Getting an inside source about Shirley's childhood, college struggles, and career at JPL written by Donna herself,

was extremely helpful. It mainly helped us with the creation of our script. All in all, this book inspired many aspects of our project.

Periodicals:

Aguirre, Jaconna. "Donna Lee Shirley." *The Daily Oklahoman*, 5 Feb. 1999. April 7, 2020. This newspaper article shows us how little recognition Ms. Shirley got in her home state, as this was one of the few pieces that displayed her accomplishments in Oklahoma. This article helped us see how the media reacted to the mission and rover as a whole.

"Astronauts Blast Off Safely to Lunar Orbit As World Hails Historic Beginning of Space Age ." *Astronauts Blast Off Safely to Lunar Orbit As World Hails Historic Beginning of Space Age*, 21 July 1969. April 1, 2020. This newspaper gave our group context as to what was happening prior to Donna's time at NASA and in the world of engineering and space prior to the faster, better, cheaper approach.

"Astronauts Land on Plain: Collect Rocks, Plant Flag." *New York Times*, 21 July 1969. March 22, 2020. This newspaper article was very important as it gave our group a good perspective on the effects of the Cold War on space and engineering in the United States.

"The Washington Post." *The Eagle Has Landed: Two Men Walk on the Moon*, 21 July 1969. April 8, 2020. This newspaper allowed us to make an interesting graphic to make our documentary more visually appealing. This was produced when the United States landed on the moon for the first time in 1969.

Time Special Report: Sojourner Rover. 4 July 1997. April 6, 2020. This magazine was very useful for our group as it proved the impact that the rover had on the world. This article was published during the peak of the rover's popularity, so it appealed to the public greatly.

Additional Resources:

“Name the Rover.” *NASA*, NASA, 1996,

[.nasa.gov/MPF/martianchronicle/martianchron3/chro39.html](https://www.nasa.gov/MPF/martianchronicle/martianchron3/chro39.html). April 5, 2020. This website was useful as it helped our group understand how the Rover was given the name Sojourner. The site explains the essay writing contest and how the names were all females, symbolizing the barrier Donna Shirley broke.

NASA FBC TASK FINAL REPORT. July 1996, [.nasa.gov/msp98/misc/fbctask.pdf](https://www.nasa.gov/msp98/misc/fbctask.pdf). April 5, 2020. This document was published to act as a final run-through of the Sojourner Rover's mission plan. It allowed our group to see the intensity of the mission as it quickly approached and all the hard work Donna Shirley and her team put into this.

Shirley, Donna. Personal Interview. November 17, 2019. Donna Shirley, the first female project leader at NASA's Jet Propulsion Laboratory (JPL) and leader of the Sojourner rover project, detailed her experiences leading to the landing of Mars Pathfinder. We used multiple clips from her interview, including descriptions of gender-based inequalities she faced and the legacy she has left on NASA.

Secondary

Photographs:

Annie Oakley Society Luncheon---Donna Lee Shirley and Jo Rowan Received Awards.

Oklahoma City, Oklahoma, 23 Oct. 2016. April 1, 2020. This picture shows Donna Shirley receiving an award for her outstanding work in the field of aeronautical engineering. This empowering picture is important as it proves Ms. Shirley's excellence and her accomplishments. We used this photo when we discussed Shirley and Spear's rivalry and the tension present in their work environment.

Anthony Spear. John Hopkins University- Applied Physics Laboratory, 10 Sept. 2002. April 11, 2020. This is a photo of Anthony "Tony" Spear speaking at a physics convention in Maryland. In this photograph, he is discussing his time at the Jet Propulsion Laboratory and his work on the Pathfinder Mission. This photo was beneficial as we used it to introduce Tony Spear, an important figure in our story.

Auctions, Heritage. The Sands of Mars. London: Sidgwick and Jackson, [1951]. First Edition.

1951. March 20, 2020. This image was used for the creation of our documentary. Donna Shirley talks about how this book was very inspiring for her. She talks about in her biography, "Managing Martians", how the book, "The Sands of Mars" helped her realize that she wants to go . It was important for us to include things that inspired Shirley, and "The Sands of Mars", was a great place to start.

Courtesy of JPL. *Donna Shirley, Director of the Science Fiction Hall of Fame, with One of the Exhibits in "Homeworld"*. 1998. April 10, 2020. In this photo, Shirley is pictured with one of her exhibits in "Homeworld". This picture was very useful when discussing Shirley's achievements. Finding as many pictures as Shirley as possible was a necessity when creating our project.

Courtesy of JPL. *Spear at JPL*. 1996. April 10, 2020. In this photo, Tony Spears is pictured patrolling the JPL headquarters. Shirley and Spears had a lot of conflicts, so we wanted to incorporate him into our Documentary. All in all, this photo was very useful for our documentary.

Courtesy of the University of Oklahoma. *The University of Oklahoma*. Norman, Oklahoma, 2019. April 5, 2020. Shirley attended the University of Oklahoma, so including a photograph of the OU campus was necessary for our project. Shirley experienced many setbacks during her time at OU, but she persevered and overcame these challenges. In this photo, the main campus is photographed.

Crosby, James. *Mars - NASA Sojourner Rover*. 1988. March 13, 2020. In this photo, a close up of the Sojourner Rover is shown. This was important for us to add because it gave a good visual representation when talking about the rover. It shows the viewer how small the rover truly is.

Donna Shirley with the Sojourner Rover. Tulsa, Oklahoma, 9 Dec. 2013. March 31, 2020. This photo allowed us to gain perspective on the everlasting influence the rover had on society. The world was forever changed because of this microwave sized robot, and including a

recent photo of Shirley with it emphasized the triumphant tone at the conclusion of our documentary.

J. Foust. *Tony Spear (Left) Illustrates a Point at the 2002 MAPLD Panel Session about Mars*

While James Garvin Looks on. 2002. April 10, 2020. In this picture, Tony Spear is photographed. Finding pictures of Tony Spear was necessary, due to the heavy discussions of him. Spear's and Shirley's relationship, Spear's impact on the project, and Spear's imposing ideas played a huge role in the mission as a whole. Adding photos of Spear was necessary, because it gives the viewer a visual representation of the lander team.

JPL. *NASA Names First Rover to Explore the Surface of Mars.* 1995. April 10, 2020. This cartoon

shows the Sojourner rover with a female sign in it. We thought it was important because it gave an ode to Shirley. The illustration is not only an ode to Shirley but an ode to all women.

Ketterer, Samantha. *Author Hank Moore.* 8 Oct. 2015. April 10, 2020. In this photo, NASA

scientist Hank Moore is pictured. Hank Moore was heavily involved in the Pathfinder Mission, and he believed in Shirley from the start. Alongside Matt Golombek, Hank Moore was able to push Tony Spear in support of Sojourner after his numerous attempts to replace Shirley.

Nasa. *Galileo.* 1989. April 6, 2020. This photo shows the Galileo Mission, a very innovative

mission that we mentioned in our documentary. This mission took place before the faster,

better, cheaper motto was put into place by NASA. This photo helped improve our intro and made our documentary stronger as a whole.

NASA. "Images Added within the Last 7 Days." *NASA*, NASA, 2001,

photojournal.jpl.nasa.gov/new. April 4, 2020. This website is a photo journal from the Mars Odyssey mission. Even though this journal does not include the Pathfinder mission, we thought it was important to research other missions that have taken inspiration from the Pathfinder mission. The Odyssey mission also used a camera attached to the vehicle that was put on Mars. This website helped us understand the impact that the Pathfinder mission had on other future missions.

NASA/JPL-Caltech. *JPL Scientist Matt Golombek at Launch Pad for NASA's Mars Exploration*

Rover Spirit, at Cape Canaveral Air Force Station, Florida. 6 Oct. 2015. April 10 2020.

This photo features the project scientist for NASA's Mars Exploration Team, Matt Golombek. He played a large role in the Pathfinder Mission, specifically being one of Shirley's first supporters. Sojourner would have never made it into space without his help, thus he became an important element to the storyline between Shirley and Spear we detailed in our film.

NASA/JPL-Caltech. *Spirit: Women on the Mars Exploration Rover Team*. 1 Jan. 2004. April 3,

2020. This picture shows all of the women on the Mars Exploration Team in 2004. The amount of women pictured has grown significantly since Shirley was in charge. This photo not only shows the impact that Shirley left, but also the amount of women that are interested in STEM.

NASA's Mars Exploration Mars Exploration Rover Mission: Press Release Image. 17 Jan. 2012.

April 3, 2020. This photo shows the lander and Curiosity Rover collecting samples on Mar's atmosphere. The picture is very important to our research as it helps us understand the relevance and influence the Pathfinder mission had on other projects NASA would later take on. This image is a secondary source as it was captured in 2012.

Nasa. *Model Of The Mars Pathfinder Rover Sojourner.* Nov. 1998. This photo shows a model of the sojourner rover. February 20, 2020. It was important for us to add to the documentary because we needed a visual representation of Shirley's work. The photo shows a detailed, high quality, colored version of the rover, that was very useful to our documentary.

NASA Names New Mars Rover Perseverance. 5 Mar. 2020. This picture is important as it helps our group understand the influence of the Sojourner Rover. The photo depicts the newest Mars Exploration Rover named Perseverance. We used this picture to draw a connection between Sojourner, and the future rovers NASA built.

National Geographic Society, MOLA Science Team, MSS, JPL, NASA. *The Landing Sites of Mars Exploration Rovers.* April 4, 2020. This graphic displays Nasa's four rovers that were designed to explore Mars. The first of these rovers was the Sojourner Rover. This was important as it proves the impact of Donna's project.

NBC. *The Mars Rover's "Mom" - NASA Aerospace Engineer Donna Shirley.* 7 Nov. 1997.

March 5, 2020. This photo shows Donna Shirley working on her own rover. This was

important for us to add because it shows all of the hard work she put into this project. This picture was a screenshot taken from NBC nightly news, where Shirley was interviewed on.

Oxford, Nick. *Donna Shirley: The Queen of Outer Space*. Tulsa, Oklahoma, 12 July 2019. March 30, 2020. This photo was perfect for the closing image of our documentary as it portrays a powerful woman, concurring challenges and making history.

Oxford, Nick. *The Space Pioneer*. Tulsa, Oklahoma, 21 Aug. 2019. April 11, 2020. This is a photo of the barrier-breaking female engineer, Donna Shirley. She's depicted standing filled with pride as she wears her NASA shirt. This is important as it is representative of a powerful woman that is surpassing standards.

Pearlman, Robert Z. *The Real Lander*. 2 Oct. 2015. This photo truly shows the influence of the Pathfinder mission. The image displays the lander from the mission being used in a popular space movie, *The Martian*. This resource draws back to pop culture and the modern day media.

Picture Courtesy of Tony Spear. *Anthony "Tony" Spear*. California, 2004. In this photo, Tony Spear is pictured at JPL headquarters. April 11 2020. Tony Spear played a huge role in the Pathfinder mission, and in Shirley's career. Spear taught Shirley how to overcome conflict, and Shirley in the end rose above Spear and her model and ideas were successful. All in all, this photo was very useful for our documentary.

Spirit: Women on the Mars Exploration Rover Team. 1 Jan. 2004. April 11, 2020. This photo depicts a team of all women working on the Spirit Rover designed to explore the unknown

parts of Mars. The team symbolizes what Donna Shirley fought for, more opportunities for women in a male-dominated industry.

Three Generations of Rovers in Mars Yard. 17 Jan. 2012. April 9, 2020. This photo displays the three most recent Mars exploration rovers Nasa has built and used for space exploration. The image is important as it helps us visualize the impact that Donna Shirley and the rover team had on future projects.

UOregon. *Labeled Sojourner Rover*. 1997. April 12, 2020. This photo shows a labeled diagram of the Sojourner Rover. This diagram was very helpful, and we used it to understand the complex Rover. All in all, this photo was very. useful during the creation of our documentary.

Uploaded by MSM1025. *Surveyor Program*. 2015. April 10 2020. This photo shows the JPL Surveyor program. The Surveyor program helped NASA/JPL learn about the Moon's surface and prepare the Apollo program to bring our astronauts to explore our Moon. All in all, when we were discussing the Surveyor program, this photo was very helpful.

Uoregon. *Mars Missions* . Mars, 4 July 1997. Landing was at about 3:00 am local time on Mars, which is 10:00 am PDT on Friday, July 4, 1997. April 13, 2020. From an hour and a half before landing until about 3 and a half hours later, the spacecraft is under control of autonomous on-board software that precisely controls the many events that must occur. The fast-paced approach of Pathfinder at Mars begins with venting of the heat rejection system's cooling fluid about 90 minutes prior to landing. This fluid is circulated around the

cruise stage perimeter and into the lander to keep the lander and rover cool during the seven month cruise phase of the mission.

Films:

AP Archive, director. *USA: MARS PATHFINDER SPACECRAFT FINALLY LAUNCHED*

UPDATE. YouTube / USA: MARS PATHFINDER SPACECRAFT FINALLY LAUNCHED

UPDATE, YouTube, 21 July 2015, www.youtube.com/watch?v=Wo96XXpV11g. March 6,

2020. This video was used for the intro of our documentary. This was an extremely

important source because it showed the Pathfinder mission beginning, as the Delta Two.

All in all, this video added a lot to our documentary and gave us a new perspective on the

Pathfinder mission.

CNN, director. *Mars Pathfinder Mission - LIVE Coverage - 1997 - Part 1. YouTube/Mars*

Pathfinder Mission - LIVE Coverage - 1997 - Part 1, YouTube, 19 May 2012,

www.youtube.com/watch?v=zUaalbRC7KA. March 31, 2020. This video was very useful

because it gave us live footage from the launch day of the Rover. This gave us an insight

into how stressful launch days are, and what Donna Shirley was feeling. All in all, these

clips were very helpful when creating our documentary.

CNN, director. *10/33 NASA Mars Pathfinder CNN News Coverage 5 July 1997 Journey to the*

Red Planet. YouTube / 10/33 NASA Mars Pathfinder CNN News Coverage 5 July 1997

Journey to the Red Planet, YouTube, 14 Apr. 2019. April 10, 2020.

www.youtube.com/watch?v=uAQXS4DfRdk. This video shows the CNN interview and

coverage of the Sojourner Rover launch day. Shirley herself was interviewed on CNN, and

it was very interesting to watch her perspective of the launch. All in all, this video was very important to our documentary.

Dan Von Carr, director. *SOJOURNER - Mars Rover Mini Documentary*. *SOJOURNER - Mars Rover Mini-Documentary / Youtube*, YouTube, 15 Aug. 2019. April 10, 2020.

www.youtube.com/watch?v=rInoSOSak0. This video shows a stop motion animation of the Sojourner Rover moving across Mars. This animation added a unique touch to our documentary and made parts of the video more compelling. All in all, this video gave an artistic touch.

“Donna Shirley, 2013 JayMac Distinguished Alumni.” Gaylord College OU, 3 Oct. 2013. March 13, 2020. This small documentary about Donna Shirley's college career and her impact on the Oklahoma University community. This short video allowed us to gain basic knowledge about all of her struggles in college.

Grush, Loren. *NASA/JPL-Caltech*. 5 Mar. 2020. April 10 2020. This video shows a short animation of the Sojourner rover. It was interesting to see how scientists interpreted the rover, and added a good visual effect to the documentary. All in all, this photo helped us get a better visual of the rover.

“Mars Pathfinder - 20th Anniversary Special.” NASA/Jet Propulsion Laboratories, 5 July 2017. April 6, 2020. This documentary gave us a lot of perspective on the rover's impact on NASA and JPL as a whole. We also used the video footage from this film in our documentary to give our viewer an interesting look at the rover when it was being built.

Nasa Jet Propulsion Laboratory, director. *NASA's Mars Pathfinder & Sojourner Rover (360 View)*. *Youtube / NASA's Mars Pathfinder & Sojourner Rover (360 View)*, YouTube, 26 Feb. 2016, www.youtube.com/watch?v=9HGRReKUzfU. March 26, 2020. This video shows a 3D model of what The Sojourner Rover looked like. We used clips from the video when creating our documentary. This helped add a visual effect to our project. All in all, this video was a very important addition to our documentary.

OETA. *Oklahoma Stories: Donna Shirley, Honorary Martian*. 17 June 2013, www.youtube.com/watch?v=5k6f2o9P-ag. April 3, 2020. This video was important as it allowed our group to understand the legacy Donna Shirley has locally and her overall influence in her home state of Oklahoma. It also gave us some information about her childhood and life as a whole.

“Sojourner Gif.” *Http://Abyss.uoregon.edu/ Sojourner Gif*, [Http://Abyss.uoregon.edu](http://Abyss.uoregon.edu), 2012, abyss.uoregon.edu/~js/space/lectures/lec19.html. April 13, 2020. This gif was used in our documentary and added a fun flair to make our project more unique. The gif shows the Sojourner rover moving around on Mars. All in all, this was a good addition to our project.

Websites:

Brian Dunbar, Internet Services Manager. “The Day the Internet Stood Still.” *NASA, NASA*, 2014, www.nasa.gov/specials/pathfinder20/. April 6, 2020. This website gave us another insight on the landing of the Sojourner rover on Mars, and the Pathfinder mission as a

whole. It gave us 360 degrees videos to look at what the rover looked like when landing on Mars, pictures, and videos. All in all, this website was very helpful.

Frank, Elizabeth. "Faster, Better, Cheaper: A Maligned Era of NASA's History." *Elizabeth A.*

Frank, Elizabeth A. Frank, 29 Jan. 2019, www.elizabethafrank.com/colliding-worlds/fbc.

April 2, 2020. This website was useful as it provided our group with context to the

Pathfinder mission by writing about the faster, better, cheaper approach NASA took after

the Cold War. It also gave us lots of pictures of other missions that took place during this

period of time.

Gene Stout, Seattle Post-Intelligencer Reporter. "Real Rocket Scientist to Head Sci-Fi Museum."

Seattlepi.com, Seattle Post-Intelligencer, 15 Mar. 2011,

www.seattlepi.com/lifestyle/article/Real-rocket-scientist-to-head-sci-fi-museum-1136684.p

hp. April 6, 2020. This website was useful as it illustrates Donna Shirley's real and

barrier-breaking accomplishments outside of her time at the Jet Propulsion Laboratory. We

used this to understand achievements as a whole.

Howell, Elizabeth. "Sojourner: Roving on Mars for the First Time." *Space.com*, Space, 3 Mar.

2020, April 7, 2020. www.space.com/17745--pathfinder-sojourner-rover.html. This

website was very helpful as it provided our group with information about the Sojourner

Rover's findings. This allowed us to elevate our script and include information about the

rock and soil discoveries.

Lemelson-MIT Program. "MIT Program." *Lemelson*, Massachusetts Institute of Technology,

Dec. 2014, lemelson.mit.edu/resources/donna-shirley. March 26, 2020. This website

helped us during our beginning stages of researching our topic. The website gave a short biography of Shirley's life, and focused mainly on her achievements and awards. All in all, this website helped us greatly when writing our script.

“Mars Pathfinder.” *NASA*, NASA, 7 Sept. 2019, .nasa.gov/-exploration/missions/pathfinder/. April 4, 2020. This website was important because it illustrated important information about the creation of the Pathfinder mission and the Sojourner Rover.

“Mars 2020 Perseverance Rover.” *NASA*, NASA, 2020, April 8, 2020. .nasa.gov/2020/. This website shows our group the legacy and influence that the Sojourner Rover had on JPL and NASA as a whole. The website details information about the newest rover NASA is working on. This is important as it provides our group with information on NASA's current projects. It is a secondary source as the website is being updated with regularity.

“Nasa Greatest Achievements and Discoveries, in Pictures.” *The Telegraph*, Telegraph Media Group, 22 Feb. 2017, Feb. 28, 2020. When creating our documentary, we knew facts would be very important because of our STEM topic. The Telegraph provided us with exact numbers from the exploration, including how many photos the rover took and the amount of data collected from the surface of the planet. These facts allowed our documentary to stay scientific and clear, giving the viewer an idea of how large the project's impact truly was.

NASA. “Mars Exploration Program Manager Donna Shirley to Retire .” *NASA*, NASA, 20 Aug. 1998, www.jpl.nasa.gov/news/news.php?feature=5126. April 3, 2020. This website gave us the scientific side of Shirley's career. It helped us understand her role in the Pathfinder

Mission, and everything she has accomplished. This website helped us understand Shirley's career and gave us inspiration for our script.

NASA. "Mars Exploration Program Manager Donna Shirley to Retire ." *NASA*, NASA, 20 Aug. 1998, www.jpl.nasa.gov/news/news.php?feature=5126. April 3, 2020. This website gave us the scientific side of Shirley's career. It helped us understand her role in the Pathfinder Mission, and everything she has accomplished. This website helped us understand Shirley's career and gave us inspiration for our script.

NASA. "Mars Pathfinder." *NASA*, NASA, 7 Sept. 2019, .nasa.gov/-exploration/missions/pathfinder/. April 6, 2020. This website gave an in depth summary of the Pathfinder mission. The website included pictures, videos, and how the rover ran on Mars. This website not only helped us understand how the mission ran, but also gave visual examples of the rover on Mars

NASA. "Mars Pathfinder." *NASA Science Mars Exploration Program*, The Mars Exploration Program, and the Jet Propulsion Laboratory for NASA's Science Mission Directorate, 7 Sept. 2019, .nasa.gov/-exploration/missions/pathfinder/. March 13, 2020. Coming from NASA, this website provided the most basic and vital information to our project. Unlike in Shirley's book, we learned the facts of the mission with no opinions shielding the truth. Each part of the rover's build is described in detail alongside the dates of each takeoff and landing.

Reynold, Catherine B. "Donna Shirley Biography." *Donna Shirley Biography -- Academy of Achievement*, 14 Oct. 2017, web.archive.org/web/20140702163826/achievem

ent.org/auto doc/page/ shi0bio-1. April 6, 2020. This website was a short biography on Shirley's work life. It also gave us access to many pictures of Shirley throughout her life. All in all, this website was very helpful to our research.

Smith, Yvette. "NASA's First Rover on the Red Planet." *NASA*, NASA, 3 July 2019, www.nasa.gov/image-feature/nasas-first-rover-on-the-red-planet. April 4, 2020. This website was very beneficial as it was one of the first sources we used because it was very informative with details about the mission and the science element of the mission.

Smithsonian National Air and Space Museum. "Mars Sojourner Rover Model." *National Air and Space Museum*, 2014. March 22, 2020. This website gives a brief scientific history of the Sojourner rover. It helped us greatly when writing our script, and helped us understand the scientific aspects of this mission. This website really helped us jump-start our research process.

"The Day the Internet Stood Still." *NASA*, NASA, www.nasa.gov/specials/pathfinder20/. April 13, 2020. This website was helpful as it provided us with information on how the public reacted to the Pathfinder images. The internet came to a complete standstill and was shocked to see such a breakthrough in space exploration.

Music:

AShamaluevMusic. *Documentary - Ambient Background Music*, 2013. April 13, 2020. This arrangement perfectly encompasses the entire spirit of Shirley's story. While maintaining a relatively upbeat rhythm, the work also included beeping sounds reminiscent of technology

and science. We used this piece while describing Shirley's journey leading up to the rover's landing on Mars, allowing for a coherent tone throughout all aspects of our documentary.

AShamaluevMusic. *Romantic Piano And Strings - Beautiful & Sentimental Cinematic*

Background Music, Soundcloud, 2012. March 4, 2020. Wanting to choose music that fit the feeling of our documentary, we needed several music changes throughout our video. This song creates a hopeful and lively sound and was perfect for the ending of our documentary, as it further confirms the happy ending we discuss for Shirley and her rover.

AShamaluevMusic. *Space - Cinematic Ambient and Suspense Orchestral Background Music*

Instrumental, AShamaluevMusic, 2013. April 13, 2020. This piece of music was specifically selected because of its ambient and space-like qualities. We used this work during our introduction and again once the Delta II Rocket launched the rover into space, in which it provided the suspenseful tone we wanted to achieve.