The Women of Science

JOURNEYS IN FILM
educating for global understanding

Table of Contents

Click the Chapter heading to be taken to that page

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?

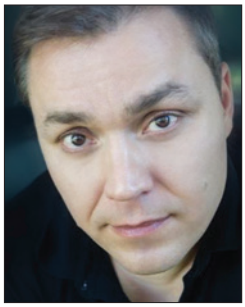
To be prepared to participate in tomorrow's global arena, students need to gain an understanding of the world beyond their own borders. ***Journeys in Film*** offers innovative and engaging tools to explore other cultures and social issues, beyond the often negative images seen in print, television,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

The Women of Science

Enduring Understandings

- Science, technology, engineering, and mathematics (STEM) disciplines are instrumental in solving a wide variety of real-world problems.
- Women (and other marginalized groups) experience disparities in access to quality STEM education; as a result, they have historically been underrepresented in STEM disciplines—and still are.
- Access to innovative programming can increase the percentages of women who enter the STEM workforce.
- Students can inspire interest and encouragement for girls to consider pursuing STEM careers.

Essential Questions

- Why are women (and other marginalized groups) underrepresented in STEM disciplines?
- Why do some girls face challenges with having access to STEM education?
- How does gender bias relate to STEM proficiency in women?
- How can gender stereotypes relating to science and scientists be culturally challenged?
- Who are the women who have become leaders in STEM fields?
- What skills and educational requirements might be needed to pursue a career in a STEM discipline?
- What kinds of STEM opportunities are available to women?
- What strategies might successfully encourage girls to explore opportunities in STEM fields?
- How can students help ignite interest in STEM disciplines for girls?

Notes to the Teacher

Space science has changed dramatically since the days of the "human computers" and so has the role of women in technology. The stories of women astronauts such as Christa McAuliffe and Sally Ride are well known, but what about the women (and men) behind the scenes? What opportunities are available to women today—not just in the field of space science, but also in all STEM disciplines: science, technology, engineering, and mathematics? What STEM or STEAM (STEM plus the arts) educational paths should they follow to train for such a career? Who are the women who have become leaders in this area?

In Part 1 of this lesson, students will discuss the role of women in science and explore the disparity in representation between men and women in STEM disciplines. They will examine the underrepresentation of women in STEM as a form of social injustice. They will then research women in STEM fields and share their findings through posters demonstrating the discipline, type of work, and achievements of these women in their particular fields of work. They will then share their work as part of a community art gallery designed to challenge gender stereotypes relating to science and scientists and to celebrate the achievements of women in STEM disciplines.

Some preparatory work and student access to computers with Internet capabilities are needed for this portion of the lesson. Prepare "Position Placards" before the start of the first class for use with Steps 5 and 6: Write or type the following words in large letters on five individual sheets of 8.5" x 11" paper: TOTALLY AGREE, KIND OF AGREE, ON THE FENCE, KIND OF DISAGREE, and TOTALLY DISAGREE. Once complete, hang the placards at eye-level around the room in the order listed above. Allow as much space as possible between each placard.

Before the final projects are collected, arrange for a space other than the classroom to showcase the work for a short period of time. When the final projects have been submitted and placed on display, arrange a "gallery opening" in the form of a small kick-off event, giving students the opportunity to introduce their STEM women to members of the school community. Invitations could be extended to faculty, younger students, or other classes during the school day. An alternative may include families, friends, and members of the greater community as part of an evening gathering. Either way, please observe that invitations may be necessary and need to be considered prior to completion of the lesson.

If you prefer, instead of a poster for this part of the lesson, students could design a piece of two-dimensional art that represents the work of the women they have researched. Other alternatives to the traditional poster include, for example, magazine covers, album covers, documentaries, advertisements, podcasts, and websites.

To help create maximum awareness surrounding the importance of women in STEM fields, this lesson would pair well with curriculum supporting the International Day of Women and Girls in Science in February or Women's History Month in March.

Part 2 of this lesson offers students the opportunity to explore ways in which girls might gain better access to education about STEM fields and be encouraged to pursue STEM careers. Students will first examine the latest research in areas of developmental psychology focused on gender bias relating to STEM proficiencies. For this assignment, students will read and answer questions about a Web-based NPR article (*Young Girls Are Less Apt to Think That Women Are*

Really, Really Smart: http://www.npr.org/sections/health-shots/2017/01/26/511801423/young-girls-are-less-apt-to-think-women-are-really-really-smart). You may need to print copies of the article for students who do not have access to the Internet outside of school hours.

For Part 3, choose between two videos. The first is a video of the space science strategist Kelli Gerardi, who discusses her work on advancing the commercial spaceflight industry at https://www.youtube.com/watch?v=jUGv-eXXH-Y. This video is part of the Celebrating Amazing Women in Science and Exploration Google Hangout collection, a partnership between the National Geographic Society and Explore by the Seat of Your Pants. More Hangouts of great STEM women in the collection can be found at http://www.exploringbytheseat.com/celebratingwomensciex. (This entire video is approximately 25 minutes long; however, the end of the video is just questions from participating classrooms, so you will probably not need the full 25 minutes.) In the event a smaller timeframe is your only option, a TED Talk by Jedidah Isler called *How I Fell In Love With Quasars, Blazars, and Our Incredible Universe* can be used as an alternative: https://www.ted.com/talks/jedidah_isler_how_i_fell_in_love_with_quasars_blazars_and_our_incredible_universe.

The lesson also sends students back to their poster gallery, so be sure you have arranged this in advance. This activity is designed as a framework for the **Your Turn, Girl!** project detailed in the next step, in which students work collaboratively on the design of innovative campaigns to generate interest in and inspire girls to continue exploring STEM disciplines.

This entire lesson is designed to highlight women in STEM disciplines, but it can easily be adapted to focus on the representation of women of color or other marginalized groups in these areas.

English and Language Arts Standards:

CCSS.ELA-Literacy.CCRA.SL.1
Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

CCSS.ELA-Literacy.CCRA.SL.2
Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

Science and Technical Subjects Standards:

CCSS.ELA-Literacy.RST.9-10.1
Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

CCSS.ELA-Literacy.RST.9-10.2
Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

CCSS.ELA-Literacy.RST.9-10.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

CCSS.ELA-Literacy.RST.9-10.6
Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

CCSS.ELA-Literacy.RST.9-10.8
Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

Common Core Standards addressed by this lesson

Writing Standards:

CCSS.ELA-Literacy.WHST.9-10.2.a
Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

CCSS.ELA-Literacy.WHST.9-10.6
Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

CCSS.ELA-Literacy.WHST.9-10.7
Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

CCSS.ELA-Literacy.WHST.9-10.8
Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

CCSS.ELA-Literacy.WHST.9-10.9
Draw evidence from informational texts to support analysis, reflection, and research.

Speaking and Listening Standards:

CCSS.ELA-Literacy.SL.9-10.1
Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

CCSS.ELA-Literacy.SL.9-10.1.a
Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.

CCSS.ELA-Literacy.SL.9-10.1.b
Work with peers to set rules for collegial discussions and decision-making (e.g., informal consensus, taking votes on key issues, presentation of alternate views), clear goals and deadlines, and individual roles as needed.

CCSS.ELA-Literacy.SL.9-10.1.c
Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.

CCSS.ELA-Literacy.SL.9-10.1.d
Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.

CCSS.ELA-Literacy.SL.9-10.2
Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.

CCSS.ELA-Literacy.SL.9-10.4
Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

CCSS.ELA-Literacy.SL.9-10.5
Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Duration of the Lesson

Three to five one-hour periods, depending on how much class time is available for student research and extension activities.

Assessment

Student posters

Class discussion

Presentations

Materials

Whiteboard

Dry-erase markers

Regular markers

8.5" x 11" paper (at least five, to be used for the Position Placards in Part 1)

Tape

Computers with Internet access (enough for a class working in pairs)

Projector

Websites provided in the procedures

Handout 1: Notable STEM Contributions

Handout 2: Self-Assessment--Notable STEM Contributions (Answer Key)

Handout 3: Breaking the Stereotype—Poster Project for Visualizing Women in STEM

Handout 4: Do Girls See Themselves As Smart?

Handout 5: Portraits of Inspiration

Handout 6: Your Turn, Girl!

Procedure

Part 1: STEM Careers: A Historical Perspective

1. Divide the students into groups of two or three. Distribute and review the instructions for **Handout 1: Notable STEM Contributions**. Remind the students that STEM stands for science, technology, engineering, and mathematics, and that "A" is sometimes added for art as part of a "STEAM" alternative. Allow groups approximately 5–10 minutes to complete the questions. (Do not reveal to students until they are finished that the answers to Set A Questions 1–10, are all women; answers to Set B Questions 11–20, are all men.)

2. When students seem to have finished the handout or run out of answers, distribute **Handout 2: Self-Assessment—Notable STEM Contributions (Answer Key)**. Ask students to tally their scores for Sets A and B separately. Then tally the total for class scores for each set and quickly calculate both averages for the entire class, noting that the scores for Set A will likely be lower than for Set B.

3. Review and discuss the answers as part of a class discussion, using the questions below to help guide the conversation:

   a. How do the class's answers in Set A compare with those in Set B?

   b. How do your own scores for each set compare with each other?

   c. How do your individual scores for each set compare with the class averages?

   d. *If the individual or class averages for Set A are lower than for Set B, ask*: Why do you think the average for Set A is lower than for Set B?

e. *If the individual or class averages for Set A are the same or higher than for Set B, ask*: How do you think the averages between Sets A and B might change if a few hundred students were asked to answer these questions?

f. Overall, why do you think the averages for Set A might be lower than Set B?

g. What do the averages tell you about the representation of women in STEM-related careers?

4. Tell the students that they will now explore their thoughts surrounding the disparity in representation between men and women in STEM fields. Point to where the five Position Placards are located around the room. Explain that you will read a series of statements about STEM fields individually (listed below, in Step 5). If students completely agree with the statement, they should move to the area of the room where the "Totally Agree" placard is positioned. The same goes for the other four placards. After each statement has been read and students have moved to the area of the room that reflects their opinions, invite several students to explain why they are in their chosen position. Note: You may wish to present each statement on a projector screen so that students can continue to process responses as others are speaking.

5. When the students are ready, work your way through as many of the following statements for which you have time. Note: The number of students who explain after each statement will also be based on the time available in class.

a. Some people are more proficient at science and math than others.

b. Historically, women have always been underrepresented in STEM fields.

c. Women are currently underrepresented in STEM fields.

d. The participation of women in STEM fields today compared with the number of men is lower due to lack of choice.

e. There are benefits to being a woman in male-dominated STEM fields.

f. Minority women have the same STEM opportunities as non-minority women.

g. Societal stereotypes exist for people who demonstrate STEM abilities.

h. STEM workplace environments encourage women to enter STEM fields.

i. Women and men have equal access to education and, therefore, equal opportunities to enter STEM fields.

j. The American education system sufficiently prepares women for entering STEM careers.

k. Gender stereotypes prevent women from entering STEM fields.

l. Women in STEM fields have the same opportunities as men to advance their careers.

m. The underrepresentation of women in STEM fields should be considered a social injustice.

6. For homework, invite students to determine if any men or women in their families or greater community have been involved with STEM fields. For the next class, students should come with the name of at least one STEM person they know, as well as information about the field in which the individual has been involved and a brief description of his or her responsibilities. You may need to revisit the definition of STEM as a refresher for students who are new to the topic.

Part 2: A Poster Gallery of STEM Women

1. Invite several students to report facts about STEM individuals in their lives whom they identified for homework. Be sure they include their relationship to each individual. Ask the students if they were surprised to learn about the involvement of family or friends in STEM fields, inviting those who volunteer to elaborate on their reaction, particularly to women.

2. Ask several students to explain whether it is important to be able to tell stories that acknowledge the role of women in history and STEM fields, and if so, why.

3. Next, explain to the students that they will have the opportunity to learn more about women in STEM fields—and celebrate them—by researching a woman of their choice. Distribute copies of **Handout 3: Breaking the Stereotype—Poster Project for Visualizing Women in STEM** to each student and explain that they will be making a poster that honors the discipline, type of work, and achievements of the woman, as well as her contributions to the STEM field in which she works or worked.

4. Review the instructions and requirements for the project with the students using the handout, noting that they should work independently and will be responsible for determining which notable STEM women they would like to research. Remind them that the STEM women chosen for this project can be past or present. Establish and announce due dates for student topic decisions, reference acquisition, and final project submission based on your available timeframe. You may use class time for research, have students work on their own, or combine approaches.

5. Allow students time to begin searching online for the STEM woman on which their project will focus. Research topics should be limited to one woman per student; encourage a wide variety of final projects.

6. When the posters are completed, hang them in your "gallery" and hold a kick-off event. (See Notes to the Teacher.) At the opening, invite the students to explain ways in which they are inspired by the work of the women highlighted in their projects with those in attendance. Their presentations should be informal and conversational, with a unique focus on the contributions of the individuals to the greater scientific community and a celebration of women in STEM fields. (Note: Leave the posters in place at the conclusion of the display for use in the next part of this lesson.)

7. To prepare for the next part of this lesson, distribute **Handout 4: Do Girls See Themselves As Smart?** and ask the students to complete it for homework. Encourage them to bring a printed or digital copy of the article to the next class; provide copies for anyone without computer access.

Part 3: Inspiring the Next Generation

1. Host a class discussion using the questions from **Handout 4: Do Girls See Themselves As Smart?** that students were asked to complete for homework.

2. Ask students to define the term "inspiration." Ask them to consider someone they know who was inspired to try something new, pursue a passion, or launch a career at some point in their lives; call on several students to discuss who this person is or was and what inspired the person.

3. Play the video you have selected (See Notes to the Teacher) and ask students to pay close attention to the STEM woman featured. At the end of the video, hold a brief class discussion using the following questions as a guideline:

   a. What kind of STEM work is the woman featured in the video involved with?
   b. Does she seem passionate about what she does? How could you tell?
   c. What was her inspiration to go into the field of STEM in which she works?
   d. What opportunities do you think she may have had earlier in life that supported her interest in her STEM career?

4. Ask the students where they think inspiration comes from, recording their responses on the board as they are offered. (Answers will vary, but may include such things as experiences, mentors, reading, service, advertising, celebrations, and education.)

5. Ask each of the students to consider a time in their lives when they were inspired to try something new, recording their responses on a sheet of paper. Ask them to describe the source of their inspiration and what the inspiration led to. (An example here might be a student who was inspired to study astrophysics after hearing Neil deGrasse Tyson speak at a local venue. Another example could be a student who was inspired to become a veterinarian after a summer vet camp she attended before entering middle school.)

6. Arrange students in pairs and ask them to read their responses to their partners. After approximately five minutes, invite each of the students to present the responses of their partner to the class. If time permits, invite all students to report.

7. Ask the students to consider the sources of inspiration for the women in STEM they researched for their poster projects. Distribute copies of **Handout 5: Portraits of Inspiration**, reviewing the instructions and keeping the student pairs together. Bring students to their poster gallery and allow 10–15 minutes for the student pairs to visit and view their posters together and brainstorm ways in which the STEM women featured may have become involved in their respective fields.

8. When the students return, invite the pairs to report their ideas on how the women they researched may have been inspired to pursue their respective STEM fields. Record the responses on the board as the students report.

9. Have the students review the list on the board. Ask them if the ideas generated could be used to inspire young girls today to become interested in STEM fields. Ask them to brainstorm other ideas that might creatively engage girls in ways that could generate interest in STEM careers.

10. Divide the class into new groups of two or three. Explain that each group will be responsible for designing an innovative method to encourage girls to consider pursuing careers in STEM disciplines. Distribute copies of **Handout 6: Your Turn, Girl!** and review the instructions for the activity. The goal of this activity is to generate a well-designed STEM outreach strategy, with the potential for real implementation under appropriate scheduling circumstances and willingness on the part of the facilitating teacher. (See Extension Activity 1, below.)

11. If time permits, allow the student groups to begin exploring and discussing ideas. Establish your final project deadline based on the available timeframe. Student research and planning could occur during or outside of class, or as a combination of both. Final projects should include (1) a presentation of the outreach campaign to the class, as well as (2) a written reflection of the project by the group.

12. Once final projects have been submitted, give students the opportunity to discuss their campaigns with the class.

Extension Activities

1. Students could implement their designs for the Your Turn, Girl! project in real-time. Ideas might include delivery to girls in younger grade classrooms or as part of a Girls-in-STEM club. Depending on the nature of the final products, the students could also integrate their activities into a local STEM symposium or learning day for younger students at school, highlighting women and careers in STEM fields.

2. Students could conduct interviews with women in STEM fields about their career experiences, comparing the professional experiences of older and younger women in terms of opportunities in the field and obstacles to advancement. If time and equipment allow, the interviews could be recorded digitally, edited, and presented as part of a small community film festival. If the women interviewed are from the community, they could be invited to attend as guests of honor. A local filmmaker may be available to act as an artist-in-residence to help with the acquisition and use of film equipment and software.

3. Students could launch a social media feed documenting their work on the STEM outreach campaign Your Turn, Girl! They could upload photos and updates of their efforts, and even create hashtags that relate to girls and women in STEM (e.g. #STEMGirlsRock, #STEMinism, #ILookLikeAnEngineer) to increase the educational range of their work in inspiring the next generation of STEM professionals.

4. Students could host a panel with STEM women from the greater community to discuss issues surrounding social injustice and careers in STEM.

Handout 1

Notable STEM Contributions

Directions:

Fill in the name of the person identified with each STEM contribution listed below.

Set	#	STEM Contribution	Contributor Name
A	1	Known for decades of research on gorillas in the mountain forests of Africa.	
	2	Credited with being the world's first computer programmer.	
	3	Invented Kevlar.	
	4	Discovered the AIDS drug Azidothymidine (AZT).	
	5	Provided the first photograph of DNA.	
	6	Discovered the first pulsar.	
	7	Pioneered research on the treatment of tumors with radiation.	
	8	Discovered nuclear fission.	
	9	Discovered that chromosomes are responsible for an organism's biological sex.	
	10	Invented the windshield wiper.	
B	11	Invented the telephone.	
	12	Discovered the structure of DNA.	
	13	Developed the theory of relativity.	
	14	Discovered penicillin.	
	15	Pioneered research that served as the basis for modern theories concerning evolution.	
	16	Determined that the Earth and the other planets revolve around the sun.	
	17	Formulated the laws of gravity.	
	18	Discovered genetic inheritance.	
	19	Heavily influenced our current understanding of black holes.	
	20	Designed and piloted the world's first successful airplane.	

Handout 2

Self-Assessment: Notable STEM Contributions (Answer Key)

Set	#	STEM Contribution	Contributor Name
A	1	Known for decades of research on gorillas in the mountain forests of Africa.	Diane Fossey
	2	Credited with being the world's first computer programmer.	Ada Lovelace
	3	Invented Kevlar.	Stephanie Kwolek
	4	Discovered the AIDS drug Azidothymidine (AZT).	Gertrude B. Elion
	5	Provided the first photograph of DNA.	Rosalind Franklin
	6	Discovered the first pulsar.	Jocelyn Bell Bernell
	7	Pioneered research on the treatment of tumors with radiation.	Marie Curie
	8	Discovered nuclear fission.	Lise Meitner
	9	Discovered that chromosomes are responsible for an organism's biological sex.	Nettie Stevens
	10	Invented the windshield wiper.	Mary Anderson
B	11	Invented the telephone.	Alexander Graham Bell
	12	Discovered the structure of DNA.	Francis Crick, James Watson
	13	Developed the theory of relativity.	Albert Einstein
	14	Discovered penicillin.	Alexander Fleming
	15	Pioneered research that served as the basis for modern theories concerning evolution.	Charles Darwin
	16	Determined that the Earth and the other planets revolve around the sun.	Galileo Galilei
	17	Formulated the laws of gravity.	Isaac Newton
	18	Discovered genetic inheritance.	Gregor Mendel
	19	Heavily influenced our current understanding of black holes.	Stephen Hawking
	20	Designed and piloted the world's first successful airplane.	Orville and Wilbur Wright

Handout 3 ▸ P.1

Breaking the Stereotype—Poster Project for Visualizing Women in STEM

The goal of this project is to help challenge the cultural image of science and scientists through the visual celebration of women in STEM fields. Your mission is to create an inspirational poster that offers a historical look at a woman of your choice in a STEM field whose discoveries and accomplishments helped transform the scientific world. The information on your poster should be typed, and presented clearly and innovatively. Your poster should be colorful, informative, creative, and inspirational. Posters should be no larger than 24" by 36" in size.

Your poster must contain the following information about the woman you are researching. At least three references should be used as part of your research.

1. Full name of the subject
2. At least two photographs (one portrait, one relating to work in the STEM field)
3. Date, city, and country of birth
4. Education (course of study, school name, and degrees)
5. Awards won
6. Location(s) of STEM career work
7. Detailed description of the STEM work performed
8. Explanation of contribution to the greater scientific community
9. Personal commentary about why this individual inspires you

Please complete the section below with the deadlines established by your teacher for this project. Be sure to acquire the signature of your teacher before research commences to ensure no topic overlaps with another in the class.

Topic Due: _____

Topic/Name of STEM Woman: _____

Teacher Signature: _____

Preliminary References Due: _____

Final Project Due:_____

Handout 3 ▸ p.2

Breaking the Stereotype—Poster Project for Visualizing Women in STEM

Some useful websites for your research:

The 50 Most Important Women in Science
http://discovermagazine.com/2002/nov/feat50

The Untold History of Women in Science and Technology
https://obamawhitehouse.archives.gov/women-in-STEM

4000 Years of Women in Science
http://4kyws.ua.edu/bioframe.html

NASA Women in STEM
https://www.nasa.gov/education/womenstem

NASA Women in Science
https://www.nasa.gov/education/womenstem/women-in-science

NASA Women in Space
https://www.nasa.gov/education/womenstem/women-in-space

NASA Women in Mathematics
https://www.nasa.gov/education/womenstem/women-in-mathematics

NASA Women in Engineering
https://www.nasa.gov/education/womenstem/women-in-engineering

NASA Women in Technology
https://www.nasa.gov/education/womenstem/women-in-technology

Celebrating Amazing Women in Science and Exploration
http://www.exploringbytheseat.com/celebratingwomensciex

Celebrating Diversity: Women Energize an Atomic World
https://www.iaea.org/women/2003/

TED Talks by Brilliant Women in STEM
https://www.ted.com/playlists/253/11_ted_talks_by_brilliant_wome

Handout 4 ▸P.1 Do Girls See Themselves As Smart?

Directions:

Read NPR's article *Young Girls Are Less Apt to Think That Women Are Really, Really Smart* at **http://www.npr.org/sections/health-shots/2017/01/26/511801423/young-girls-are-less-apt-to-think-women-are-really-really-smart**). Then, using the information from the article, answer the questions below to the best of your ability. You can work alone or with a partner.

1. According to the article, how do young girls see themselves in terms of their own "smartness" compared with boys of the same age?

2. Andrei Cimpian is s professor of psychology at New York University and author of one of the studies detailed in the article. Cimpian claims that stereotypes about the kinds of people with the innate talent to succeed in STEM fields begin to be applied at a much younger age than previously thought. Why might this be the case?

3. How did Cimpian and his team test the idea that stereotypes regarding who might be "good" in STEM fields might begin during childhood? Be specific with your answer, citing details from the experiments conducted by his team.

Handout 4 ▸P.2

Do Girls See Themselves As Smart?

4. In a different investigation by Sapna Cheryan, an associate professor of psychology at the University of Washington, older girls were shown to be even less likely to associate their own gender with "brilliance," even though they were likely to get good grades in school. What do you think might account for the difference between academic ability and self-image in this case?

5. What does the article offer as good ways of helping girls become more confident as a way of influencing their academic and career choices?

6. Cimpian cautions that it is "important not to fall into the trap of always assuming it is the girls who need to change." What does Cimpian mean by this? What does he suggest might be a good alternative? Do you agree with his reasoning? Please explain.

Handout 5

Portraits of Inspiration

For this activity, work with a partner to explore the sources of inspiration that may have encouraged the women you researched for your poster project to enter the fields in which they work or worked. Review the lives and careers of the two women, focusing on their STEM disciplines and contributions to the greater scientific community. With your partner, brainstorm three ways each woman might have been inspired to pursue her career. Consider the opportunities and mentors she may have had, or the experiences that may have shaped her interest in her field of study. A woman who pursued a career in marine conservation, for example, may have listened to an inspiring marine biologist speak to her third grade class. Alternatively, she may have attended a marine sciences summer camp in high school or done a project about marine mammals in middle school that sparked her interest in the field. Remember that the sources of inspiration here are theoretical, so get creative.

Your name	
Name of the STEM woman you researched	
Three ways in which this individual may have been inspired to pursue a STEM career at an early age	1.
	2.
	3.

Your partner's name	
Name of the STEM women your partner researched	
Three ways in which this individual may have been inspired to pursue a STEM career at an early age	1.
	2.
	3.

Handout 6

Your Turn, Girl!

Statistically, participation in STEM disciplines decreases for women as they move through K–12 educational classrooms; the rate of STEM coursework drops even more significantly at the college level. According to the National Science Foundation, women remain underrepresented in science and engineering fields and accounted for a mere 29 percent of the STEM workforce in 2016 when the film Hidden Figures was released. Consider having students research updated statistics to see where the workforce is today. In addition, minority women accounted for even fewer than 1 in 10 employed individuals in STEM disciplines. [1,2]

For this project, you will work with a team to establish an outreach campaign designed to expose girls to STEM disciplines. Your campaign should inspire and encourage girls to consider pursuing careers in science, technology, engineering, and math. It should provide an enjoyable and exciting way for girls to become engaged in STEM fields, as well as learn how to train for STEM careers.

Consider the types of outreach strategies that might cultivate the interest of girls in STEM. Ideas could include such things as art projects, music, mentoring programs, direct instruction, videos, storytelling, demonstrations, games, public service announcements, clothing brands, or advertisements. The final product for this project will be the completed STEM outreach campaign your group designs—it must be creative, fun, age-appropriate, and specifically designed with STEM exposure for girls in mind.

In addition to presenting your final outreach campaign to the class, your group should provide a one-page typed reflection of the following campaign elements:

1. A summary of your STEM outreach campaign, to include: (a) a thorough project description, (b) goals, and (c) objectives.
2. An explanation of how the idea for your campaign relates to the goals of the assignment in fostering STEM interest.
3. A description of the specific STEM disciplines and careers presented as part of the campaign concept, and details relating to the skills women may need to master for these disciplines.
4. A description of your target audience.
5. An explanation of how your campaign fosters interaction between participants as a way of cultivating engagement with STEM disciplines.

[1] https://nsf.gov/statistics/2016/nsb20161/#/
[2] https://www.nsf.gov/statistics/2017/nsf17310/

Journeys in Film
PO Box 65357
Albuquerque, NM 87193
www.journeysinfilm.org