

Lesson Plan

Strategies and Compromises: Women in Astronomy at Harvard College Observatory, 1870- 1920



Charles Pickering with Women Computers, courtesy AIP Emilio Segre Visual Archives



Harvard College Observatory, courtesy AIP Emilio Segre Visual Archives

Grade Level(s): 9-12

Subject(s): History, Astronomy

In-Class Time: 45-70 Minutes

Prep Time: 10-15 minutes

Materials

- Photocopies of Mack, Pamela. *“Strategies and Compromises: Women in Astronomy at Harvard College Observatory, 1870-1920.”* Journal for the History of Astronomy 21, no. 1 (1990): 65-75 (included in Supplemental Materials)
- Photocopies of the Williamina Fleming Diary (included in Supplemental Materials)

Objective

Students will learn how women at Harvard Observatory coped with the discrimination they faced and partially overcame it to gain recognition for their efforts.

Introduction

In the late 19th and early 20th century, the Harvard College Observatory employed many women as “computers.” These women mostly cataloged and identified stars; although some actually used the observatory’s telescopes. Students will learn about the environment for the “computers” and the experiences of four women in particular: Williamina Paton Fleming, Annie Jump Cannon, Antonia Maury and Henrietta Swan Leavitt. Excerpts from Williamina’s diary introduce the lesson. **Note:** An interview with Henrietta Swope and Cecilia Payne-Gaposchkin, who also worked at the Harvard College Observatory, as well as further information about female computers, are featured in the lesson plans “Struggle for Employment: Anti-Nepotism Rules in the Academy” and “Oral Histories of Women Astronomers.”

Instructions

Engage: 10 Minutes

Williamina Paton Fleming was born in Dundee, Scotland in 1857 and moved to the United States when she was 21. After her husband deserted Williamina and her newborn son, she took on a position as a maid to Charles Edward Pickering, Director of the Harvard Observatory. Pickering was a brilliant but impatient man. One day, having grown frustrated with his assistants, he declared that his housekeeper could do a better job than they were doing. This turned out to be true as once Williamina was hired, she became a hugely successful observational astronomer, cataloging over 10,000 stars during her career and discovering the Horsehead Nebula in 1888. In 1900, the employees at the Harvard Observatory in Cambridge, Massachusetts were asked to keep a journal of their activities inside of and outside the Observatory. This activity features excerpts from Williamina’s journal.

What is the teacher doing?

Tell the students a little about Williamina Fleming. Then, pass out hard copies or tell the students to use computers to look at the excerpts from Fleming’s journal. Assist with any problems or questions students have about what they’ve read.

What are the students doing?

Students should be reading the journal excerpts and taking notes. They should think about questions the journal raises.

Explore: 25-40 minutes

Now students will have the opportunity to learn about the activities Fleming describes in her journal and the strategies of early female astronomers. Begin with a discussion of the journal excerpts and what questions and observations students have about them. Once you or the students have compiled a list of questions they want answered, have them read the Mack article (found in Supplemental Materials) to look for possible answers (many of the questions about what computers actually did and why they were paid less are answered in the article).

<p>What is the teacher doing? The teacher should ask for and compile questions students have about the Fleming journal. You can write down the best questions for the entire class to think about while reading the article.</p>	<p>What are the students doing? Students should be asking questions and stating their observations about the journal excerpts.</p>
<p>Once this is completed, hand out copies or links to the Mack article and, if desired, the Discussion Questions handout. Answer any questions students have about terminology or other aspects of the article.</p>	<p>Students should read the Mack article and take notes. If they have a Discussion Question handout, they should fill it out. They should also ask any questions they have about the reading.</p>

Explain: 10-20 minutes

<p>Have a short class discussion after students have read the assigned readings. This is a chance for students to reflect upon what they just learned and how this might have changed their thinking from the beginning of the period. Make sure to encourage students to ask any questions that they may have about gender defining careers and how this has changed over time.</p>	
<p>What is the teacher doing? Leading a large group in discussion of what students learned. Possible Discussion Questions are below with answers in the Supplemental Materials.</p>	<p>What are the students doing? Students should be participating in the group discussion. They should be answering and asking further questions about Harvard’s astronomical computers and the history of women scientists and engineers more generally. They should also make sure any assigned questions have been completed.</p>

Elaborate: included in “Explain”

<p>Throughout the “Explain” discussion, take the opportunity to elaborate on how both computers and women’s roles in science have changed. Computers have gradually shifted from people who compute equations to machines that take up whole rooms to things that fit within our phones. Similarly, the role of women in science has shifted from being math support for scientists to independent scientists and engineers.</p>	
<p>What is the teacher doing? While having the class discussion described during the explain section, steer students to think more about how things are today.</p>	<p>What are the students doing? Students should be thinking about the changes that have occurred in both technology and the position of women. They should ask questions and expand on what they thought before learning this story.</p>

Evaluate:

<p>Students can be evaluated on their participation and thoroughness with which they read the materials. If desired, the teacher can print out worksheets of the discussion questions for the students to answer as they read. Another possibility is to break students into groups to do further research and a presentation on each of the four women represented in Mack’s article.</p>
--

Required/Recommended Reading and Resources

Both readings are available in the Supplemental Materials of this lesson.

- Excerpts from the Journal of Williamina Paton Fleming: March 1 – March 12, 1900
- Mack, Pamela. “Strategies and Compromises: Women in Astronomy at Harvard College Observatory, 1870-1920.” *Journal for the History of Astronomy* 21, no. 1 (1990): 65-75.

Discussion Questions

Discussion Questions can be found as a Handout with a corresponding Answer Key in the Supplemental Materials to this lesson plan.

1. What were the differences between the roles of the four women mentioned in the article?
2. What are the differences between their attitudes towards the roles they were assigned?
3. Why was astronomy a field that women worked in and why did women become so prominent within the astronomical community?
4. Why were so many women hired specifically at Harvard College Observatory, especially at a time when many women found it hard to get jobs in scientific fields?
5. What methods did the women use in order to have their work be recognized?
6. Was Harvard College Observatory forward thinking in the hiring of women, in your opinion?
7. In your opinion, why are the names of these women not better known?

Further Reading and Additional Resources

- Johnson, George. *Miss Leavitt’s Stars: The Untold Story of the Woman Who Discovered How to Measure the Universe*. New York: W. W. Norton and Company, 2006.
- Photographs of Williamina Paton Fleming and the Harvard College Observatory from the “Women Working, 1800-1930” online exhibit at the Harvard Open Collections Program <http://ocp.hul.harvard.edu/ww/vcsearch.php?any=Fleming&genre=photographs>

Extensions

Related AIP Teacher’s Guides on Women and Minorities in the Physical Sciences:

- “When Computers Wore Skirts:” Katherine Johnson, Christine Darden, and the “West Computers”
- Oral Histories of Women Astronomers
- Struggle for Employment: Anti-Nepotism Rules in the Academy

Common Core Standards

For more information on Common Core Standards, visit <http://www.corestandards.org/>.

Speaking & Listening	
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.
<u>CCSS.ELA-LITERACY.SL.9-10.4</u>	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.
<u>CCSS.ELA-LITERACY.SL.11-12.1</u>	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
<u>CCSS.ELA-LITERACY.SL.11-12.4</u>	Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.
History/Social Studies	
<u>CCSS.ELA-LITERACY.RH.9-10.1</u>	Cite specific textual evidence to support analysis of primary and secondary sources, attending to such features as the date and origin of the information.
<u>CCSS.ELA-LITERACY.RH.9-10.2</u>	Determine the central ideas or information of a primary or secondary source; provide an accurate summary of how key events or ideas develop over the course of the text.
<u>CCSS.ELA-LITERACY.RH.9-10.3</u>	Analyze in detail a series of events described in a text; determine whether earlier events caused later ones or simply preceded them.
<u>CCSS.ELA-LITERACY.RH.9-10.9</u>	Compare and contrast treatments of the same topic in several primary and secondary sources.
<u>CCSS.ELA-LITERACY.RH.11-12.1</u>	Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.
<u>CCSS.ELA-LITERACY.RH.11-12.2</u>	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.
<u>CCSS.ELA-LITERACY.RH.11-12.7</u>	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.
<u>CCSS.ELA-LITERACY.RH.11-12.9</u>	Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.

Next Generation Science Standards

For more information on the Next Generation Science Standards, visit <http://www.nextgenscience.org/>.
N/A