

## Lesson Plan

### Oral Histories of Women Astronomers



*From left: Jocelyn Bell Burnell, Ellen Dorrit Hoffleit, Henrietta Hill Swope.  
Image of Swope courtesy of the Archives, California Institute of Technology.  
All other images courtesy of the AIP Emilio Segre Visual Archives.*

**Grade Level(s): 9-12**

**Subject(s): History, Astronomy**

**In-Class Time: 65-100 minutes**

**Prep Time: 15 minutes**

#### Materials

- Photocopies of Cecilia Payne-Gaposchkin, Henrietta Hill Swope, Dorrit Hoffleit, Vera Rubin, and Jocelyn Bell-Burnell Oral History Excerpts (found in Supplemental Materials)

#### Objective

Students will learn about the life and career of female astronomers through their own words. They will trace the connections between astronomers, as well as the different circumstances and challenges women in science have faced over the years. They will apply this knowledge to a role-playing activity where they will try to explain the experiences and difficulties these women faced to the rest of the class.

#### Concepts & Vocabulary

- History: Oral histories, biographies
- Social Studies: Gender discrimination in science

#### Introduction

This activity will allow students to learn about the experiences of some important women astronomers. In the early 20<sup>th</sup> century, many women who were interested in astronomy and trained in mathematics could find work as human “computers,” who would catalogue and identify stars as well as compute

orbits for a male astronomer. However, some women went beyond merely a supporting role and performed original research and became professional astronomers in their own right. As the century progressed, female astronomers became more accepted, but they still faced immense difficulties navigating a male-dominated field, dealing with gendered expectations of family and careers, and societal expectations of their proper role. This lesson will follow five women who became astronomers at different times in the twentieth century and made significant contributions to astronomy.

**Instructions/Activities**

**Engage: 5 Minutes**

Students read oral histories from female astronomers and participate in a role play activity that will allow for conversation about the experiences that female astronomers had over the decades. Some students may not be familiar with the concept of an *oral history*, so the lesson will begin by students sharing out what they know.

**What is the teacher doing?**

The teacher should ask students if they've ever listened to stories from their parents and grandparents about their family and its history. Ask them what they learned or why it might be interesting or useful to listen to their elders speak about their experiences. Then ask if any of them know what an oral history is. An oral history is very similar to their family passing down its stories, but an oral history is usually done by someone unrelated who wants to hear about a person's experiences to document historical events and their life.

**What are the students doing?**

The students should be thinking about why people tell stories of their lives and answering any questions from the teacher. They should be prepared to take notes and think about why someone would be interested in the past and how things have changed.

**Explore: 30-45 minutes**

Students should break into groups to read the oral history excerpts from a particular scientist. In small groups students will read assigned sections of the transcript from an oral history interview with an important female astronomer (found in the Supplemental Materials). Students will take notes about the astronomer and answer as many Discussion Questions as possible. Students should discuss with their groups what they think their particular astronomer was like and how she should be presented.

**What is the teacher doing?**

The teacher should pass out copies of an oral history to each group and the associated Discussion Questions or direct them to the appropriate website/PDF. Assist with any uncertainties students have about the Discussion Questions (found in Supplemental Materials) and help them find the material if they are uncertain of its location. Answers to the Discussion Questions can also be found in Supplemental Materials.

**What are the students doing?**

The students should read the oral history excerpts with their groups. They should take notes about important experiences or details about their astronomers' personality. They should also be answering the assigned Discussion Questions.

The excerpts included with the lesson plan focus on these women's experiences as a woman in a male-dominated field. Links to the full oral histories—which include further information on

	<p>their professional lives more generally—are found in the Required/Recommended Readings for this Lesson Plan.</p> <p>After reading the history, students should discuss what the astronomer was like with their group.</p>
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**Explain: 20-30 minutes**

<p>Students will now role-play their assigned astronomer. Tell the students they are going to have a panel discussion with the five selected astronomers, but they, the students, are going to make up the panel. A list of suggested panel discussion questions is included below.</p>	
<p><b>What is the teacher doing?</b></p> <p>Depending on the layout of the classroom, it may be easiest to make a “panel” of groups of students, or just the group spokesperson. The teacher will be the moderator of the panel discussion. They should ask the panel participants questions and encourage them to interact with one another. Particular questions can be asked of all panel participants or directed at only a few of them.</p> <p>Possible questions for the large panel discussion:</p> <ol style="list-style-type: none"> <li>1. How did you become interested in astronomy?</li> <li>2. What time period were you working in?</li> <li>3. What sort of research did you do?</li> <li>4. Were there any people who strongly encouraged you in your career? How did they do that?</li> <li>5. Did you face any discrimination in your career? If so, how?</li> <li>6. Did you have to make any sacrifices in your life to have a career?</li> <li>7. What was your family life like?</li> <li>8. What challenges do you think women in astronomy face?</li> <li>9. Do you have any particular stories you’d like to share with the audience?</li> <li>10. Do you have any advice for women in the audience who are thinking about a scientific career?</li> </ol>	<p><b>What are the students doing?</b></p> <p>If desired, have each group nominate a spokesperson to participate in the panel discussion. That spokesperson should have the group’s list of important experiences and information to present to the rest of the class.</p> <p>Groups/spokespeople should answer any questions directed at the panel. They should also interact with each other and roleplay as their particular astronomer.</p>

**Elaborate: 10-20 minutes**

Debrief the students on what they learned about astronomy and the pioneering female astronomers. This is their chance to make explicit connections between the women and the time periods they worked in.

**What is the teacher doing?**

The teacher should ask the whole class (not just the panel participants) what they learned from the oral histories and the moderated discussion.

Possible topics include:

- Were there any changes in women’s place in astronomy between the different time periods these women worked in?
- What similarities do you see between the stories of these 5 women? What differences?
- What similarities and differences do you see in what problems the different scientists decided to work on?

**What are the students doing?**

Students should be answering Discussion Questions and presenting their ideas. This is also their chance to ask about the current state of women in astronomy and other sciences (see the lesson plan “She is an Astronomer: Experiences of Contemporary Women Astronomers” for more information).

**Evaluate:**

The evaluation portion comes naturally from student’s participation in the group panel discussion. If desired, the teacher could also collect students’ discussion question worksheets and grade those. Other possible evaluations include a short essay about their particular astronomer, or a different one using additional research. Other female astronomers with oral histories are included in the additional resources section.

**Required/Recommended Reading and Resources**

Oral history interviews of the Niels Bohr Library and Archives (<http://www.aip.org/history-programs/niels-bohr-library/oral-histories>):

- Jocelyn Bell Burnell: [www.aip.org/history-programs/niels-bohr-library/oral-histories/31792](http://www.aip.org/history-programs/niels-bohr-library/oral-histories/31792)
- Dorrit Hoffleit: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/4677>
- Henrietta Swope: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/4909>
- Vera Rubin, September 21, 1995 by David DeVorkin: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/5920-1> (two sessions, second on May 9, 1996) and April 3, 1989 by Alan Lightman: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/33963>
- Cecilia Payne-Gaposchkin, March 5, 1968 by Owen Gingerich: <https://www.aip.org/history-programs/niels-bohr-library/oral-histories/4620>

Significant excerpts can be found in the Supplemental Materials to this lesson plan.

**Discussion Questions**

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

### **Henrietta Hill Swope Discussion Questions**

1. How did Swope develop an interest in astronomy?
2. Who were her mentors?
3. How did her family's wealth and status benefit Swope's career?
4. What was Swope's relationship like with superiors, including Shapley and Baade?
5. What was Swope's relationship like with other women in the observatories?
6. What challenges did Swope face as a woman in astronomy?
7. What was the general attitude toward women in the observatory?
8. What sacrifices did Swope make for her career?
9. What kinds of work did Swope pursue when she was not in the observatory?

### **Cecilia Payne-Gaposchkin Discussion Questions**

1. What challenges did Cecilia Payne face as a woman studying physics in college?
2. How did she decide what she was going to study astronomy?
3. How did other scientists react to Payne's presence?
4. How did Payne learn how to do scientific research?
5. How did Cecilia Payne feel about moving to and working at Harvard?
6. How did other scientists react to Payne's first book?
7. She was the first person to suggest hydrogen and helium are the most abundant elements in stars. How was this idea presented? How did other scientists react to it?
8. How did Payne-Gaposchkin work with Dr. Shapley on the second book she wrote?

### **Dorrit Hoffleit Discussion Questions**

1. What was Hoffleit's relationship like with her superiors, specifically the Harvard College Observatory directors?
2. What was Hoffleit's impression of Henrietta Swope? How does she perceive other women in her profession?
3. What were Hoffleit's early interests and hobbies? How did she develop an interest in astronomy?
4. Did Hoffleit's family and teachers encourage or discourage her early scientific pursuits?
5. What sacrifices did Hoffleit make to pursue fulfilling research? Would a man have been confronted with the same obstacles?
6. Describe Hoffleit's level of confidence throughout her education and career.
7. Did Hoffleit struggle with pay or advancement?
8. What career did Hoffleit plan to pursue after finishing her studies at Radcliffe?

### **Vera Rubin Discussion Questions**

1. How did Rubin develop an interest in astronomy?
2. How did Rubin's family feel about her interest in astronomy?
3. Why did Rubin decide to go to Vassar College?
4. Why did Vera decide to study at Cornell? What did her professors think of her choice?
5. What were some of the challenges Vera Rubin faced as a woman in astronomy?
6. How did Rubin decide to work on the rotation of galaxies? How did people react to her data that there must be more matter in galaxies than could be observed?
7. What sacrifices did Rubin make for her career? For her family?
8. What does Vera Rubin think steers some women away from science? How does she think this can be changed?

### Jocelyn Bell-Burnell Discussion Questions

1. How did Burnell's family life encourage or discourage her from pursuing a career in science?
2. What role(s) did Burnell's teachers play in the development of her interests in astronomy?
3. What do you think were the most important experiences of her youth that led her to this career path?
4. What kind of discrimination did Burnell face in college? In graduate school?
5. Describe Burnell's relationship with thesis advisor Tony Hewish.
6. Why did Burnell's peers and supervisors treat her differently after the discovery of pulsars?
7. Did Burnell's marriage enhance or detract from her scientific career?
8. What work occupied Burnell in the later stages of her career?

### Further Reading and Additional Resources

Other oral histories with female astronomers (also may be integrated into the activity):

- Beatrice Tinsley, June 14, 1977 by David DeVorkin: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/4914>
- Charlotte Moore Sitterly, June 15, 1978 by David DeVorkin: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/4784>
- Margaret Myall, August 11, 1986 by Owen Gingerich: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/28323-1> (two sessions, second on September 12, 1986)
- A.G. Masevich, September 1, 1976 by Spencer Weart: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/4761>
- Dorothy Locanthi, August 3, 1977 by David DeVorkin: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/4747>
- Helen Hogg, August 18, 1987 by Owen Gingerich: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/29928-1> (two sessions, second on October 25, 1987) and August 17, 1979 by David DeVorkin: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/4679>
- Sandra Faber, October 15, 1988 by Alan Lightman: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/33932> and July 31, 2002 by Patrick McCray: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/25489>
- Mildred Allen, June 18, 1979 by Katherine Sopka: <http://www.aip.org/history-programs/niels-bohr-library/oral-histories/4480>

### Extensions

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

- Fair or Unfair: Should these women have received Nobel Prizes too? (features Jocelyn Bell Burnell)
- Struggle for Employment: Anti-Nepotism Laws in the Academy (features Cecilia Payne-Gaposchkin)
- She is an Astronomer: Experiences of Contemporary Women Astronomers
- Strategies and Compromises: Women in Astronomy at Harvard College Observatory, 1870-1920

**Common Core Standards**

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

Speaking & Listening	
<u>CCSS.ELA-LITERACY.SL.9-10.1</u>	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
<u>CCSS.ELA-LITERACY.SL.9-10.3</u>	Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any fallacious reasoning or exaggerated or distorted evidence.
<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.11-12.3</u>	Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.
<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