

Women in Astronomy: A Resource Guide

A Chinese proverb says “Women hold up half the sky” and celebrating the contributions of women to astronomy can be a good way to give that proverb deeper meaning. For much of history, women with an interest in the universe were kept out of astronomy (as they were out of most professional fields) and they were restricted to helping their husbands or brothers in their scientific pursuits. But this has changed dramatically in the last century, and many of the most important posts in astronomy have been held by women and many key discoveries have been made by them.

400 Years of the Telescope features interviews with Catherine Cesarsky, the President of the International Astronomical Union (which is the U.N. of astronomers); Wendy Freedman, the astronomer who worked with the Hubble Space Telescope to pin down the age of the expanding universe; and Claire Max, who heads the Center for Adaptive Optics (helping astronomer get a clearer view of the sky).

For those who want to explore the contributions of women to astronomy in more detail, we list some general resources and then some articles and books that can help you understand the specific work of a few selected women astronomers. (Note that a number of books for younger readers are included in section 1.)

1. Resources on the General Topic of Women in Astronomy

- Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. Covers the lives and careers of 21 women astronomers, past and present, for teenagers and up.
- Ghez, Andrea & Cohen, Judith *You Can Be a Woman Astronomer*. 2006, Cascade Press. A picture book for children from grades 3 - 5.
- James, C. “Edward and Mina” in *Astronomy*, July 2002, p. 46. Despite the title, this treats several women who worked at the Harvard Observatory.
- Mack, P. "Straying from Their Orbits: Women in Astronomy in America" in G. Kass-Simon & P. Farnes, eds. *Women of Science*. 1990, Indiana U. Press.
- Rizzo, P. "Early Daughters of Urania" in *Sky & Telescope*, Nov. 1954, p. 7.
- Rubin, Vera "Women's Work: Women in Modern Astronomy" in *Science* 86, Jul/Aug. 1986, p. 58.
- Spradley, J. "Women and the Stars" in *The Physics Teacher*, Sep. 1990, p. 372.
- Warner, Deborah "Women Astronomers" in *Natural History*, May 1979, p. 12.

2. Material on Selected Women Astronomers of the Past

Cannon, Annie (1863-1941), who helped classify and organize the stars by their characteristics:

- Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. This book for teens has a chapter on Cannon.
- Camp, Carole *American Astronomers: Searchers and Wonderers*. 1996, Enslow. One chapter of this book for teen readers is devoted to Cannon's life and work.

Greenstein, George "The Ladies of Observatory Hill" in *American Scholar*, Feb. 1993, p. 437.
(Reprinted in his book *Portraits of Discovery*, 1998, John Wiley.)
Kidwell, P. "Three Women of American Astronomy" in *American Scientist*, May/June 1990, p. 244.

Herschel, Caroline (1750-1848), who discovered comets and nebulae, made astronomical catalogs, and helped her brother William with many of his astronomical discoveries:

Alic, Margaret *Hypatia's Heritage: A History of Women in Science*. 1986, Beacon Press. Chapter 9 has a good section on Herschel's work.
Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. This book for teens has a chapter on Herschel.
Belkora, Leila *Minding the Heavens: The Story of Our Discovery of the Milky Way*. 2003, IOP Publishing. Chapter 4 is about the Herschels.
Brock, Claire *The Comet Sweeper: Caroline Herschel's Astronomical Ambition*. 2008, Totem Books. A popular-level biography.
Higgins, F. *Sweeper of the Skies: Caroline Herschel*. 1967, Follett. For young people.
Hoskin, Michael "Astronomy's Matriarch" in *Sky & Telescope*, May 2005, p. 42-46.
Lubbock, C. *The Herschel Chronicle*. 1933, Cambridge U. Press. Family chronicle of William and Caroline, by his grand-daughter.

Leavitt, Henrietta (1868-1921) who discovered the method of finding distances to stars and galaxies, using the behavior of stars that vary in brightness:

Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. This book for teens has a chapter on Leavitt.
Crowe, Michael *Modern Theories of the Universe from Herschel to Hubble*. 1994, Dover. See especially Chapter 6.
Ferguson, Kitty *Measuring the Universe*. 1999, Walker. Chronicle of how distances were found in the universe, with good discussions of contributions by individual astronomers.
Johnson, George *Miss Leavitt's Stars: The Untold Story of the Woman Who Discovered How to Measure the Universe*. 2005, Atlas/Norton.
Singh, Simon *Big Bang*. 2004, Harper. Chapter 3 has a nice section on her life and work.

Mitchell, Maria (1818-1889), the first professional woman astronomer in the U.S. and comet discoverer:

Albers, Henry, ed. *Maria Mitchell: A Life in Journals and Letters*. 2001, College Avenue Press. Many excerpts from her writings, interspersed with biographical information.
Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. This book for teens has a chapter on Mitchell.
Camp, Carole *American Astronomers: Searchers and Wonderers*. 1996, Enslow. One chapter of this book for teen readers is devoted to Mitchell's life and work.
Gormley, Beatrice *Maria Mitchell: The Soul of an Astronomer*. 1995, Eerdmans Publishing. A book for youngsters.

Kidwell, P. "Three Women of American Astronomy" in *American Scientist*, May/June 1990, p. 244.
McPherson, Stephanie *Rooftop Astronomer: A Story about Maria Mitchell*. 1990, CarolRhoda Books. For younger children.
Merriam, Eve, ed. *Growing Up Female in America: Ten Lives*. 1971, Doubleday. Has excerpts from Mitchell's diary in the section about her (pp. 75-92).
Morgan, Helen *Maria Mitchell: First Lady of American Astronomy*. 1977, Westminster. For children.
Opalko, J. "Maria Mitchells' Haunting Legacy" in *Sky & Telescope*, May 1992, p. 505.
Wright, Helen *Sweeper in the Sky: The Life of Maria Mitchell*. 1950, Macmillan. (Recently updated and reprinted by College Avenue Press.)

Payne-Gaposchkin, Cecilia (1900-1979), who first understood that the Sun and the stars are made mainly of the simplest element, hydrogen:

Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. This book for teens has a chapter on Payne-Gaposchkin.
Bartusiak, Marcia "The Stuff of the Stars" in *The Sciences*, Sep/Oct. 1993, p. 34. Excerpt on her work from Bartusiak's book, *Through a Universe Darkly* (1993, HarperCollins.)
Camp, Carole *American Astronomers: Searchers and Wonderers*. 1996, Enslow. One chapter of this book for teen readers is devoted to her life and work.
Greenstein, George "The Ladies of Observatory Hill" in *American Scholar*, Feb. 1993, p. 437. (Reprinted in his book *Portraits of Discovery*, 1998, John Wiley.)
Haramundanis, Katherine, ed. *Cecilia Payne Gaposchkin: An Autobiography and Notes*, 2nd ed. 1996, Cambridge U. Press.
Kidwell, Peggy "Three Women of American Astronomy" in *American Scientist*, May/June 1990, p. 244.
Soter, Steven & Tyson, Neil, eds. *Cosmic Horizons*. 2001, New Press. See p. 75ff
Whitney, Charles "Cecilia Payne-Gaposchkin: An Astronomer's Astronomer" in *Sky & Telescope*, Mar. 1980, p. 212.

3. Material on Selected Living Astronomers who are Women

Bell Burnell, Jocelyn (1943 -), who discovered pulsars, the collapsed remnants of stars that explode as supernovae:

Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. This book for teens has a chapter on Bell Burnell.
Bell Burnell, Jocelyn "Little Green Men, White Dwarfs, or What?" in *Sky & Telescope*, Mar. 1978, p. 218.
Reed G. "The Discovery of Pulsars: Was Credit Given Where it was Due?" in *Astronomy*, Dec. 1983, p. 24.

Burbidge, Margaret (1919 -), who helped figure out how the stars make elements and is an expert observer of galaxies and quasars:

Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. This book for teens has a chapter on Burbidge.

Croswell, Ken *The Alchemy of the Heavens: Searching for Meaning in the Milky Way*. 1995, Doubleday. See Chapter 9.

Reed, J. "A Great Woman Astronomer Leaves England Again" in *Smithsonian*, Jan. 1974, p. 34. "The Stargazer" in *Time* magazine, Mar. 20, 1972, p. 38.

Fischer, Debra (1953 -), who is the first woman in history to discover a planet:

Naeye, Robert "Unlocking New Worlds" in *Astronomy*, Nov. 2002, p. 48. A profile and discussion of her work.

Freedman, Wendy (1957 -), who led the effort to pin down the time the universe has taken to expand (and is profiled in the show):

Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. This book for teens has a chapter on Freedman.

Ferguson, Kitty *Measuring the Universe*. 1999, Walker. Chronicle of how distances were found in the universe, with good discussions of contributions by individual astronomers.

Stephens, Sally "Hubble Warrior" in *Astronomy*, March 2000, p. 52. Profile of her work trying to find the Hubble constant and other cosmological parameters.

Geller, Margaret (1947 -), who made pioneering maps of the large-scale distribution of galaxies in the universe:

Ames, Joan. *Mastery: Interviews with 30 Remarkable People*. 1997, Rudra Press.

Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. This book for teens has a chapter on Geller.

Chaikin, Andrew "Surveyor of the Universe" in *Air & Space*, Aug./Sept. 1991; vol. 6, p. 84.

Geller, Margaret. "The Big Picture" in *Natural History*, Feb. 2000, vol. 109, p. 74.

Goldsmith, Donald *The Astronomers*. 1991, St. Martin's Press. The chapter entitled "Mapping the Universe" profiles Geller's life and work.

Greenstein, George *Portraits of Discovery*. 1998, John Wiley. Chapter 8 of this collection of biographical articles is about Margaret Geller and John Huchra.

Lightman, Alan & Brawer, Roberta "Interview with Margaret Geller" in *Origins*. 1990, Harvard U. Press.

Overbye, Dennis *Lonely Hearts of the Cosmos*. 1992, HarperCollins. See Chapter 19.

Wiley, John "Margaret Geller: Star Mapper" in *Astronomy*, Nov. 2000; vol. 28. p. 104.

Hammel, Heidi (1960 -), who is a world-renowned expert on Uranus, Neptune, and the outer reaches of our solar system:

Bortz, Fred: *Beyond Jupiter: The Story of Planetary Astronomer Heidi Hammel* (2005, Franklin Watts/Scholastic & Joseph Henry Press). A colorful profile of Hammel as a person and scientist, written for teenagers (but enjoyable reading for everyone.)
Flanagan, R. "Observer of the Gas Giants" in *Astronomy*, July 1997, p. 50.

Luu, Jane (1963 -), who was co-discoverer of the first object in the Kuiper Belt:

Bartusiak, Marcia "The Remarkable Odyssey of Jane Luu" in *Astronomy*, Feb. 1996, p. 46.
Davies, John *Beyond Pluto: Exploring the Outer Limits of the Solar System*. Chapter 4 features Luu's life and work.
Flamsteed, Sam "'Where Comets Come from - Hubble Space Telescope Provides Evidence for Kuiper Belt" in *Discover*, Nov. 1995, p. . Includes some about her life and early work.

Rubin, Vera (1928 -), an expert on the study of galaxies, whose work first showed the existence of dark matter in the universe:

Bartusiak, Marcia "The Woman Who Spins the Stars" in *Discover*, Oct. 1990, p. 88. See also Bartusiak's book, *Through a Universe Darkly*, 1993, HarperCollins, p. 202ff.
Boslaugh, John *Masters of Time: Cosmology at the End of Innocence*. 1992, Addison-Wesley. Chapter 2 features Rubin's life and work.
Camp, Carole *American Astronomers: Searchers and Wonderers*. 1996, Enslow. One chapter of this book for teen readers is devoted to Rubin's life and work.
Goldsmith, Donald *The Astronomers*. 1991, St. Martins. Chapter 2 profiles Vera Rubin.
Irion, Robert "Vera Rubin Profile: The Bright Face Behind the Dark Sides of Galaxies" in *Science*, vol. 295, no. 5557, p. 960 (Feb. 8, 2002).
Lightman, Alan & Brawer, Roberta "Interview with Vera Rubin" in *Origins*. 1990, Harvard U. Press.
Overbye, Dennis *Lonely Hearts of the Cosmos*. 1992, HarperCollins. Chapter 17 focuses on her work.
Schomaker, William "Interview with Vera Rubin" (very brief) in *Astronomy*, June 2003, p. 18.

Shoemaker, Carolyn (1929 -), who has discovered many asteroids and comets, including one that hit Jupiter; she holds the world record for the largest number of comets discovered by an individual:

Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. This book for teens has a chapter on Shoemaker.
Levy, David "Star Trails: Carolyn Shoemaker" in *Sky & Telescope*, June 1991, p. 658.
Levy, David *Shoemaker by Levy: The Man who Made an Impact*. 2000, Princeton U. Press. Biography of Eugene Shoemaker, but with much information about Carolyn's work.
Preston, Richard *First Light*. 1987, Atlantic Monthly Press. Section 2 is a profile of the Shoemakers.
Reeves, R. "Interview with Gene and Carolyn Shoemaker: Meteor Crater to Palomar" in *Astronomy*, June 1993, p. 13.

Tarter, Jill (1944 -), who coined the term “brown dwarf” for failed stars, and is the leader of the effort to find extra-terrestrial civilizations using radio waves:

Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. This book for teens has a chapter on Tarter.

Drake, Frank & Sobel, Dava *Is Anyone Out There?* 1992, Delacorte/Bantam. Page 152 ff. Has a number of discussions of Tarter’s life and work, especially in Chapters 7 & 10.

Jackson, Ellen *Looking for Life in the Universe: The Search for Extraterrestrial Intelligence*. 2005, Houghton Mifflin. A profile of Tarter and her work for young people in grades 4-8.

Lubick, N. “An Ear to the Stars” in *Scientific American*, Nov. 2002, p. 42. A brief profile of Tarter and her SETI work.

Swift, David "Interview with Jill Tarter" in *SETI Pioneers*. 1990, U. of Arizona Press.

For information about the work of many other women astronomers, see the resource guide at: http://www.astrosociety.org/education/resources/womenast_bib.html

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