

4-2018

The Personal is Archival: Researching and Teaching With Stories of Women Engineers, Scientists, and Doctors

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Recommended Citation

Bix, Amy, "The Personal is Archival: Researching and Teaching With Stories of Women Engineers, Scientists, and Doctors" (2018). *History Conference Papers, Presentations and Posters*. 5.
https://lib.dr.iastate.edu/history_conf/5

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The Personal is Archival: Researching and Teaching With Stories of Women Engineers, Scientists, and Doctors

Abstract

Personal stories from archives are essential to understand the historical gendering of American science, medicine, technology, and innovation. Advocates promoted science, medicine, and engineering to young men, yet the twentieth-century brought increasing numbers of women into STEM education and employment. This paper illustrates the above by offering guidance to key archival and digital collections that show how women (individually and as groups) made places for themselves in modern science, technology, and medicine. Sources illustrate complex intersections for women simultaneously shaping professional and personal identities. This paper suggests how historians can reach beyond individual biographies to build broader analyses that deploy insights about personal experiences to parse cultural understandings of STEM and diversity. It models pedagogy foregrounding women's lived experiences for classwork analyzing science, technology, and innovation. By integrating archival stories, educators can bridge gaps between STEM majors and other students through engaging dialogue about the past/present/future gendering of intellectual life and work.

Keywords

Women, gender, science, engineering, medicine, STEM, archives

Disciplines

Cultural History | Engineering | Feminist, Gender, and Sexuality Studies | History | Science and Mathematics Education | Women's Studies

Comments

This proceedings is published as Amy Bix, "The Personal is Archival: Researching and Teaching With Stories of Women Engineers, Scientists, and Doctors," NYU Center for the Humanities for STEM: Using Archives to Bridge the Two Cultures Divide. Brooklyn, NY. April 6-7, 2018. Posted with permission.

**The Personal is Archival: Researching and Teaching
With Stories of Women Engineers, Scientists, and Doctors**

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ABSTRACT:

Personal stories from archives are essential to understand the historical gendering of American science, medicine, technology, and innovation. Advocates promoted science, medicine, and engineering to young men, yet the twentieth-century brought increasing numbers of women into STEM education and employment. This paper illustrates the above by offering guidance to key archival and digital collections that show how women (individually and as groups) made places for themselves in modern science, technology, and medicine. Sources illustrate complex intersections for women simultaneously shaping professional and personal identities. This paper suggests how historians can reach beyond individual biographies to build broader analyses that deploy insights about personal experiences to parse cultural understandings of STEM and diversity. It models pedagogy foregrounding women's lived experiences for classwork analyzing science, technology, and innovation. By integrating archival stories, educators can bridge gaps between STEM majors and other students through engaging dialogue about the past/present/future gendering of intellectual life and work.

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When teaching undergraduates about the history of women and gender in science, I often encourage them to try a casual experiment, by asking roommates or friends to name a famous female scientist (leaving aside any of their own professors, parents, or other personal acquaintances). I suggest to my students that nine times out of ten, people will immediately respond, “Marie Curie.” Despite the fact that Curie died more than eighty years ago, in many people’s eyes, she still personally stands for the entire history of women in science. As students may also learn, however, nine times out of ten, those questioned may prove unable to think of any other female scientists, and nine times out of ten, they may not actually know much about Curie’s background, experiences, and accomplishments.

Learning about the life and work of Marie Curie represents an invaluable historical case-study, of course; her discoveries, influence, and Nobel Prizes represent excellent reasons why her name has become so powerfully symbolic. (Ogilvie, 2004; Wirten, 2016) Yet in order to even begin understanding the history of women and gender in science, as well as engineering and medicine, students need to think beyond the “great name(s).” Working with archival collections and primary-source material offers a natural, important approach for helping students appreciate this wider history, as well as its relevance to ongoing discussions about diversity in STEM.

Tucked into their physics, chemistry, or biology textbooks, elementary, high-school, and college students today often encounter sidebar vignettes talking about female scientists, as well as minorities and participants from other cultures. Well-intentioned authors and publishers may incorporate such brief material with the aim of pushing both male and female students alike to recognize that science does not “belong” to any single group. Studies suggest that finding precedents in STEM may be useful in making some young women feel more comfortable in traditionally male fields, though research also shows how “role models” can have complex

effects. (Betz and Sekaquaptewa, 2012) In the end, however, this “add women and stir” technique, as it has often been described, proves far less than ideal. Learning about individual figures in isolation does not help students think more broadly about questions of gender, power, and knowledge in STEM. A focus on “great names” (even when drawn from a wider pool) risks concealing the nature of science, engineering, and medicine as socially-constructed human enterprises. A proper look at the history of women in STEM requires integrating it with the larger context of American women’s history, including the complex trajectory of women’s access to education, paid employment, and legal protection.

Similarly, history majors are not well served by textbooks and treatments that offer nuanced analysis of women’s experiences in politics, activism, workplaces, personal life, etc., only to omit or skate over the history of women in science, engineering, and medicine. Given the large and growing influence of STEM over recent centuries, all students can benefit by learning how those fields developed, intellectually, professionally, and socially. Spotlighting the rich possibilities for archival investigations of gender in STEM history offers the potential for helping close the “two cultures” gap from both sides. Just as those in the STEM world can gain immeasurably by adding historical depth to their approach to today’s hot-button diversity issues, so too historians can profitably complicate the broad picture of women’s personal, family, and community lives by incorporating more studies of women and gender in STEM.

Before delving into special collections, students can gain important background perspective through careful reading in the historiography of women and gender in STEM. Students should quickly begin to realize the many ways in which science, engineering, and medicine have a gendered history. They will see, for instance, the pattern in which twentieth-century advocates promoted science, medicine, and engineering to young men, promising solid

careers enabling them to marry, establish homes, and support children. Industrial, medical, and academic STEM jobs were constructed around assumptions that stay-home-mothers freed male employees to concentrate on work without distraction by domestic demands. Caltech linked “success as a research scientist or engineer” to the 1967 observation that most faculty “spend relatively little time with their wives.” Such conservative gender and family-role visions both reflected and reinforced associations of STEM with masculinity. (Oldenziel, 1999; Bix, 2014)

Yet with American women’s growing access to higher education, the twentieth-century brought increasing numbers of women into science, technology, and medicine, who rarely enjoyed the luxury of neatly separating work and family. Many were denied opportunities by employers who assumed that serious STEM accomplishment and family were incompatible. To remain professionally active, some women changed career direction, moved in and out of the workforce, or created their own medical practices and entrepreneurial businesses. (Rossiter, 1983, 1995, 2012; Des Jardins, 2010) Especially when they were formally excluded or casually deterred from joining existing scientific associations and honor societies, women in STEM formed their own organizations to share professional advice, support each other, and press for change.

Over recent decades, the historical literature about women and gender in STEM has developed impressively. For purposes of this paper, I highlight here the coverage of women and gender in the history of American science, engineering, and medicine. However, for full perspective, it is ideal for students to learn about the history of women, gender, and knowledge across the full human timespan and across international contexts. (Schiebinger, 1989; Furth, 1999; Sheffield, 2006; Watts, 2007)

Once grounded in this rich context, students who are eager to tackle primary sources for

the history of women and gender in STEM can find a growing availability of material online. For example, Wayne State University houses collections of the Society of Women Engineers (SWE), one of the oldest and most influential organizations for female engineering students and professionals. (SWE 2015) Building on local gatherings that small groups of women in engineering began holding on the East Coast during the late 1940s, about sixty of them met in New Jersey in May 1950 to establish SWE. Archivists have posted photographs from that founding meeting (including formal group poses and informal images of the women checking in, picnicking, playing baseball and badminton) along with other photos documenting SWE's members, activities, and growth from the 1950s to the present. (SWE archives)

Online SWE material also includes audio clips, video clips, and transcripts of oral-history interviews with more than sixty current and former officers and members. (SWE archives; SWE Pioneers) Working through this, students can derive substantial insight into questions about how, when, and why women entered American engineering. In oral histories, for example, many female engineers speak about their unconventional interests met with teasing, criticism, or discouragement from mothers, fathers, teachers, friends, and peers. But in interviews, these women also talk about the factors that helped them persist, their love of knowledge, and sources of support. The background of Maryly VanLeer Peck, the first woman to earn a chemical engineering degree from Vanderbilt (1951), for instance, illustrates a common pattern, early female engineers who grew up in engineering families. With a father who was president of Georgia Tech and a mother who was one of the country's earliest female architects, Maryly was soon "introduced to a lot of interesting people," including pioneering engineer Lillian Gilbreth, "So certainly I knew, one, what engineers did, and... that it wasn't confined to just young men." (Van Leer Peck, 2003) Online material includes interviews with Betty Lou Bailey, who worked

at General Electric from 1950 to 1994; Eleanor Baum, the first woman in the US chosen as dean of an engineering college (at Pratt Institute in 1984); astronaut and engineer Bonnie Dunbar; Thelma Estrin, president of the Biomedical Engineering Society; Ruth Gordon, entrepreneur in earthquake engineering; Lois Graham, the first female Ph.D. in mechanical engineering; Arminta Harness, the first female engineer with the U.S. Air Force; Westinghouse engineer Naomi McAfee, and others. In interviews, these women speak about what drew them individually into engineering, their experiences in college and career, and their views about gender and STEM more generally.

By analyzing these online oral-history interviews, students can get a good sense of the multiple challenges that the first generations of female engineers experienced, in moving into one of the most traditionally male-professions. To note just one example, in a 2008 interview, Mary Anderson-Rowland remembered that when she became the first female engineering faculty member at Arizona State University in 1974, the “male faculty members did not throw a party for me. They were not happy.” Given the anti-nepotism rules in place that for years had kept some women out of positions if their husbands had jobs in the same institution, Anderson-Rowland recalled that she took the advice that she should “lay low.” (Anderson-Rowland, 2008)

Instructors with access to the database “Women and Social Movements in the United States” (or using free trials) can have students work with thirty-one documents illustrating the first twenty-five years of SWE history. (Women and Social Movements) The set contains multiple letters, reports, and other documents from Beatrice Hicks, SWE co-founder and first president. These papers illustrate not just her personal perspective and the work of SWE, but also the essential historical context of the era. In 1951, in the depths of McCarthyism, some potential members wanted confirmation that the newly-created organization would not engage in anything

that critics might attack as “subversive.” To avoid scaring anyone away and build the largest possible group, Hicks and SWE’s board of directors decided to specify that their organization had no political affiliation and would not lobby on legislative issues. (Hicks, 1951)

Online material also highlights the role of local SWE chapters and student sections. SWE currently has local/regional groups in every state in the country (as well as abroad).

Undergraduate and graduate researchers in many places may well discover that their school (or one nearby) has a SWE chapter, for which campus archives may contain valuable historical material. Researchers will do well to build on such archival SWE documents by looking at local publications, yearbooks, and other campus sources, to tease out more information about their local SWE chapter.) While recent scholarship has deepened understanding of the history of women at the national level, at some universities, and in certain areas, many opportunities remain wide open for locally-oriented analysis of the history of women in engineering. By learning through primary sources just how strongly the occupation of engineering was gendered as male, over more than a century, students may gain new perspective on some possible reasons that engineering remains one of the most gender-imbalanced areas of academic study today, despite women’s growing participation in the field over recent decades.

One particularly interesting case-study for the history of women in STEM is the story of women in computer science. In 1985, female students earned 37% of all U.S. undergraduate computer-science degrees; by 2012, their share had plummeted to 18%. Historians, sociologists and computer scientists themselves have offered various interpretations and explanations of that phenomenon. (Margolis and Fisher, 2002; Misa, 2010; Abbate, 2012; Aspray, 2016; Hicks, 2017) Students can begin thinking about the intersections of gender and computer history by consulting a rich set of online oral-history interviews with female computer scientists and

engineers. (Women in Computing Oral History Collection) In these conversations, influential women discuss how they chose that field, what educational preparation they had, their career paths, and their own analysis of “hitting the glass ceiling” and other gender issues in the discipline. Particularly exciting interview subjects include Anita Borg, who established the influential Grace Hopper Celebration of Women in Computing, and the Institute for Women and Technology; Betty Campbell and Judy Clapp, who helped develop early computing machines at MIT; Adele Goldberg, former president of the Association for Computing Machinery; Susan Graham, UC-Berkeley’s first female engineering professor; Lois Haibt, the lone woman working on IBM’s development of FORTRAN; and Elsie Shutt, who in 1958 set up the first American company of freelance female computer workers. Shutt explained that thanks to her mother’s work as a laboratory technician, she had always “gravitated toward science.” In her interview, Shutt comments on a vital dimension of computer history, the fact that manpower shortages during World War II meant that computer builders recruited women to serve as some of the first-ever programmers for ENIAC and other calculating machines. (Light, 1999) That pattern meant that into the postwar years, women continued to remain a vital part of computer development and work. Shutt learned to code as a graduate student, working in the all-female programming department at Maryland’s postwar Aberdeen Proving Ground. In her interview, Shutt noted, “I thought it [programming] was a woman’s field at first, and I do think it was. And then men discovered it was really interesting.” But as students will discover, postwar women encountered multiple difficulties in the work world, including the obstacles to balancing family and employment. Shutt left corporate employment upon having babies, soon created her business, and became known for hiring “pregnant programmers.” Women with children, like Shutt herself, appreciated the scheduling flexibility and valued freelancing as a means “to stay up to date in a

rapidly changing field, so that when the children were grown and left, you could go back to a career.” (Shutt, 2001)

Moving from the history of women in engineering to women in science, students and researchers these days can find a wide variety of archival material available online. The American Institute of Physics website hosts a large number of oral-history interviews, including several dozen with women. Mining these presents evidence and insights into the broader story of women in physics. For example, given the all-male nature of so many colleges in the nineteenth-century and early twentieth-century, women’s colleges such as Mount Holyoke, Vassar, Wellesley, and Bryn Mawr played a vital role in giving young women access to physics training. These colleges also offered faculty employment to women, in an era when most scientific departments remained resolutely male. The AIP offers several oral histories with female physicists whose careers were connected with women’s colleges, such as Lucy Wilson, Janet Guernsey, Dorothy Heyworth, and Mildred Allen. AIP has online interview excerpts and/or transcripts available for some of the most well-known women in American and international physics and astronomy, including Jocelyn Bell Burnell, who led in the discovery of pulsars; Cecelia Payne-Gaposchkin, who analyzed composition of the sun and stars; Vera Rubin, who confirmed the presence of dark matter. Other interview subjects of interest include Betsy Ancker-Johnson, Esther Conwell, Andrea Dupree, Helen Hogg, Hilde Levi, Margaret Mayall, Nancy Roman, Charlotte Moore Sitterly, Henrietta Swope, and Beatrice Tinsley. (AIP Oral History Interviews)

Oral histories give these fascinating women’s first-hand accounts of what first stimulated their interest in physics or astronomy, what they experienced in male-dominated classrooms, laboratories, and workplaces, and how they feel about their career directions and intellectual

accomplishments. For example, Jocelyn Bell Burnell's life has been the subject of complaints about injustice for years. As a graduate student, she was the one who detected the anomalies in radio-telescope data that led to detection of radio pulsars, and her name came second on the 1968 paper documenting that discovery. However, in recognizing that breakthrough in 1974, the Nobel Prize committee gave its award to two men, Burnell's thesis advisor and another supervisor. In this 2000 interview, Burnell said that she was just delighted at the time to see a Nobel Prize honoring astronomical discovery and that her friends at the time joked about the pun "Nobel = No Bell." She also talked about the effects on her personal life, saying that "my husband became twitchy at my successes, and I learnt to play them down, certainly at home and probably in other circumstances as well." (Bell Burnell, 2000) Students can compare Burnell's AIP interview to comments that she made on the controversy on other occasions, reflecting about what has changed and what hasn't for women in science over these years. For further reference, UCLA has a good online collection of articles by and relating to female physicists.

(Contributions of Twentieth-Century Women to Physics)

As students come to realize just how long it was before Harvard, Yale, Princeton, Caltech, and a number of other American universities even considered opening degree programs or faculty rosters to women, it is useful to remind them that in order to find women in the history of science, you need to know where to look. That principle leads to understanding the significance of women's colleges in hiring female faculty and staff to teach astronomy, biology, chemistry, geology, physics, anatomy, and other sciences to female students. Similarly, the 1862 Morrill Act fostered the creation of public land-grant colleges, many coeducational from the start, in an era when many Americans still found that concept controversial. Generations of young women studied math and science as part of their preparation to become schoolteachers,

college-educated wives for college-educated men, and home economists. The entire field of home economics, often known as “domestic science” or “domestic engineering,” provided a vehicle and a rationale for expanding women’s higher education in the late nineteenth century and well into the twentieth. Female professors pursued research in nutrition, child care, kitchen-equipment studies, and other technical topics, while teaching young women to become consumer advocates, institutional managers, home-ec teachers, “women’s page” journalists, food-company testers, or efficient modern homemakers. (Elias, 2010; Stage and Vincenti, 1997; Goldstein, 2012; Bix, 2002) Students at schools with a deep history of home-economics programs (especially Cornell, Kansas, Wisconsin, Iowa State, Illinois, and many other public universities) should be able to locate rich archival material on the hiring, promotion, scholarship, and curricula of female faculty, along with department publications, scrapbooks, student theses, and many similar records. Cornell hosts a major online resource in the history of domestic science that includes decades-long runs of journals in the field, as well as books from the late 1800s and early 1900s. (HEARTH) A second Cornell website offers a guided tour through home-ec history, illustrated with visual and written primary sources and a few oral histories. (What Was Home Economics) The University of Wisconsin similarly offers online documents from the archives of its respected School of Human Ecology, as well as decades’ worth of photos showing Madison’s female students in bacteriology lab, reading to children, designing clothes, and more. (The Human Ecology Collection) Students will be amused by the period feel of a 1951 film, “The Home Economics Story,” produced by Iowa State College to help explain why high-school women should consider pursuing home-ec degrees. (The Home Economics Story, 1951)

Switching focus to the history of medicine, a quick introduction to the field can remind students that across cultures, women traditionally served as family caretakers, community

healers, and midwives. Images and transcriptions of Martha Ballard's 1785 to 1812 diary are available online, through a website with tips for deciphering her handwriting and comments on significant themes in her life, including her treatment of scarlet fever, attitudes toward marriage and premarital pregnancy, and her observations of human dissections performed by male doctors. (Martha Ballard's Diary)

The history of nursing as a formal feminized profession is well-documented online. Various sites have begun making available the correspondence of Florence Nightingale, which touches on important themes in her life, work, and attitudes toward healing, including the improvement of hospital building and design, sanitation, and military medicine. (Florence Nightingale Digitization Project; Florence Nightingale Letters Collection; Florence Nightingale Selection of Letters) Thanks to popular interest in the Civil War, there is sizable scholarship on both Union and Confederate nursing. The Library of Congress has posted letters and other documents from both Mary Ann "Mother" Bickerdyke, and American Red Cross founder Clara Barton. (Mary Ann Bickerdyke Papers; Clara Barton Papers)

Libraries, nursing schools, universities, hospitals, public-history groups, and state and local groups have made available an impressive range of primary-source material on nursing from the late 1800s through the twentieth-century. An excellent site on North Carolina nursing history brings together photo collections from multiple sources. Studying nursing-school yearbooks and comparing ones from different places or years, students can get a sense of who were the students (female), faculty, and administrators (both genders). Photos showing student class exercises, socializing, and leisure are excellent sources, as are yearbook "class histories" and "class prophecies." Images of students wearing traditional nursing uniforms, caps, and gowns illustrates both the professionalization and the feminization of nursing. These photographs

also allow students and researchers to connect the history of nursing to broader medical history; for example, images of nurses working with patients in iron-lung machines provide a gateway to discuss the history of polio, public fear of the disease, and the development of treatment and vaccination. (North Carolina Nursing History) The Graham Hospital School of Nursing Library in Illinois also has posted such photographs of nurses across the decades, along with documents (nursing-school exams, study notes, student scrapbooks, old nursing licenses), along with photographs of nineteenth-century bone saws and other surgical equipment. (Graham Hospital School of Nursing Library) Other sites document the lives and work of individual nurses, such as late-nineteenth-century Pennsylvania nurse Mary Clymer, and Caroline Benoist, one of Mississippi's first public-health nurses in the 1930s and 1940s. (Mary Clymer collection; Caroline Benoist collection)

The life and work of Elizabeth Blackwell, the first American woman to earn an M.D. degree, deserves note, as a natural opening to study the history of female physicians. (Elizabeth Blackwell; Blackwell Family Papers). Drexel has digitized yearbooks, photographs, documents, diaries, and ephemera from several Philadelphia nursing and medical schools, including the Women's Medical College of Pennsylvania, one of the first American institutions founded specifically to train female doctors. Some of these primary sources have been assembled into a guided timeline lesson. (Yearbooks from Medical Colleges; Women Physicians; Doctor or Doctress?)

Going further, researchers can hunt for material by executing well-selected keyword searches (for example, "nurses") within the website of the US National Library of Medicine, which turns up nineteenth and twentieth-century nursing manuals, war-nurses memoirs, and other extensive and varied material. A NLM search for "women" turns up an even wider array of

sources, ranging from Victorian books and medical lectures on women's diseases, to relatively-recent posters from awareness campaigns on women and AIDS, domestic violence, WIC food programs, and more. (National Library of Medicine) One additional source of importance to note is the collection of Margaret Sanger's papers, including online versions of many of her articles, speeches, and editions of *The Woman Rebel*. Studying Margaret Sanger's life and work can open discussions about the training and community work of nurses, about early twentieth-century ideas and issues of health, poverty, family well-being, immigration, and urbanization, about the history of women's activism and women's rights, and about the long medical and social history of sexuality, contraception, and abortion. (Margaret Sanger Papers Project)

Iowa State University's Special Collections Department hosts the Archives of Women in Science and Engineering, pulling together over one hundred sets of material relating to individual female scientists and engineers, plus records of national and regional groups for women in STEM. Some material is available online, including portions of oral-history transcripts from interviews with seven female chemists from across the U.S. An unusual episode that may intrigue many students is the World War II Curtiss-Wright Engineering Program, for which Iowa State has made available digital copies of photographs, documents, and even films. Desperately short of manpower, the Curtiss airplane company needed technical support to reach its defense production goals, so Iowa State was one of seven schools that set up programs to train female students to become engineering aides. The initiative gave about seven hundred young women a ten-month immersion course in aeronautical engineering. The Cadette material illustrates how much these female students enjoyed the challenge of mastering what had always been considered a man's field and their patriotic pride in doing their bit to serve the country. (Iowa State University Archives for Women in Science and Engineering)

In addition to drawing on these growing sets of digital material, students have a good chance of finding valuable sources for the history of women, gender, and STEM right on their own campus, at almost any school. Students can start by establishing the historical fundamentals – was their college or university established as coeducational or a women’s institution? If so, what type of access to scientific training did it offer to female students early on, and how did that change over the decades? For this topic, as noted, it pays for students to explore well beyond records of science departments alone. Land-grant schools commonly required women majoring in home economics to take substantive courses in physics, chemistry, and human biology. Looking at local records of home-economics programs can thus help students understand how these departments gave women access to serious science work, but in ways legitimized through a highly-gendered domestic and care-giving context. Similarly, medical and nursing school programs are natural sources for the study of women and gender, but looking at animal-science programs also can prove valuable. Late-nineteenth-century veterinary-medicine training at agricultural colleges emphasized farm-service practice, where male students learned to handle oxen, hogs, and other large animals. By the late twentieth-century, veterinary-medicine students increasingly concentrated on treatment of small household pets, a shift that opened new professional opportunities for women, but also lowered salaries. (Irvine and Vermilya, 2010; Lincoln, 2010)

For students at institutions that originated as male-only, administration and trustee papers, newspapers, oral histories, and many other archival sources can help students explore when, how, and why the move to admit women occurred, and what challenges and questions that change raised. Beyond that, research can investigate what old college catalogs, yearbooks, department records, and collections of personal papers show about gendered hiring in STEM,

comparing local patterns to national trends. When did their institution hire the first female faculty, were they able to gain promotion? Who served as laboratory assistants and support staff, who were the administrators? Did the institution have support groups for female employees, how did it respond to equal-employment opportunity initiatives? Taken together, such stories can bring home to students, right in their own institution, the historical gendering of science and engineering. Special collections departments hold decades-worth of university bulletins and course catalogs, which students can learn to scour for overt and encoded assumptions about gender and STEM. For instance, early twentieth-century course catalogs at Iowa State College listed two separate classes on dairying, with slightly different titles; descriptions and prerequisites of the class based in the agricultural department made it clear that it was intended for male students, while the other dairying class was positioned to accommodate women.

Upon consulting archivists, students may find that their home institution contains other collections that can serve as lenses for looking at the history of women in science, engineering, and medicine. Almost every educational institution in the United States, for example, instituted special programs during World War II, including crash courses to train women (and men) in scientific and technical fields deemed essential for national defense. Colleges in Texas created wartime classes in petroleum engineering, colleges in California trained airplane-factory workers, and colleges nationwide instituted special training in production and safety engineering, applied mathematics, and more. Looking at those emergency measures can underline lessons about how a wartime mentality temporarily altered (or at least called into question) gendered assumptions about what was and was not “proper” for women. (Bix, 2005; Puaca, 2014)

There remain many other possibilities for material in local special-collections departments that students can search out, regarding the history of women in STEM. Many

university special-collections departments may hold the papers of female faculty members, administrators, alumna, and staff members in STEM, or oral histories with these figures. Bits of information may lie scattered in master's theses or doctoral dissertations, obituaries, census records, or other wide-ranging sources. Archives may hold papers of the campus chapters of SWE, AWIS (the Association for Women in Science), Graduate Women in Science, or locally-constituted programs to support women in STEM, which became increasingly popular from the late 1960s onward. By digging into this material, researchers can pinpoint when such groups were founded, what issues rose to the top of their agendas during different periods, and how they connected with other local and national programs for women and programs for scientists and engineers. The relationship between such programs for women in STEM and feminism, for example, has often been a complex one, in which many participants might embrace much of the women's rights language and aims but reject overt identification as "feminist.

Even as students learn to dig out such material both online and in their own area, most may come to realize how relatively difficult it can still be to find good information about women and other underrepresented groups in STEM, even in the archives of institutions where they spent years. It is worth asking undergraduates to reflect on that phenomenon and link this to the broader story of historical attention to women, minorities, and "others" in the United States. Students can engage with questions about how professionals and the general public have assessed whose history is most valued, most important to preserve, and most meaningful to know.

In instances where the local archives lack deep collections of material on women in STEM, courses seeking to explore the history of gender and STEM might require students to perform their own oral-history interviews, interpreting them through written analysis and sharing

insights in collaboration with classmates. The value of such an exercise is clear; for one thing, assuming first-hand responsibility for collecting source material drives home for science and engineering students the lesson that research in history is ongoing, just like scientific investigation. More than that, student participation can help correct archival silences, especially if students learn to work closely with local historians, librarians, and other specialists in planning and carrying out interviews and arranging consent to donate resulting material to special collections.

The frustration of finding fewer archival sources than might be hoped can pave the way for student reflection and discussion about the limitations of established collections. This is particularly significant for conversations about the history of gender in science and technology, where for decades, as Margaret Rossiter and others have documented, female graduates were channeled into employment as science and engineering librarians, laboratory assistants, museum curators, data-crunchers, and other low-pay, low-status “women’s work.” (Rossiter, 1983, 1995, 2012; Mack, 1990; Rayner-Canham, 1996; Madsen-Brooks, 2009; Sobel, 2016) Students will soon recognize that many traditional source-collecting paths overlooked or downplayed women’s participation in the scientific enterprise, thereby obscuring their essential role. To facilitate dialogue about this topic, students might profit by watching the film *Hidden Figures* or, better, reading the book, in which author Margot Lee Shetterly explains how her childhood experience growing up in Washington-area black communities gave her the inside lead for conducting interviews and uncovering other buried sources for this intriguing history. (Shetterly, 2016)

Hidden Figures, of course, can create pathways for important considerations of intersectionality. It is worth pointing out to students that the same techniques described above for accessing the history of women in STEM may also be useful for approaching the history of race,

class, and other identities and factors in STEM. Students may seek out papers and other documentary material for local chapters of the National Society of Black Engineers, the Society of Hispanic Professional Engineers, or perhaps the California-based Triangle Area Gay Scientists, the Los Angeles Gay and Lesbian Scientists, or the National Organization of Lesbian and Gay Scientists. Again, their speeches, writings, and biographical accounts (both individual and collective) can guide students to think about the normativity of professional enculturation, the value of diversity, and the way scientific and technical communities both reflect and shape broader social and political debates about the nature of American life.

Such archive-based analysis can give science and engineering majors entry points for critical thinking about ethics and social justice in STEM fields today. They may see how women and male allies organized, both locally and nationally, to share their concerns and mobilize for change. For example, minutes of women's STEM associations at MIT in the 1960s and 1970s show how students, faculty, and staff began discussing what later generations would call sexual harassment and their common frustration at come-ons, put-downs, and brush-offs. Classes can connect this story to the broader context of the rise of second-wave feminism, creation of the National Organization for Women, and consciousness-raising groups. That history opens a path for conversations about recent and ongoing issues of sexual harassment and employment inequities in reputable college STEM programs and in Silicon Valley, where headlines have brought a flood of revelations about problems at Google, Uber, Tesla, Microsoft, and other world leaders in high-tech.

Looking back at history, students may also be able to identify the roots of today's high-profile, million-dollar campaigns to draw more young women and minorities into STEM. Back in the 1950s, SWE members poured enormous energy into encouraging young women who

defied convention to express interest in engineering, speaking to high-school students, parents, and counselors. Today, government agencies and institutions (the National Science Foundation, National Academy of Engineering) collaborate with universities, K-12 schools, museums, libraries, the Girl Scouts, the YWCA, sponsoring corporations, and other partners to host conferences, create websites, organize summer camps and special programs, all geared toward encouraging girls and minorities to pursue STEM opportunities. Yet over these same decades, psychologists, educators, sociologists, scientists and engineers themselves have worked to tease out the complex factors that still keep women under-represented in physics, mechanical engineering, and many other STEM specialties. By looking at the literature on “chilly classrooms,” “stereotype threat,” the “imposter syndrome,” and other issues, students can begin thinking about connecting the long history of gender in STEM to topics of immediate relevance today.

As the above examples indicate, archival collections all over the United States contain a wealth of material that can help science and engineering students (as well as counterparts majoring in history or other areas) first-hand insight into issues of gender and STEM. Sources illustrate complex intersections for women simultaneously shaping professional and personal identities. Though limited by certain common gaps in collecting practices, these sources of personal stories illuminate the historical gendering of American science, medicine, technology, and innovation. Science and engineering students frequently find the specialized study of the history of women and gender in science intriguing; they often enjoy it more than “straight” undergraduate history survey courses, since the STEM focus carries personal relevance for them. Through a pedagogy that foregrounds women’s lived experiences across decades in science, technology, and innovation, educators can bridge gaps between STEM majors and other students

through engaging dialogue about archival stories that illustrate the past/present/future gendering of intellectual life and work in the United States.

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