

Lesson Plan

The Physical Sciences at Women's Colleges



*Young women conducting an experiment in the Physics Laboratory, Wellesley College. The original building, College Hall, burned down on March 17, 1914.
Photo courtesy AIP Emilio Segre Visual Archives*

Grade Level(s): 9-12

Subject(s): History, Physics, Contemporary

In-Class Time: 70-90 Minutes

Prep Time: 15-20 Minutes

Materials

- Copies of AIP Physics at Women's Colleges Selection Table (found in Supplemental Materials)
- Word Processor or Microsoft Publisher
- Internet access and credible research sources (see Required/Recommended Readings)
- Copies of the Analyzing Historical Photographs Worksheet (found in Supplemental Materials)
- (Optional) Map of the United States

Objective

In this lesson plan, students will be introduced to the history of women's colleges in the United States and their role in physical science education. Students will learn about opportunities to earn a Bachelor's or graduate degree in physical science at different women's colleges. Using photographs and other primary source material, students will research the long history of the physical sciences at women's colleges.

Introduction

The first institutes of female higher education were created in the mid-1800s.¹ They naturally tended to grow in the locales in which there were enough women able to take advantage of higher education; these tended to be larger towns and cities in the eastern part of the United States.

Founders of these women's colleges frequently believed that women ought to be able to learn for the same reasons that men did – for a career or simply because they wanted to. But the founders of new institutions had to justify women's higher education in the language and needs of the time. Various arguments were made against women's education in the early nineteenth century (and for many years before and since.) For example, in the early eighteenth century it was commonly believed that a woman was incapable of higher education, and even if she were capable that it was probably inadvisable. It was thought that much of a woman's bodily and mental energy was taken up by the maintenance and use of her reproductive system. Many people also worried that an educated woman would become radicalized in her political views, or become masculinized and try to take over men's jobs.

Advocates for women's education made a number of counter-arguments. They argued that women without means or a man to take care of them would find themselves a burden on society if they could not support themselves. Once a woman's college was established, they also published physical evaluations of their students to show that education caused no adverse health effects. And importantly, advocates for women's education asserted that higher education would actually make the women better wives and mothers.

Women's colleges justified teaching the sciences in much the same way. For example, at Mount Holyoke College, science instruction gave the students an "empirical understanding of natural laws" which "buttressed scholarly integrity by Christian ideals of personal witness rather than simple moral discipline."² By the 1830s, higher education for women was becoming increasingly accessible to the middle classes. While more women were attending college, there remained a strong gender divide. Liberal arts, the classics, and Latin or Greek were perceived as subjects reserved for men to study, and as a result scientific courses (like astronomy, chemistry, or natural history) were left to the women.³ Women's early access to science in higher education was thereby a byproduct of a conservative social structure. Women's colleges received a boost in the later 1800s when it was realized that graduates of the college could work as teachers in the expanding American west for much less pay than a man. Many new women's colleges were founded, especially in the decades after the civil war.

Beginning in 1968, a number of male-only colleges became coeducational. Some women's colleges, such as Radcliffe and Pembroke, were absorbed into nearby male colleges (Harvard and Brown, respectively).

¹ For example, Wesleyan College (originally Georgia Female College) was chartered in 1836, and Mount Holyoke College (originally Mount Holyoke Female Seminary) in 1837. Saint Mary-of-the-Woods College, the first Catholic women's college, was chartered in 1846.

² Levin, Miriam R. *Defining Women's Scientific Enterprise: Mount Holyoke Faculty and the Rise of American Science*. Hanover: University Press of New England, 2004. Pg. 27,28

³ Kim Tolley, *The Science Education of American Girls: A Historical Perspective* (New York and London: RoutledgeFalmer, 2003), 42-49.

Barnard College strengthened its connection to nearby Columbia University, but has remained separate. Many other women's colleges, like Vassar, became coeducational.

There still are many types of women's colleges in the United States. A number of women's colleges are denominationally Catholic, and one (Stern) is denominationally Jewish. Spellman College is a historically Black college as well as being a women's college. Typically, women's colleges that offer graduate degrees have made their graduate programs co-educational.

Debates continue today about the relevance or necessity of women's colleges. However, a number of studies indicate that women's colleges do provide tangible benefits to their students. For example, graduates of women's colleges are more likely to pursue non-gender-normative subjects, attend graduate school, or take up recognized leadership positions.⁴

In this lesson plan, students will acquire an overview of 7 women's colleges that offer degrees in the physical sciences. Through research into the history of these institutions, students will determine the significance of women's colleges and their physics programs. Students will also use historical photographs to compare and contrast physical sciences education at different women's colleges and in different times.

Instructions

Engage: 5-10 Minutes

Teachers will introduce students to the history of women's colleges and universities through a short discussion. Information for this discussion can be found in the introduction to this lesson plan.

What is the teacher doing?

Introduce students to the history of women in higher education. Discuss the early resistance to their inclusion, and the emergence women's colleges and institutions in the nineteenth century.

Ask students if they can name any women's colleges, and (if available) use the map of the United States to emphasize their geographic distribution as they are mentioned.

What are the students doing?

Participate in the discussion about the history of women in higher education and the formation of women's colleges. Note the historical context during the time many of these institutions emerged (Hint: Victorian Era, ideals of "sheltering" women).

Name any known women's colleges. If available, note or show their location on the map of the United States. Note their geographic distribution. (Why predominantly the Northeast?)

⁴ Judith L. Stoecker and Ernest T. Pascarella. "Women's Colleges and Women's Career Attainments Revisited." *The Journal of Higher Education*. Vol. 62, No. 4 (Jul. - Aug., 1991), pp. 394-406

Daryl G. Smith. "Women's Colleges and Coed Colleges: Is There a Difference for Women?" *The Journal of Higher Education*. Vol. 61, No. 2 (Mar. - Apr., 1990), pp. 181-197.

See citations in these articles for further references, especially publications by Elizabeth Tidball and Vera Kistiakowsky.

Explore: 45-50 Minutes

Students will read the overview of women's colleges from the Women's Colleges Selection Table (found in the Supplemental Materials), split into 7 small groups, and be assigned a women's college from the table to research. They will conduct research on their chosen institution, and then create a brochure for their institution and its physics program.	
What is the teacher doing? Split the class into 7 small groups. Distribute the Women's Colleges Selection Table (located in the Supplemental Materials) to each group. Assign each group an institution from the Selection Table to research. Assist student research by providing the Discussion Questions (located in the Supplemental Materials of this lesson plan)	What are the students doing? Split into 7 small groups. Receive and examine the Women's Colleges Selection Table provided by the teacher. Once assigned an institution from the list, conduct research on it. To guide research, consider the Discussion Questions provided by the teacher, in addition to other pertinent information about the selected institution and its physics program.
Have each group use their research to create a brochure advertising their assigned college or university and its physics program. Assist groups in organizing or attaining information for their brochures. When students are ready to include photographs, the College Women search tool, the Emilio Segré Visual Archives, the Library of Congress and the Smithsonian digital photo repositories are excellent starting points (links found below in Required/Recommended Readings).	Use the research to create a brochure to advertise the assigned university or college and its physics department. Brochures should address the history of the institution AND women's colleges generally, physics programs offered, and notable graduates. They should also be visually appealing and well-organized, containing text and graphics/photos.

Explain: 10-15 Minutes

Students will present their brochures to the class, educating their peers about the various institutions, their histories, and the physics departments at each. In addition, this is a potential source of evaluation by the teacher.	
What is the teacher doing? Observe (and if desired, evaluate) student presentations of brochures. Be sure students have addressed all relevant questions and information, posing additional questions if not.	What are the students doing? As groups, present brochures to the class. Address the research questions, and any additional questions posed by the teacher or the class.

Elaborate: 10-15 Minutes

Students will re-form into their 7 small groups, and examine historical photographs from historical women's colleges via the Analyzing Historical Photographs Worksheet (found in the Supplemental Materials). Each group will create a captions based on what is observed. Groups will then share their captions with the class and compare them to the actual versions. If desired, collect student captions and evaluate.
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<p>What is the teacher doing?</p> <p>Split students back into their groups. Provide each group the Analyzing Historical Photographs Worksheet. Instruct them to examine the photographs, and to create a captions based on what they observe.</p> <p>Have groups share their photo and constructed caption with the class, then as a class compare the student captions with the actual ones.</p> <p>If desired, collect student captions and evaluate for participation and effort.</p>	<p>What are the students doing?</p> <p>Return to small groups. Each group receives the Analyzing Historical Photographs Worksheet (provided by the teacher).</p> <p>Examine the photographs. Note the placement of individuals in relation to each other and the camera, the setting, and how formal each photograph appears to be. Create captions based on observations.</p> <p>Share captions with the class. After all groups have presented, compare the student captions with the actual ones provided by the teacher.</p> <p>If instructed, submit captions worksheet to the teacher for participation and effort evaluation.</p>
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Evaluate:

Opportunities for evaluation occurred organically during the explanation and elaboration sections of this lesson. Teachers may elect to evaluate student brochures and presentations. In addition, teachers may collect the groups' captions from the Analyzing Historical Photographs worksheet, and evaluate student effort and participation.

Required/Recommended Reading and Resources

Research and Brochure Section

- The Physical Sciences at Women's Colleges Selection Table (found in Supplemental Materials)
- *Women's College Coalition*: list (of a majority) of women's colleges in the United States, with a search tool to find schools with specific programs (i.e. Physics):
<http://womenscolleges.org/colleges>
- *College Women*: digital collection of primary documents and photographs from women at the "Seven Sisters" Schools:
<http://www.collegewomen.org/>
- Emilio Segré Visual Archives
<https://photos.aip.org/>
- Library of Congress Prints and Photographs Online Catalog
<http://www.loc.gov/pictures/>
- Smithsonian Institution Research Information System
<http://www.siris.si.edu/>

Analyzing Historical Photographs

- AIP Physical Sciences at Women's Colleges Historical Photograph Worksheet (Supplemental Material)

- (Optional) Library of Congress “Teacher’s Guide on Analyzing Photographs & Prints”:
http://www.loc.gov/teachers/usingprimarysources/resources/Analyzing_Photos_and_Prints.pdf.
- (Optional) National Archives and Records Administration “Photo Analysis Worksheet”:
http://www.archives.gov/education/lessons/worksheets/photo_analysis_worksheet.pdf

Discussion Questions

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

1. Where is your institution located?
2. Who or what was your institution named after?
3. When was your institution founded?
4. Why was your institution founded?
5. Was the institution affiliated with a church at its inception?
6. What was/is the academic focus of the institution?
7. Does the institution offer a Bachelor’s, Master’s, and/or PhD program in Physics or a related discipline?
8. What are the major courses offered in Physical Science curriculums?
9. Has the institution remained single-sex? If not, how and when did this change?

Further Reading and Additional Resources

Tolley, Kim. *The Science Education of American Girls: A Historical Perspective*. New York and London: RoutledgeFalmer, 2003.

Peril, Lynn. *College Girls: Bluestockings, Sex Kittens, and Coeds, Then and Now*. New York and London: W.W. Norton, 2006.

Levin, Miriam R. *Defining Women’s Scientific Enterprise: Mount Holyoke Faculty and the Rise of American Science*. Hanover: University Press of New England, 2004.

Thelin, John R. *A History of American Higher Education*, 2nd Edition. Baltimore: Johns Hopkins University Press, 2011.

Extensions

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

- The Physical Sciences at Historically Black Colleges and Universities

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.9-10.2</u>	Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
<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.9-10.5</u>	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.
<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.
<u>CCSS.ELA-LITERACY.SL.11-12.5</u>	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.
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.9-10.4</u>	Determine the meaning of words and phrases as they are used in a text, including vocabulary describing political, social, or economic aspects of history/social science.
<u>CCSS.ELA-LITERACY.RH.9-10.7</u>	Integrate quantitative technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text form.
<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.11-12.4</u>	Determine the meaning of words and phrases as they are used in a text, including analyzing how an author uses and refines the meaning of a key term over the course of a text (e.g., how Madison defines <i>faction</i> in <i>Federalist</i> No. 10).
<u>CCSS.ELA-LITERACY.RST.11-12.7</u>	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
<u>CCSS.ELA-LITERACY.RST.11-12.9</u>	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Subject Writing	
<u>CCSS.ELA-LITERACY.WHST.9-10.7</u>	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.
<u>CCSS.ELA-LITERACY.WHST.9-10.8</u>	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.
<u>CCSS.ELA-LITERACY.WHST.9-10.9</u>	Draw evidence from informational texts to support analysis, reflection, and research.
<u>CCSS.ELA-LITERACY.WHST.11-12.7</u>	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.
<u>CCSS.ELA-LITERACY.WHST.11-12.8</u>	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
<u>CCSS.ELA-LITERACY.WHST.11-12.9</u>	Draw evidence from informational texts to support analysis, reflection, and research.

Next Generation Science Standards

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