Lesson Plan
The Physical Sciences at
Historically Black Colleges and Universities

A class Institute in mathematical geography at Hampton Institute studying the earth's rotation around the sun, Hampton, Virginia, ca 1899.
Image courtesy the Frances Benjamin Johnston Collection at the Library of Congress, Prints and Photographs Division.

Grade Level(s): 9-12	**Subject(s): History, Physics, Contemporary**

In-Class Time: 65-95 Minutes	**Prep Time: 15-20 minutes**

Materials

- Copies of AIP Physics at HBCUs Selection Table (found in Supplemental Materials)
- Copies of AIP HBCU Information Sheets (found in Supplemental Materials)
- Student access to a word processor or PowerPoint program to make brochures
- Internet access and credible research sources
- (Optional) Map of United States
- Copies of Analyzing Historical Photographs worksheet (found in Supplemental Materials)

Objective

In this lesson plan, students will acquire an overview of Historically Black Colleges and Universities (HBCUs) that offer degrees in the physical sciences. Through research into the history of 8 of these institutions, students will determine the significance of HBCUs, particularly in science education. Students will also use historical photographs and video clips to compare and contrast HBCUs in different eras.

Introduction

Defined as institutions of higher education "whose principal mission is the education of Black Americans," Historically Black Colleges and Universities (HBCUs) are a unique group of colleges and universities. HBCUs emerged as places to educate African Americans at a time when they could not attend predominately white institutions by law and custom. Prior to the Civil War, only 28 African Americans received baccalaureate degrees from U.S. colleges and universities (Roebuck and Murty, 1993). The majority of HBCUs founded were primarily private institutions, yet the passage of the second Morrill Land-Grant Act of 1890 led to the establishment and financing of 17 public HBCUs (Allen and Jewell, 2002; Provasnik et al., 2004; Redd, 1998; Roebuck and Murty, 1993). From the mid-19th century until the mid-20th century, HBCUs formed the core of black higher education. However, in the "separate but equal" system, HBCUs were severely underfunded compared to predominantly white institutions.

The first physics departments were established at HBCUs in the 1920s. The Department of Physics and Astronomy at Howard University in Washington, D.C. was established in the early 1920s. Dr. Elmer Imes, the second African American to receive a doctorate in physics, inaugurated the physics program at Fisk University in Nashville, Tennessee in 1930. Despite the struggle for equal resources to predominantly white institutions, educators at HBCUs endeavored to establish laboratories that would facilitate first-class science education.

Statistics show that HBCUs have been and continue to be an extremely important force in educating African American scientists. According to a recent study, eleven HBCUs are among the top fifteen institutions graduating the most African American students earning degrees in the physical sciences (Phillips, 2013). While HBCUs educate more than one-fifth of African Americans who earn bachelor's degrees, they produce around fifty percent of the African American bachelor's degrees in physics and show similar numbers in the other sciences. The National Science Foundation found that a third of all African American science and engineering doctorate recipients nationally completed their undergraduate education at an HBCU. Among known U.S. baccalaureate-origin institutions of 1997–2006 Black science and engineering doctorate recipients, the top eight–and 20 of the top 50–were HBCUs (National Science Foundation, 2008). The top five baccalaureate-origin institutions between

African American students who attend HBCUs for their undergraduate degrees and go on to earn master's, doctoral and professional degrees in STEM, law, and medicine from top-ranked universities illustrates that HBCUs do prepare students to compete on a global scale. In fact, African American students attending HBCUs are more likely to go to graduate or professional schools than African American students from other institutional types.

This lesson plan highlights the striking contributions of Historically Black Colleges and Universities (HBCUs) in supplying the scientific workforce of African Americans throughout history. Students will be introduced to the long history of HBCUs in this country and their role in physical science education. They will also learn about and research different opportunities to pursue an undergraduate and graduate degree in the physical sciences at HBCUs.

References

William, Quinton L. "Undergraduate Physics Programs at HBCUs: Can We Stop the Losses?" *Physics Today* 63 no. 6 (2010): 47-48.

Burrelli, Joan and Rapoport, Alan. "Role of HBCUs as Baccalaureate-Origin Institutions of Black S&E Doctorate Recipients." National Science Foundation InfoBrief NSF 08-319 (2008): 1-8.

Allen, Walter R. and Jewell, Joseph O. "A Backward Glance Forward: Past, Present, and Future, Perspectives on Historically Black Colleges and Universities." *The Review of Higher Education* 25 no. 3 (2002): 241-261.

Roebuck, Julian B. and Murty, Komanduri S. *Historically Black Colleges and Universities: Their Place in American Higher Education*. Westport, CT: Praeger, 1993.

Theodore Hodapp, "The Economics of Education: Closing Undergraduate Physics Programs," *APS Physics* 20 no. 11 (2011): The Back Page.

Instructions/Activities

Engage: 5-10 Minutes

Teachers will introduce students to Historically Black Colleges and Universities through a short discussion.	
What is the teacher doing? Introduce Historically Black Colleges and Universities to the class, including what they are and why many of them were formed. Emphasize that many African American students were excluded from attending predominantly white institutions for decades. Ask students if they can name any HBCUs, 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 Historically Black Colleges and Universities, noting why many were formed and how African American students had traditionally not been able to attend white institutions. Name any known HBCUs, noting their location on the map (if available). Note their geographic distribution.

Explore: 40-55 Minutes

Students will read the overview of HBCUs from the HBCU Selection Table offered in the Supplemental Materials, split into 8 small groups, and choose an HBCU 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 8 small groups. Distribute the HBCU Selection Table (located in the Supplemental Materials) to each group. Assign each group an institution from the Table. Distribute the HBCU Information sheets (found in the Supplemental Materials) to the appropriate groups. Instruct them to research their institution. (If desired, allow students to use internet sources to conduct research beyond the Information Sheets.) Assist student research by providing the Discussion Questions (found in the Supplemental Materials).	**What are the students doing?** Split into 8 small groups. Receive and examine the HBCU Selection Table provided by the teacher. Research the school assigned by the teacher. Receive the HBCU Information Sheet for the assigned school and begin researching it. (If instructed, use teacher-verified internet sources for research beyond the Information Sheets.) To guide research, consider the Discussion Questions posed by the teacher, and incorporate them into the brochures. Include any other pertinent information about physics at the university as well.
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 prepare to include photographs, the Emilio Segré Visual Archives at AIP's Niels Bohr Library and Archives is a great starting point. The Library of Congress and Smithsonian digital photo repositories are also useful (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 HBCUs, 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 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 8 small groups, and examine historical photographs from HBCUs with the Analyzing Historical Photographs worksheet (found in the Supplemental Materials). Each group will create captions for the historical photographs. Groups will then share their captions with the class and compare them to the actual versions. If desired, collect student captions and evaluate.	
What is the teacher doing? Split students back into their groups. Provide each group with the Analyzing Historical Photographs worksheet. Instruct them to examine the photographs, and to create a captions based on what they observe. Have groups share their captions with the class, then as a class compare the student captions with the actual ones. If desired, collect student captions and evaluate for participation and effort.	**What are the students doing?** Return to small groups. Each group receives the Analyzing Historical Photographs worksheet (provided by the teacher). 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. Share student captions with the class. After all groups have presented, compare the student captions with the actual ones provided by the teacher. If instructed, submit worksheet to the teacher for participation and effort evaluation.

Evaluate:

Opportunities for evaluation occurred organically during the explanation and elaboration sections of this lesson. Teachers may elect to evaluate student brochures and the presentations of them. 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 HBCUs Selection Table (found in Supplemental Materials)
- HBCU Information Sheets (also in Supplemental Materials)
- White House Initiative on Historically Black Colleges and Universities: http://www.ed.gov/edblogs/whhbcu/where-are-the-hbcus/
- Emilio Segré Visual Archives at the Niels Bohr Library & 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/

- (Optional) Library of Congress "Teacher's Guide on Analyzing Photographs & Prints": http://www.loc.gov/teachers/usingprimarysources/resources/Analyzing_Photographs_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. Was the institution established co-ed? If not, when did it become so?
7. What was/is the academic focus of the institution? If possible, explain when the physics program was created.
8. Name some influential or well-known alumni of the institution.

Further Reading and Additional Resources

- AIP Statistics on Minority issues in Physics: http://www.aip.org/statistics/minorities.
- Historical Photographs of Hampton Institute from the Frances Benjamin Johnston Collection at the Library of Congress, Prints and Photographs Division: http://www.loc.gov/pictures/item/86706170/
- Bobby L. Lovett, *America's Historically Black Colleges & Universities: A Narrative History from the Nineteenth Century into the Twenty-First Century* (Macon, Ga: Mercer University Press, 2011).
- James Oliver Horton and Lois E. Horton, *A History of the African American People: The History, Traditions & Culture of African Americans* (Detroit: Wayne State University Press, 1997).

Extensions

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

- "The Physicist's War:" Dr. Herman Branson and Scientific Training of African Americans during World War II
- Historical Detective: Edward Alexander Bouchet and the Washington-Du Bois Debate over African-American Education
- Physicist Activist: Dr. Elmer Imes and the Civil Rights Case of Juliette Derricotte
- Dr. Elmer Imes and Spectroscopy

Common Core Standards

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

Speaking & Listening	
CCSS.ELA-LITERACY.SL.9-10.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
CCSS.ELA-LITERACY.SL.9-10.2	Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
CCSS.ELA-LITERACY.SL.9-10.4	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.
CCSS.ELA-LITERACY.SL.9-10.5	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.
CCSS.ELA-LITERACY.SL.11-12.1	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.
CCSS.ELA-LITERACY.SL.11-12.4	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.
CCSS.ELA-LITERACY.SL.11-12.5	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	
CCSS.ELA-LITERACY.RH.9-10.1	Cite specific textual evidence to support analysis of primary and secondary sources, attending to such features as the date and origin of the information.
CCSS.ELA-LITERACY.RH.9-10.2	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.
CCSS.ELA-LITERACY.RH.9-10.4	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.
CCSS.ELA-LITERACY.RH.9-10.7	Integrate quantitative technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text form.

CCSS.ELA-LITERACY.RH.11-12.1	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.
CCSS.ELA-LITERACY.RH.11-12.2	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.
CCSS.ELA-LITERACY.RST.11-12.7	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.
CCSS.ELA-LITERACY.RST.11-12.9	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	
CCSS.ELA-LITERACY.WHST.9-10.7	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.
CCSS.ELA-LITERACY.WHST.9-10.8	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.
CCSS.ELA-LITERACY.WHST.9-10.9	Draw evidence from informational texts to support analysis, reflection, and research.
CCSS.ELA-LITERACY.WHST.11-12.7	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.
CCSS.ELA-LITERACY.WHST.11-12.8	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.
CCSS.ELA-LITERACY.WHST.11-12.9	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/.
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