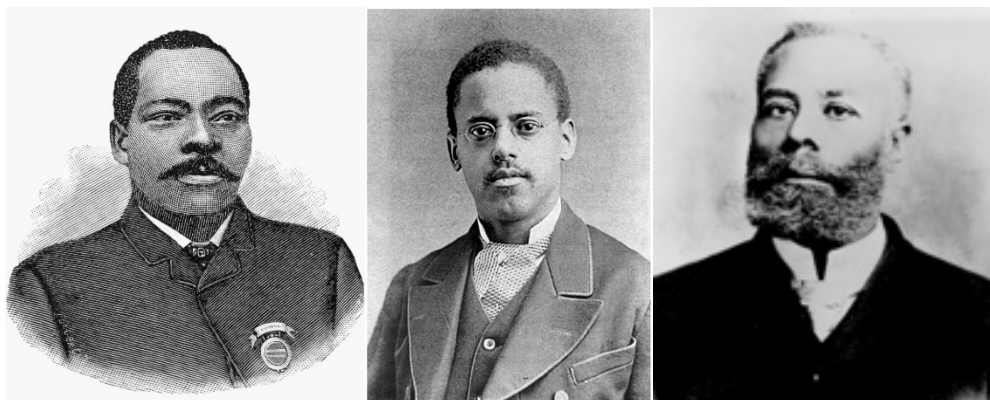


Lesson Plan

African American Inventors in History



From left to right: Granville T. Woods circa 1887, Lewis Howard Latimer in 1882, and Elijah McCoy were three famous African American inventors in the nineteenth century and early twentieth century. Images Courtesy of Wikimedia Commons.

Grade Level(s): 6-12

Subject(s): History, Contemporary

In-Class Time: See below

Prep Time: 15 min

Part One: African American Inventors in History (60-80 minutes)

Part Two: Create Your Own Invention! (60-80 minutes)

Materials

Part One: African American Inventors in History

- African American Inventors Matching Worksheet (see Supplemental Materials)
- African American Inventors Patent List (see Supplemental Materials)
- Student web access for research

Part Two: Create Your Own Invention!

- (optional): student web access for research
- Create Your Own Invention Worksheet
- Create Your Own Patent Worksheet
- Art supplies: Paper, markers, colored pencils, glue, etc.
- Graph paper
- Legos, foam shapes, shaping clay, cardboard or other three-dimensional modeling supplies (optional)

Objective

This two-part lesson will introduce students to the lives of black inventors with the aid of media, primary sources, and government documents. The first part invites students to research the lives of notable African American inventors and analyze some of their patents. In the second part, students can create their own invention.

Introduction

In the eighteenth century African American slaves were not allowed to patent their own inventions. According to U.S. patent laws of 1793, “the master is the owner of the fruits of the labor of the slave both manual and intellectual.” Therefore, the majority of African Americans, who were enslaved, were not able to file for patents. Despite this, a free man named **Thomas L. Jennings** became the first African American to be granted a patent in the United States in 1821. Jennings was a tradesman and abolitionist who operated a tailoring and dry-cleaning business in New York City. In 1821, he filed a patent for a process which he called “dry scouring” for cleaning clothes. His patent caused a controversy in the United States, however; as a free man, the restrictions that applied to slaves did not affect him. Laws in the United States would not extend patent rights to all African Americans until 1861. African American inventors before the civil rights revolution of the mid-twentieth century were remarkable. Not only did they have to combat a racially discriminatory legal system and society, they also had to struggle against the prevailing white American belief in black intellectual inferiority.

Contrary to popular understanding, invention has never been the result of simply an individual’s work; it also relies on a number of social structures such as access to education, technical training, apprenticeship opportunities, membership in professional societies, and legal rights. Due to the racial discrimination throughout American history, many African American inventors did not have equal access to these larger structures. Until WWII, most schools and universities (other than Historically Black Colleges and Universities) did not admit non-white or non-male students, especially into scientific and engineering fields. In addition, professional organizations and societies which provided access to crucial business and scientific networks were segregated. Invention often requires capital and because of systematic economic disadvantage, many African Americans were barred from the financial resources that made scientific invention possible. While technological innovation has come to represent an essential aspect of the American Dream, African Americans’ access to that dream has always been limited. Despite these barriers, African Americans have made significant contributions throughout history to the development of technology in the fields of agriculture, electronics, engineering, and more.

In this lesson plan, students will meet several African American inventors whose lives reveal much about what it meant to be a black inventor in the late nineteenth and early twentieth century. Students will then learn about contemporary African American inventors such as physicist Dr. James West who invented the modern-day microphone. This lesson plan also includes a list of notable African American inventors to allow students to research additional historical figures in more detail. While this lesson plan will present these individuals as heroes and celebrate their remarkable accomplishments, it is our hope that students will also be introduced to the importance of historical context and a more complex understanding of heroes.

The following brief biographies can be used to introduce students to some famous African American inventors. Please see the list in the Instructions/Activities section of African American inventors as well as the Resources sections for more information about African American inventors.

Granville T. Woods (April 23, 1856 – January 30, 1910) was a prolific inventor in the late nineteenth and early twentieth century, mainly of electrical equipment. The *Catholic Tribune* proclaimed Woods “the greatest inventor in the history of the race,” and a year later called him “the greatest electrician in the world.” Many also referred to Woods as “the Black Edison.” Like Edison, Woods spent his career in electrical engineering. Woods’ early life is something of a mystery. Woods held a number of patents that were issued to him on various electronic devices. These included patents on an electromagnetic brake apparatus, and an overhead conducting system for electric railways. Though Woods was often compared to Thomas Edison, the two actually were at odds. Woods and Edison went to court twice over “patent interferences” – disputes between two or more inventors who are attempting to patent the same invention. In both disputes, Woods won.

Lewis Howard Latimer (September 4, 1848 – December 11, 1928) was born in Chelsea, Massachusetts. His parents were George and Rebecca Latimer, escaped slaves from Virginia. Latimer studied drafting in Massachusetts and worked for patent solicitors Crosby & Gould, where he helped draft the drawings for Alexander Graham Bell’s patent application for the telephone. An original draftsman for Thomas Edison, Latimer was the only African American member of the twenty-four “Edison Principles,” Thomas Edison’s engineering division of his company. In 1890, Latimer co-authored a book on electricity titled “Incandescent Electric Lighting: A Practical Description of the Edison System.” In addition to working for Edison, Latimer was an inventor, draftsman, engineer, author, poet, musician, and, at the same time, a devoted family man and philanthropist. Many people consider Latimer one of the most important inventors of all time, not only for the sheer number of inventions he created and patents he secured but also for the importance of his most famous development: the addition of carbon filament to the newly-invented incandescent light bulb. In 1882, Latimer patented a method of manufacturing his carbon filaments. Latimer’s other inventions include a threaded wooden socket for light bulbs, the first toilet that could be used in trains, and a forerunner of the air conditioner.

James Edward West (February 10, 1931–) was born on February 10, 1931 in Prince Edward County, Virginia. After graduating from high school he attended Hampton University before being drafted to serve in the Korean War, where he earned a Purple Heart. After his return to the U.S. after the war, he transferred to Temple University, where he studied physics. While in school, West worked during the summers as an intern for the Acoustics Research Department at Bell Laboratories in Murray Hill, New Jersey. Upon graduation he was hired by Bell Labs to work full-time as an acoustical scientist specializing in electroacoustics, physical and architectural acoustics. In 1960, West teamed with Gerhard M. Sessler, a German-born physicist, to develop an inexpensive, highly sensitive and compact microphone. At the time, condenser microphones were used in most telephones, but were expensive to manufacture and necessitated a large battery source. Microphones convert sound waves into electrical voltages, thus allowing the sound to be transmitted through a cord to a receiver. Their electric microphone solved every problem they were seeking to address. By 1968, the microphone was in wide scale production and was quickly adopted as the industry standard. Approximately 90% of microphones in use today are based on this invention and almost all telephones utilize it, as well as tape recorders, camcorders, baby monitors and hearing aids.

Lonnie Johnson (October 6, 1949–) is an engineer and inventor who was born in Mobile, Alabama in 1949. Johnson worked on NASA’s Cassini mission to Saturn and invented the popular toy, the Super Soaker. After graduating from Tuskegee University with a master’s degree in nuclear engineering, Johnson worked as a research engineer at Oak Ridge National Laboratory before becoming the Acting Chief of the Space Nuclear Power Safety Section at the Air Force Weapons Laboratory in New Mexico. In 1979, Johnson became a Senior Systems Engineer at NASA’s Jet Propulsion Laboratory in California. By 1989, Johnson decided to found his own company to market the Super Soaker. Within its first two years on the market the Super Soaker generated over \$200 million in sales, making it the most popular toy in the United States. Johnson has received over 80 patents.

Instructions/Activities

Part One: African American Inventors throughout History

Engage: 8-12 Minutes

The teacher will introduce the students to African American inventors by discussing a few individuals, including their lives and work, through a short lecture (information on these individuals is found in the Introduction to this lesson).

What is the teacher doing?

Give a short lecture about the lives and work of Granville T. Woods, Lewis Howard Latimer, James Edward West, and Lonnie Johnson. Information about these men is found in this lesson’s Introduction.

What are the students doing?

Listen and take notes on the lecture about Granville T. Woods, Lewis Howard Latimer, James Edward West, and Lonnie Johnson.

Explore: 25-30 Minutes

Individually or in groups, students will select an inventor from the provided list (in Supplemental Materials), and conduct research on the person’s life and work (incorporating the Discussion Questions also provided in the Supplemental Materials). This section could be completed as homework to save in-class time if desired. Students will create a report detailing their findings, to be shared with the class.

What is the teacher doing?

Specify if students are to work individually or in groups.

Provide students with the list of African American inventors, found in the Supplemental Materials.

(This section could be assigned as homework to preserve in-class time, if necessary) Help students select an inventor, then direct them to appropriate internet/text sources for research. The Required/Recommended and Further Reading sections of this lesson plan contain useful sources.

What are the students doing?

Working individually or in groups (as specified by teacher) select an inventor from the provided list. Elect 1-2 of their inventions to examine. Research the life and work of the selected individual, using the [Black Inventors Online Museum](#). Create a report based on your findings to share with the class.

Consider and answer the provided Discussion Questions during preparation of the report and presentation.

Provide students with the Discussion Questions (in the Supplemental Materials) to help guide their research.	
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Explain: 20-25 Minutes

These reports or presentations will then be shared with the class. Students will present a brief biography of the individual as well as an analysis of one of their patents and how their invention worked.	
What is the teacher doing? Observe (and if necessary, evaluate) student presentations. Inquire about any obvious lacking information.	What are the students doing? Present reports on chosen inventor to the class. Include a brief biography (that addresses the Discussion Questions) and an analysis of one of their patents.

Elaborate: 8-12 Minutes

The class will exit their groups and reconvene for a large group discussion. Students will compare presentations and the stories of the different inventors discussed.	
What is the teacher doing? Have students exit their groups and prepare for a class discussion. Guide class discussion by prompting the students to consider the following: <ul style="list-style-type: none"> a. What were the similarities and differences among the stories of the inventors? Think about their birthplace, experiences as an inventor, socio-economic background, gender, etc. b. What were the major laws, events or turning points in history that affected African American inventors. Possibilities could include: <ul style="list-style-type: none"> i. Slavery and U.S. patent laws ii. Jim Crow segregation iii. The Civil War and the 1861 granting of patent rights to African Americans iv. The Civil Rights Movement and end of legal segregation 	What are the students doing? Exit small groups and prepare for a class discussion. Consider the prompts offered by the teacher as the class discusses what they have learned through research and the presentations.

Evaluate:

Evaluation potentially occurred during the explanation section of the lesson (as the teacher may have evaluated the student presentations). The teacher could opt to assign the African American Inventors Matching Worksheet (see Extensions below) as homework following the lesson, and collect/evaluate them.

Part Two: Create Your Own Invention!

Engage: 5-10 Minutes

<p>Building on the previous part of this lesson plan, students will review patents filed by famous African American inventors. This will function as a quick review (or introduction, if this Part is used individually), in addition to stimulating student thoughts about how inventions are created and the patent process.</p>	
<p>What is the teacher doing? Provide the list of patents filed by famous African American inventors to the students (found in the Supplemental Materials). Display this on a projector, or have each student explore the document on a computer. The latter option is ideal, as the students could open hyperlinks to observe the patent descriptions and images.</p>	<p>What are the students doing? Explore the list of patents filed by African American inventors. If possible, open hyperlinks of select patents to observe patent descriptions and see accompanying diagrams or sketches. Note common features of what patents look like and how inventions are often drawn.</p>

Explore: 20-25 Minutes

<p>Students will further familiarize themselves with how inventions are created and how patents are awarded. Google Patents is a useful resource here. Individually or in small groups, students will develop an invention themselves using the Create Your Own Invention worksheet (grades 6-8) or the Create Your Own Patent worksheet (grades 9-12), both located in the Supplemental Materials.</p>	
<p>What is the teacher doing? If possible, provide students with access to Google Patents, so that they may search for household items or technology in order to get an idea of how inventors describe their work. If desired, split the class into small groups. Provide students with the appropriate Create Your Own Invention/Patent worksheet. Instruct students to use these worksheets to develop an invention of their own.</p>	<p>What are the students doing? If possible, explore Google Patents. Search for common household items or other pieces of technology, and be sure to note how inventors describe and design their work. If instructed, split into small groups. After receiving the appropriate Create Your Own Invention/Patent worksheet, use it to develop an invention yourself.</p>

Explain: 10-15 Minutes

<p>Students will present their invention proposal, either to the teacher or the class. Students will address the Discussion Questions (from the Supplemental Materials) in their presentations. This is a potential source of evaluation.</p>	
<p>What is the teacher doing? Provide students with the Discussion Questions (found in Supplemental Materials), then observe (and if necessary, evaluate) the students' presentations.</p>	<p>What are the students doing? Present invention ideas to the teacher or the class. Incorporate the second set of Discussion Questions into the presentations.</p>

If their proposal/presentation is adequate, allow the student to proceed to the next step (drafting/building their invention).	
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Elaborate: 25-30 Minutes

Students will now create drafts and/or prototypes of their inventions. They will draw diagrams using graph paper and other materials, and/or create three dimensional models using modeling materials.

<p>What is the teacher doing? Provide students with materials to create diagrams or drafts of their inventions, including art and drafting supplies. If desired, also provide students materials to construct physical models or prototypes of their inventions, including Legos, cardboard, clay, toothpicks or other three dimensional modeling materials.</p>	<p>What are the students doing? Use pencils, pens, protractors, rulers, and graph paper to create diagrams of invention ideas. If instructed, use provided three dimensional modeling supplies to create a physical prototype of the inventions.</p>
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Evaluate:

The main source of evaluation emerged during the explanation section, through student presentations. Teachers could evaluate proposals on an individual basis, or the students could present their ideas to the class. In addition, teachers could evaluate the students' final drafts and/or prototypes.

Required/Recommended Reading and Resources

Part One: African American Inventors throughout History

- The Black Inventor Online Museum: <http://blackinventor.com/>
- (Recommended): Biography.com provides a good starting point for basic biographical information of many of the inventors: <http://www.biography.com/people/groups/famous-black-inventors>

Part Two: Create Your Own Invention!

- Access to GooglePatents, a tool that allows students to search and browse patent text and images: <https://patents.google.com/>

Discussion Questions

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

Part One: African American Inventors throughout History

1. Where was the inventor from and when were they born?
2. Describe the inventor's childhood and youth.
3. What was life like for African Americans during the time the inventor was alive and working? Think about laws, social norms, economics, and other factors. For example, would the inventor be living in a segregated society or were African Americans able to apply for patents at the time?

4. What region did the inventor live and work in? Where did they receive their education?
5. What was occurring technologically in the United States during this time? Example: the Industrial Revolution, the Space Age, etc.
6. What field did the inventor specialize in?

Part Two: Create Your Own Invention!

1. How did you think of your invention? Did you begin by thinking about your daily life or the people around you?
2. What does the process of coming up with an invention teach you about how inventors come up with their innovations?

Further Reading and Additional Resources

Books on African American Inventors:

- Louis Haber, *Black pioneers of science and invention* (New York: Harcourt, Brace & World, 1970).
- James Haskins, *Outward Dreams: Black Inventors and Their Inventions* (New York: Walker, 1991).
- Portia P. James, *The Real McCoy: African-American Invention and Innovation, 1619-1930* (Washington, D.C.: Smithsonian Institution Press, 1989).
- Aaron E. Klein, *The Hidden Contributors: Black scientists and inventors in America* (Garden City, N.Y.: Doubleday, 1971).
- Carroll W. Pursell, *A Hammer in Their Hands: A Documentary History of Technology and the African-American Experience* (Cambridge, Mass: MIT Press, 2005).
- Dick Russell, *Black Genius: Inspirational Portraits of America's Black Leaders* (New York: Skyhorse Pub, 2009).
- Patricia Carter Sluby, *The Inventive Spirit of African Americans: Patented Ingenuity* (Greenwood Publishing Group, 2004).
- Otha Richard Sullivan, *Black Stars: African American Women Scientists and Inventors* (San Francisco, CA: Jossey Bass, 2012).
- Ivan Van Sertima, *Blacks in Science: Ancient and Modern* (New Brunswick, NJ: Transaction Books, 1983).
- Bruce Sinclair, ed., *Technology and the African-American Experience* (Cambridge, MA: MIT Press, 2004).

Online Resources:

- Adscape International, The Black Inventor Online Museum, <http://blackinventor.com>. The Black Inventor Online Museum is an educational website that features multimedia profiles of dozens of black inventors.
- U.S. Patent and Trademark Office, "Minority Inventors: America's Tapestry of Innovation," http://www.sutherlandmedia.com/video_minority_inventors.php. This video (3 min, 54 sec) features Dr. James West, inventor of the Electret microphone. He discusses his research at Bell Laboratories and the significance of his invention.
- http://www.nj.com/insidejersey/index.ssf/2010/09/how_new_jersey_saved_civilizat_19.html
- Eric W. Gutttag, "The Black Edison: Granville T. Woods," IPWatchdog, February 3, 2014, <http://www.ipwatchdog.com/2014/02/03/the-black-edison-granville-t-woods/id=47764/>. This

article is an in-depth exploration of the life of Granville T. Woods as well as the scientific principles behind his most famous invention – induction telegraphy.

- National Inventors Hall of Fame, <http://invent.org/>.

Extensions

African American Inventors Matching Worksheet

Found in Supplemental Materials, this worksheet could be assigned as homework following Part One of the lesson.

Extension Activity: Getting Your Invention Patented

1. Ask your students to list some of the machines they use everyday (e.g., computers, MP3 players, televisions), including objects in the classroom. Then, use Google Patents (www.google.com/patent) to locate the patent for this machine. Write down the patent number and discuss some of the processes by which such machines arrive in the user's hand— invention, patent, production, marketing, sale.
2. Then ask students to research and draw up an outline of the development of one machine. Have them consider the following:
 - a. What does this machine do?
 - b. What did the developers perceive as the need for this machine?
 - c. How did they get started financially?
 - d. Did somebody hire them to do it?
 - e. Did their ideas build on earlier ideas?
 - f. Who did the actual development of the machine?
 - g. Who got credit for it? Who profited from it?
 - h. What were the reasons for building it?
 - i. Who uses it? Do students believe this machine is useful? How?

Common Core Standards

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

Speaking & Listening	
CCSS.ELA-LITERACY.SL.6.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.
CCSS.ELA-LITERACY.SL.6.4	Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.
CCSS.ELA-LITERACY.SL.7.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.

<u>CCSS.ELA-LITERACY.SL.7.4</u>	Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.
<u>CCSS.ELA-LITERACY.SL.8.1</u>	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
<u>CCSS.ELA-LITERACY.SL.8.4</u>	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
<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.9-10.4</u>	Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
<u>CCSS.ELA-LITERACY.SL.11-12.1</u>	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
<u>CCSS.ELA-LITERACY.SL.11-12.4</u>	Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.
History/Social Studies	
<u>CCSS.ELA-LITERACY.RH.6-8.2</u>	Determine the central ideas or information of a primary or secondary source; provide an accurate summary of the source distinct from prior knowledge or opinions.
<u>CCSS.ELA-LITERACY.RH.6-8.7</u>	Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.
<u>CCSS.ELA-LITERACY.RH.9-10.7</u>	Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text.
<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.

Science & Technical Subjects	
<u>CCSS.ELA-LITERACY.RST.6-8.1</u>	Cite specific textual evidence to support analysis of science and technical texts.
<u>CCSS.ELA-LITERACY.RST.6-8.2</u>	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
<u>CCSS.ELA-LITERACY.RST.6-8.4</u>	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 6-8 texts and topics</i> .
<u>CCSS.ELA-LITERACY.RST.9-10.4</u>	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 9-10 texts and topics</i> .
<u>CCSS.ELA-LITERACY.RST.9-10.6</u>	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
<u>CCSS.ELA-LITERACY.RST.11-12.2</u>	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
<u>CCSS.ELA-LITERACY.RST.11-12.6</u>	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
Subject Writing	
<u>CCSS.ELA-LITERACY.WHST.6-8.7</u>	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
<u>CCSS.ELA-LITERACY.WHST.6-8.9</u>	Draw evidence from informational texts to support analysis, reflection, and research.
<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.9-10.9</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.11-12.9</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/>.

<p>Dimension One: Practices</p>	<ol style="list-style-type: none"> 1. Asking questions (for science) and defining problems (for engineering) 2. Developing and using models 6. Constructing explanations (for science) and designing solutions (for engineering) 7. Engage in argument from evidence 8. Obtaining, evaluating, and communicating information
<p>Dimension Two: Crosscutting Concepts</p>	<ol style="list-style-type: none"> 1. Systems and system models 2. Structure and function
<p>Dimension Three: Disciplinary Core Ideas</p>	<p>ETS1: Engineering Design ETS2: Links Among Engineering Technology, Science, and Society</p>