Welcome to Online Office Hours!

We’ll get started at 2PM ET
Welcome! We’re glad you’re here! Use the chat box to introduce yourselves. Let us know:

➢ Your first name
➢ Where you’re joining us from
➢ Grade level(s) and subject(s) you teach
Thank you!

Questions? Post them in the chat box!
STEM Primary Sources in the Manuscript Division
(Expect the Unexpected)

Michelle Krowl and Josh Levy, historical specialists
Manuscript Division
There are many Manuscript Division collections in which you would expect to find STEM-related primary sources

Edward O. Wilson, 
biologist

Charles Townes, 
physicist, astrophysicist

Margaret Mead, 
anthropologist

Thomas Eisner, 
biologist

Jack S. Kilby 
enGINEER, inventor

Vera C. Rubin, 
astrophysicist

Glenn Seaborg, 
nuclear chemist

Alexander Graham Bell, 
inventor

Orville and Wilbur Wright, 
aviation pioneers

Herman Hollerith, 
inventor, computer pioneer

Benjamin Franklin, 
scientist

Samuel F. B. Morse, 
inventor

Montgomery C. Meigs, 
enGINEER, architect

Carl Sagan, 
astronomer

Maxine Singer, 
biochemist

Luther Burbank, 
botanist, horticulturist

Frances Oldham Kelsey 
pharmacologist

Barry Commoner, 
biologist, ecologist

Gloria Hollister Anable, 
zoologist

J. Robert Oppenheimer, 
physicist
But had you also considered the papers of …?

George Washington

Thomas Jefferson

The American Colony in Jerusalem

Civil War mapmaker Jedediah Hotchkiss

Olmsted Associates, landscape architects
Let’s take a closer look at three documents in the Manuscript Division that might be incorporated into a STEM lesson in unexpected ways…
Penny-farthing bicycles in Charles Wellington Reed Papers: How can these be STEM resources?

https://www.loc.gov/resource/mss37457.0301/?sp=380

https://www.loc.gov/resource/mss37457.0301/?sp=366
Depends on the questions you ask!

• What are the physics involved with such a bicycle?

• What is the advantage to having a large wheel in the front and a small one in the back?

• How does the rider get on the bicycle?

• What challenges might someone encounter in riding it?

• How fast might it go?

• How does the rider stop it?

• Was it prone to crashing, as this sketch suggests, and if so, why?

• Could a woman in a long skirt ride a penny-farthing? Were fashion and engineering compatible in bicycle design? (See LibGuide on this subject: [https://guides.loc.gov/chronicling-america-early-bicycle-fashion](https://guides.loc.gov/chronicling-america-early-bicycle-fashion))

• In what way is the technology of bicycles today different than those of the “penny-farthing,” and when did that shift start to occur?
Can pair with images from Prints & Photographs Division and Chronicling America to add to the lesson

Precarious mounting of a penny-farthing style bicycle
Prints & Photographs Division
https://www.loc.gov/pictures/item/2016827929/resource/

Example of a new “safety” bicycle similar to modern models

Connecticut Western News (Salisbury, Conn.),
September 25, 1889. Chronicling America
Maps helps us orient ourselves to the world around us, but what else do they reveal? This 1837 map of Marietta, Ohio was produced amid a heightened interest in Hopewell mound builders.

https://www.loc.gov/item/mcc.048/
Will comparison with more familiar maps help us find out what questions to ask? Here we can see more clearly how Marietta’s mounds were/are included within its downtown street grid.

https://www.loc.gov/item/mcc.048/
Pair with images from Prints & Photographs Division to add to the lesson

Great Mound at Marietta, Ohio, 1848
Lithograph illustration in Squire, Ancient Monuments of the Mississippi Valley
Prints & Photographs Division
https://www.loc.gov/pictures/item/2003675053

Mound Cemetery, Marietta, c. 1920-1950
Prints & Photographs Division
https://www.loc.gov/pictures/item/98512163
So what questions could these maps help us answer?

- What technologies did Hopewell people use to build these mounds, and to incorporate items from places as distant as Minnesota in their burials?

- Record the height and calculate the circumference of Marietta’s cone-shaped mound. Then measure a building near your home or campus. How do the structures compare?

- Calculate the volume of each of Marietta’s mounds in 1837, then go online and find the volume of the mounds that remain today. What percentage of the 1837 soil has been lost to development and erosion?

- The plan for Marietta was first laid out in 1788. How have land surveying instruments changed since then?

- Why did the Ohio Company give Marietta’s mounds Latin names? (*Sacra Via, Quadranaou, Capitolium, Conus*) (Hint: Roman ruins)

- Why did early settlers take so much interest in Ohio’s mounds, even as the U.S. was engaged in a series of Indian Wars? What did the mounds tell them about what it meant to be an American, shortly after 1776? Or an Ohioan, as the new state’s population grew?

https://www.loc.gov/item/mcc.048/
It would be logical to look in the Alexander Graham Bell Papers for documentation of Bell’s experiments with the telephone, such as his 1875-1876 scientific notebook in the Subject File series March 10, 1876, “’Mr. Watson. Come here. I want to see you.’ To my delight he came and declared that he had heard and understood what I said."

https://www.loc.gov/resource/magbell.25300201/?sp=22
But did you know that Bell’s notebooks available online also document his extensive experiments with propulsion and flight?

The December 29, 1891 to June 5, 1893 laboratory notebook is particularly rich with experimentation and data. See https://www.loc.gov/item/magbell.36500101/
On this page, Bell looks to nature to solve the mysteries of flight by examining bird wings. Questions that might be asked of this and subsequent pages:

• How did the natural world influence Bell in his pursuit of flight?

• What type of data did Bell record based on his observations?

• Were other early aviators similarly inspired by nature?

• Does nature continue to inspire invention? Can you provide examples?

• Why do you think Bell initialed and dated many of the entries in this notebook? (Hint for one reason: patents)

https://www.loc.gov/resource/magbell.36500101/?sp=19
Not all of Alexander Graham Bell’s scientific and laboratory notebooks are currently available online, and they are not all in one place in the collection.

But if you keyword search for “notebook” in the “This Collection” search bar, you’ll have several options from which to choose to explore!
How do I find STEM materials in the Manuscript Division?

- Manuscript Division collections are usually not described at the level of individual items, as photographs or maps often are, so you may have to do a little searching and use your intuition.

- Search the online catalog (https://catalog.loc.gov/) for relevant names and subjects. Sorting the results by “Date (oldest to newest)” will often bring Manuscript material to the top. Look for the “Manuscript or Mixed Format” icon. The catalog record will provide links to any online presentation and the collection finding aid, and includes a collection summary which may help determine relevance to your project.

- Look at the list of online Manuscript Division finding aids for names/organizations that look promising; see https://www.loc.gov/rr/mss/f-aids/.

- Browse options “Digital Collections” (https://www.loc.gov/collections/) by clicking on “Manuscript Division” facet in “Part of” section of left navigation bar.
How do I find STEM materials in the Manuscript Division?

• Browse “Words and Deeds in American History” grouping for individual STEM-related documents.
  https://www.loc.gov/search/?fa=partof%3Awords+and+deeds+in+american+history%3A+selected+documents+celebrating+the+manuscript+division%27s+first+100+years&sb=date&st=gallery&c=160 (apologies for the currently very long URL!)

• Look at current and past exhibits represented online; see https://www.loc.gov/exhibits/ Manuscript Division material may be included in an exhibit, and those items/images may not be available online elsewhere. (The full list of exhibitions is at https://www.loc.gov/exhibits/all/)

• And sometimes a little serendipity is involved in coming across STEM materials in Manuscript collections!
And you can always ask us for help!

Josh Levy: jlevy@loc.gov
Science specialist, Manuscript Division

Michelle Krowl: mkrowl@loc.gov
Civil War and Reconstruction specialist, Manuscript Division

Manuscript Division, general email address: mss@loc.gov

Manuscript Division homepage: https://www.loc.gov/rr/mss/
Includes helpful links to additional information, guides, etc.

Ask a Manuscript Librarian: https://www.loc.gov/rr/askalib/ask-mss.html
Math, Science and Technology

in the Manuscript Division of the Library of Congress

Selected facsimile documents from the collections with possible questions for engagement with primary sources
(presented in roughly chronological order)

mss@loc.gov
http://www.loc.gov/rr/mss/
George Washington studied geometry, as shown in his 1745 school copy book.

Can you solve the problems on this page?

How might Washington have used this geometrical training in his early career as a surveyor?
Look at one of George Washington’s diaries.

How often does he mention the weather?

Why might Washington be so interested in the weather?

How does the weather in Washington’s time and location compare with the weather in that location now?
Thomas Jefferson's drawing of a macaroni machine and instructions for making pasta, ca. 1787, Thomas Jefferson Papers, Manuscript Division. [https://www.loc.gov/resource/mcc.027/](https://www.loc.gov/resource/mcc.027/)

The Thomas Jefferson Papers are available online; see [https://www.loc.gov/collections/thomas-jefferson-papers/about-this-collection/](https://www.loc.gov/collections/thomas-jefferson-papers/about-this-collection/)

**What do Thomas Jefferson’s notes on macaroni tell you about his relationship with technology?**

**How does the macaroni Jefferson described compare with what is available today?**

**Can you find other examples in his papers of his scientific interests?**
What are bifocal eyeglasses and how do they work?

How are they different than other eyeglasses?

What conditions in the eye make them useful for some people?
What was Thomas Jefferson documenting in this chart?

Why do you think he collected this data?
(Think not only about his interest in science, but also his involvement in agriculture)

Read more about this item:
- [https://blogs.loc.gov/teachers/2015/06/teaching-with-thomas-jeffersons-vegetable-market-chart/](https://blogs.loc.gov/teachers/2015/06/teaching-with-thomas-jeffersons-vegetable-market-chart/)
What sort of figures was the young Abraham Lincoln calculating on this page?

Why might Lincoln have studied land measures?

"Plan of the Ancient Works at Marietta, Ohio," by Charles Whittlesey, 1837, E. G. Squier Papers, Manuscript Division. [https://www.loc.gov/item/mcc.048/](https://www.loc.gov/item/mcc.048/)

**Study the map of Marietta, Ohio.**
**What information does the map convey about the area?**

**In what ways could this information be useful?**

**What skills did the mapmaker need to create all the elements of the map?**
Aug. 2, 1847 diary entry with map, Diaries, 1845-1899, Jedediah Hotchkiss Papers, Manuscript Division. [link]

The Jedediah Hotchkiss Papers are available online; see [link]

What skills did Jedediah Hotchkiss employ to produce what looks like a simple map of Port Republic, Virginia?

Does his diary entry provide any clues to the information he assembled?

How would you map an area near you? What information would you collect?
What kind of structure has George B. McClellan sketched in his notebook?

Why do you think Captain McClellan was so interested in it?

What types of math and technological considerations are represented in this structure? Would topography also influence the design and construction?
Teenaged LeRoy Gresham worked on this word problem in 1863.

How would this word problem be written today?

What type of transportation would be used?

Would the figures included in the word problem change with the type of transportation?
The American Civil War saw the introduction of iron-clad vessels.

**How were they made?**

**How did they change naval technology?**

**Did a heavier building material change the draft, propulsion, and navigation of these ships?**
Examine this sketch and the back of the same page, which is the first sketch Alexander Graham Bell made of his telephone in 1876. How did Bell’s telephone work? What technology was involved?

Then look at Bell’s notebook for 1876. How much experimentation did Bell do in developing the telephone? Did the technology change over time?

If so, how did Bell document his advances, and/or failures?
Consult the Arnold Arboretum job file in the Olmsted Associates Records. Given the information presented about the property, how would you determine the available acreage for the landscape design project? How much space must be devoted to infrastructure (roads, pathways). How much space can be used for gardens/woods, taking into account public areas, property boundaries, and topography?

What kind of plants did the Olmsted Associates record for the project? How do the plants accord with the ecosystem in Boston? Are they native plants or meant to look natural? How might the list may reflect the needs/interests of the client (an arboretum)?

How would you answer similar questions about the gardens and public spaces in your area?
Look at Alexander Graham Bell’s laboratory notebook on aviation experiments.

How did the natural world influence him?

Were other early aviators similarly inspired?

Does nature continue to inspire invention?
Alexander Graham Bell responded to two tragedies in 1881 by experimenting with inventions. He worked on an “induction balance machine” or metal detector to try to find the bullet in President James A. Garfield after he was shot by an assassin in 1881. The same summer Bell’s infant son died because his lungs were not developed enough to breath on his own, and Bell long experimented with a “vacuum jacket” (seen above) to provide artificial respiration.

Can you think of other inventions that were created to address a practical problem?

Have you ever made something because you had a problem to solve?

What problems do you wish could be solved by a new invention?
Consider the physics of the penny-farthing style of bicycle represented above.

How does the rider get on the bicycle?

What are the challenges to riding it?

Would it have been prone to crashing?

What is technologically different about the bicycles of today?
Herman Hollerith saw train conductors punch train tickets to record transportation information, and later applied the punch card technology to compiling federal census data and other computing tasks.

*How does a punch card work to collect data?*

*How did punch card tabulation lead to modern computing?*
Plate for Herman Hollerith's Electric Sorting and Tabulating Machine, ca. 1895, Herman Hollerith Papers, Manuscript Division. [https://www.loc.gov/resource/mcc.023/?sp=9](https://www.loc.gov/resource/mcc.023/?sp=9)

Punch card for Herman Hollerith's Electric Sorting and Tabulating Machine, ca. 1895, Herman Hollerith Papers, Manuscript Division. [https://www.loc.gov/resource/mcc.023/?sp=8](https://www.loc.gov/resource/mcc.023/?sp=8)
Although the central focus of this document is artistic, art involves science and technology as well.

What metal would you use to make this sculpture and why?

What are the physics involved in keeping the horse balanced securely on its hind legs?
Entry for October 27, 1903, Orville Wright notebook, Wilbur Wright and Orville Wright Papers, Manuscript Division. https://www.loc.gov/resource/mwright.01007/?sp=10

Selections from the Wilbur Wright and Orville Wright Papers are available online; see https://www.loc.gov/collections/wilbur-and-orville-wright-papers/about-this-collection/

Consult the diaries and notebooks of Orville and Wilbur Wright as they worked out the logistics of flight.

What data did they collect with each experiment?

How did they use this information to adapt their airplanes?
Describe the effect of the locusts on the tree pictured above.
How did the locusts do this damage?
What might be the effect of plagues of locusts and other insects on agriculture?
Can you find other examples of similar insect “plagues”?
How might farmers deal with insect swarms?
This hand-drawn diagram by astronomer Carl Sagan represents all of space and time. The X axis represents time, going into the future and into the past and the Y axis represents scale, from the size of the electron to the distances between galaxies. It marks the relatively small “realm of direct human experience” and the much larger “realm of quantum physics” and “realm of special relativity.”

*How would you diagram all of space and time?*
Study this drawing by the young Carl Sagan.

What did Sagan predict about space flight?

What do his headlines say about the time in which the picture was drawn?
   What was happening then?

Did any of these headlines come true?

What would your headline predictions be if you made a similar drawing today?