

This Issue's Theme:

Teaching Science with Primary Sources

This issue explores how teachers can use primary sources in science instruction.

Primary sources offer often untapped value for teaching science. By analyzing primary sources such as inventor notebooks and letters, architectural drawings, newspaper articles, and photographs, students can better understand scientific innovation. Teachers and students can find the notes and correspondence of Thomas Edison, Emile Berliner, the Wright brothers and other scientists and inventors on the Library of Congress Web site. The site also offers primary sources related to the work of environmentalists, which students can examine. This issue of the TPS Quarterly gives strategies for using digitized primary sources to help students understand the methods of scientific achievement, and better appreciate the history and application of scientific discoveries.

About TPS Quarterly

Teaching with Primary Sources (TPS) Quarterly is an online publication created by the Library of Congress Educational Outreach Division in collaboration with the TPS Educational Consortium.

Published quarterly, each issue focuses on pedagogical approaches to teaching with Library of Congress digitized primary sources in K-12 classrooms. The *TPS Quarterly* Editorial Board and Library staff peer review all content submitted by TPS Consortium members and their partners. Please email questions, suggestions or comments about *TPS Quarterly* to Stacie Moats, Educational Resources Specialist, at smoa@loc.gov.

Contents

Primary Sources and Science

In this feature article, science teachers share strategies for using primary sources to teach students scientific inquiry and experimentation. Pg 2

Research and Current Thinking

Summaries of and links to online resources—articles, research reports, Web sites and white papers—that provide research and current thinking relating to the theme. Pg 4

Learning Activity – Elementary Level

Students work in pairs or groups to analyze key pages from the laboratory notebook of Alexander Graham Bell to discover the elements of the scientific method. Pg 5

Learning Activity – Secondary Level

Students analyze correspondence and notes to identify stages of the scientific process and how scientists seek evidence to support their hypotheses. Pg 6

Teacher Spotlight

Sharon Murphy, a middle school science teacher in Lansing, Illinois, engages her students with primary sources. Pg 7

Newsletter Archives

Previous issues of *Teaching with Primary Sources Quarterly* are always available at www.loc.gov/teachers/tps/quarterly

Primary Sources and Science

by Mark Newman and Carrie Copp

"The results were fantastic!" said high school physics teacher Casey Veatch after implementing a Library of Congress primary source into a science lesson. Middle school science teacher Rebecca Prince further explains. "Primary sources always create what I like to call the 'lean in factor:' students sit up in their seats, lean forward on their desks, and engage in the discussions that revolve around the primary sources."

Analyzing historical primary sources about science expands critical thinking and promotes student inquiry, just as it does in other disciplines. Students can learn about the history and application of various scientific discoveries through the use of primary sources. Using historical primary sources in science instruction also builds important skills, such as observation and inference, that are integral to experimentation and the scientific method. Primary sources can appeal to all learners. They promote interdisciplinary instruction and involve students in learning content as well as building skills.

Rebecca Prince, middle school science teacher at Rhodes School in River Grove, Illinois, first used primary sources while student teaching. "I really liked the way primary sources sparked critical thinking and interest in social studies among my students," she commented. "Once I became a science teacher, I wanted to use primary sources from the Library to create authentic scientific inquiry experiences. "

Prince's current classroom includes students who are English language learners or have special needs. She has found images to be more effective learning aids than print resources because many students have low reading skills. Many science experiments, however, rely primarily on written procedures, which can be difficult for students to follow. Prince wanted to design a learning experience that built on student strengths and created an environment that encouraged them to strive for success in science.

In one example of how Prince has used Library of Congress primary sources as the basis for scientific inquiry, she gave students Samuel Morse's sketches as a model for building their own telegraphs. Prince used photographs to have students study the uses of the telegraph. "Then, as they became more adept at using primary sources to find information," Prince explained, "they studied Samuel Morse and his telegraph sketches." Having learned how to interpret primary sources in a meaningful way, students made working telegraphs. The Morse sketches were inspiration for their creativity.

Equally important, Prince noted, "They really enjoyed their experience. That exuberance for learning extended to the lab where they used what they had learned from primary sources to build their own telegraphs," she said. "As a teacher, it was exciting to watch as students took over their own learning."

Casey Veatch is a physics teacher at Bennett High School in Bennett, Colorado. He also is the District Librarian for the Bennett School District and an Anatomy, Physiology, and Physics instructor for Morgan Community College. He and his wife Carrie, an online social studies teacher for Vilas Online School in Colorado, developed a lesson for his high school physics class that used Alexander Graham Bell's science notebook from the Alexander Graham Bell Family Papers in the American Memory Collection.

In her social studies classroom, Carrie observed the lesson helped "the students make a connection to their prior knowledge about Bell and sound reproduction. They had read about Bell and sound reproduction in their textbook, but the primary sources from the Library of Congress helped students make a personal connection to the concept and the scientist." Bell was no longer an abstract historical figure; he had become a real person to the students.

Casey had physics students recreate Bell's tuning fork experiment to prove sound can be transmitted through a wire. He used the primary sources to further teach the scientific method. As was the case with Rebecca Prince's science students, Casey's students used their greater skill at interpreting primary sources to recreate Bell's experiment successfully. "These primary sources from the Library led students to connect, construct, and wonder," he noted.

An important learning lesson for both groups of students concerned the often difficult path of scientific inquiry and experimentation. Casey commented that his students "could see the writing and sketches in his [Bell's] notebook and wondered why some of the entries were scratched out as they attempted to follow Bell's line of thinking." Prince explained that her students followed a path similar to that of many inventors. "Since many first attempts did not succeed, my students learned to accept failure as a challenge rather than defeat. And, it definitely inspired them to work harder. Many of the students were successful in the end and they really enjoyed their experience."

Both Rebecca Prince and Casey Veatch continue to use primary sources from the Library of Congress in their science classes. As part of her seventh grade curriculum, Prince's students are constructing a bridge using pasta. She plans to show them primary sources that contain actual bridges to serve as guides and inspiration for scientific inquiry.

Veatch is currently developing a lesson on the mechanics of flight using a letter from Orville Wright to his father describing a science experiment he performed as a young student. He sees how this document can generate excitement among his students as they attempt to interpret the meaning behind Orville Wright's experiment.

Mark Newman is Director of the Federation of Independent Illinois Colleges and Universities' Teaching with Primary Sources project and associate professor of Curriculum & Instruction at National-Louis University, Chicago, Illinois. Carrie Copp is a project associate on the Federation TPS project and a graduate student in the Elementary Education MAT Program at National-Louis University.

Selected Science Resources from the Library of Congress

Presentations and Activities: From Flight to Fantasy

Resources from the Library of Congress documenting the history of flight.

<http://www.loc.gov/teachers/classroommaterials/presentationsandactivities/presentations/fantasy-flight/>

Presentations and Activities: What in the World is That? Ingenious Inventions throughout History

Throughout history, creative men and women have developed ingenious inventions that have solved problems and changed people's lives. Use your observation skills in this matching activity to learn more about some of these wonderful innovations.

http://www.loc.gov/teachers/classroommaterials/presentationsandactivities/activities/science/non_flash.html

Themed Resources: Science and Invention

Learn about the early recording efforts of Emile Berliner, Bell's experiments with the telephone, early aviation, and the history of household technology through presentations and primary source images, notebooks and letters. Study early environmental movements and photographs.

<http://www.loc.gov/teachers/classroommaterials/themes/science/>

Themed Resources: Nature and the Environment

Study man-made and natural disasters, origins of the American conservation movement, and view Landsat photographs, valued for aesthetics more than contributions to geography. Use maps to trace the growth and unique features of the National Parks. Learn about nature writers and visual artists.

<http://www.loc.gov/teachers/classroommaterials/themes/nature/>

Research and Current Thinking

For each issue, Teaching with Primary Sources Consortium members submit summaries of and links to online resources—articles, research reports, Web sites, and white papers—that provide research and current thinking relating to the theme. This Research & Current Thinking focuses on teaching science with primary sources.

Guide to Library Research in Science: Scientific Communication

From The College of Wooster – Timken Science Library

This article describes primary sources science, including materials that might not have been produced for publication, such as laboratory notebooks, memoranda, or personal and professional correspondence.
<http://www3.wooster.edu/library/sciref/Tutor/EvSciInfo/primary.php>



Lee, Russell, 1903-1986, photographer Children at the blackboard. Lake Dick Project, Arkansas From Library of Congress, Prints and Photographs

Inquiry and the National Science Education Standards

From CIRES

(Cooperative Institute for Research in Environmental Sciences)

This article summarizes the goals of the National Science Education Standards, defines the role of inquiry in the standards, describes essential scientific abilities of observation, investigation, interpretation or analysis, and reporting on findings, and recommends strategies for teaching the scientific method. Readers will find some similarities between the components of the scientific method as described in this article with the inquiry model frequently used in social studies education.

<http://cires.colorado.edu/education/outreach/rescipe/collection/inquirystandards.html>

Primary and Secondary Sources for Science

University Libraries, University at Albany, State University of New York

These reference charts define primary and secondary sources in science and list examples of each type of resource.

<http://library.albany.edu/usered/dr/prisci.html>

The Scientific Method: Seeing Science Everywhere

By Ellen Booth Church, Scholastic

This article looks at the natural inclination of children toward inquiry and then suggests ways to encourage children in observation, investigation, and experimentation.

<http://www2.scholastic.com/browse/article.jsp?id=11866>

Internet History of Science Sourcebook

From Fordham University

This online resource listing provides information and links to documents, websites, and articles "dealing with the history of science derived from Paul Halsall's internet sourcebook series, a 'world wide web project designed to provide easy access to primary sources and other teaching materials in a non-commercial environment.'"

<http://www.fordham.edu/halsall/science/sciencesbook.html>

To access links to resources cited above please visit the online version of this edition of the Teaching with Primary Sources Quarterly online at <http://www.loc.gov/teachers/tps/quarterly>

Learning Activity - Elementary Level

EXPLORING THE SCIENTIFIC METHOD: "MR. WATSON - COME HERE - I WANT TO SEE YOU."

Overview

Working in pairs or groups, students analyze key pages from the laboratory notebook of Alexander Graham Bell to discover the elements of the scientific method. Successful scientific investigation requires methodical, careful testing of hypotheses and recording the results.

Objectives

After completing this learning activity, students will be able to:

- identify the elements of the scientific method;
- analyze a manuscript; and
- Describe the scientific method using evidence from this manuscript.

Time Required

One 45 minute class period; activity extension idea requires additional class period

Grade Level

4 - 5

Topic/s

Science/Scientists

Subject/Sub-subject

Science

Standards McREL 4th Edition Standards and Benchmarks

Science

Standard 12. Understands the nature of scientific inquiry
Level II (Grades 3-5)

1. Knows that scientific investigations involve asking and answering a question and comparing the answer to what scientists already know about the world
5. Knows that scientists' explanations about what happens in the world comes partly from what they observe (evidence), and partly from how they interpret (inference) their observations

Historical Understanding

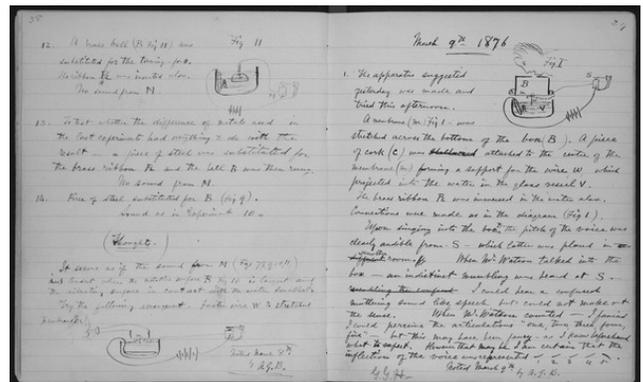
Standard 2. Understands the historical perspective

Credits

Adapted from a lesson plan created by Lynn Dille, TC Williams High School, Alexandria City Public Schools, Virginia

View and Print the complete learning activity:

<http://www.loc.gov/teachers/tps/quarterly/pdf/Winter2011ElementaryLevelLearningActivity.pdf>



Bell, Alexander Graham. Notebook by Alexander Graham Bell, from 1875 to 1876. Manuscript. From Library of Congress, The Alexander Graham Bell Family Papers, 1862-1939.

Learning Activity - Secondary Level

SCIENTIFIC INQUIRY: WHAT DO SCIENTISTS AND INVENTORS THINK ABOUT?

Overview

Students will read and analyze selected notes and correspondence from an inventor. Working together, they will identify specific places in each document that reflect the scientific processes of systematic observation, collecting evidence, reasoning, and developing hypotheses. Finally, students will speculate on what might have happened before the events reflected in the document, how a scientist would design the next phase, and how a scientist could test the results.

Objectives

After completing this learning activity, students will be able to:

- analyze a primary source;
- identify states of the scientific processes; and
- Understand how scientists seek evidence to support hypotheses.

Time Required

Two 45-minute class periods

Grade level

7 - 8

Topic/s

Science/Scientists

Subject/Sub-subject

Science

Standards McREL 4th Edition Standards and Benchmarks

Science

Standard 12. Understands the nature of scientific inquiry
Level III (Grades 6-8)

1. Knows that there is no fixed procedure called "the scientific method," but that investigations involve systematic observations, carefully collected, relevant evidence, logical reasoning, and some imagination in developing hypotheses and explanations
2. Understands that questioning, response to criticism, and open communication are integral to the process of science

Historical Understanding

Standard 2. Understands the historical perspective

Credits

Adapted from a lesson plan created by Rebecca E. Prince, Rhodes School, River Grove, Illinois

View and Print the complete learning activity:

<http://www.loc.gov/teachers/tps/quarterly/pdf/Winter2011SecondaryLevelLearningActivity.pdf>



*The American inventor [clipping]
Washington, D.C.: The American
Inventor Publishing Co., 1900 July
1 From Library of Congress,
Emile Berliner and the Birth of the
Recording Industry*

Teacher Spotlight

**Sharon
Murphy**



In each issue, we introduce a teacher who participated in Teaching with Primary Sources (TPS) professional development and successfully uses Library of Congress primary sources to support effective instructional practices.

This issue's Teacher Spotlight features middle school science teacher Sharon Murphy. The TPS program at Governors State University nominated Sharon for her effective classroom use of primary sources in science instruction. Sharon has taught for 17 years, including 5th, 6th and 7th grade science, at Heritage Middle School in Lansing, Illinois. In this interview, she discusses teaching strategies and her favorite Library of Congress online resources.

What motivated you to participate in the TPS workshops in your local area?

When first hearing about the workshop, I thought, "How am I going to use primary sources? I'm a science teacher." But everything has a historical component, including science, and I hate to see science isolated from other disciplines. I like to help students understand science is everywhere. Teachers may think of Library of Congress primary sources as history based but you can certainly apply them to your curriculum regardless of what subject you teach.

Tell us about the first time you tried using primary sources in the classroom.

I used a 1940s image of a science classroom to introduce a unit on insects. In this picture, young students are studying insects with their teacher. I quickly discovered that seventh-grade students get a real kick out of observing and learning from historical images. I used guiding questions to help my students discuss their observations and inferences: What insects were the students holding? How was their classroom the same or different from ours? What might their clothes tell us about where they lived (city or country) or how their parents made a living? I loved students' analyses of the image; they noticed things I had overlooked! I am always surprised by the details that students notice and how they often interpret primary sources differently from me.

How do you use primary sources to teach science?

In my experience, primary source documents and visuals provide learning opportunities for students' discussion and appreciation of science and its relationship to the real world, both past and present. For example, in that same life science unit on insects, students examined Civil War-era envelopes, including one featuring a grasshopper and another, a hornet's nest, to connect different insects' physical characteristics to their cultural interpretations.

On study guides, I pair primary source images with sample test questions for students to do "then and now" comparisons with regard to scientific principles, technology or materials. For example, historical images can help prompt students to consider how scientific tools, such as microscopes, have evolved and the impact of new technologies on the timing of scientific discoveries. Likewise, historical illustrations can prompt students to think about improved safety standards in science laboratories or how scientific methods and materials have changed.

Using primary sources, whether films or journal excerpts, can help students understand that inventors like Thomas Edison were real people who made mistakes, and makes scientific achievement more real and attainable for students. Plus, stories behind scientific inventions—like why Benjamin Franklin needed bifocals—can inspire students to experiment.

What is your favorite resource available on the Library of Congress Web site?

I teach seventh grade students, so I select primary sources carefully because the past is like a different culture to them; it's new. I remind students that we need to treat things from the past with respect even if we don't understand them. My quest for science-related materials can lead almost anywhere on the Library of Congress site but the *Teachers Page* never gets stale because new resources are constantly added to it. My favorites include *Everyday Mysteries: Fun Science Facts from the Library of Congress* and *Science and Invention Themed Resources*.

What advice do you have for teachers who have never tried teaching with primary sources?

I encourage all teachers to make a commitment to try what the Library of Congress has to offer online no matter what subject area they teach. You will be very surprised by what the Library's Web site offers and how you can adapt these resources to any curriculum. When you teach using primary sources, you open an avenue of learning to students that will be at their fingertips for the rest of their lives.