Chapter 6

Why Is There a Tunnel Here? A Planning Walkthrough for Place-Based Elementary Inquiry (Dimension 2: Geography, Economics, and History)

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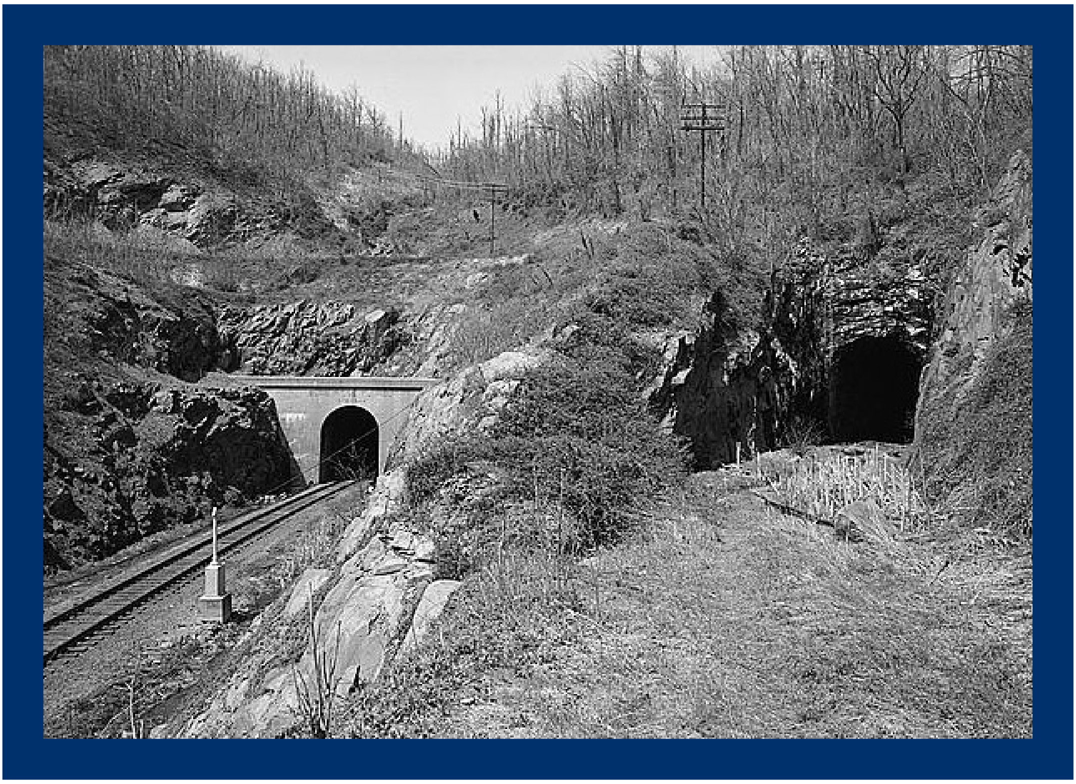
Figure 1. ***Blue Ridge Tunnel, Afton, Virginia***



Note. The currently operational (left) and original (right) Blue Ridge Tunnel in Afton, Virginia. Boucher, J. (1971). *Chesapeake & Ohio Railroad, Blue Ridge Tunnel, Highway 250 at Rockfish Gap, Afton, Nelson County, VA* [Photograph]. Library of Congress. www.loc.gov/item/va0254/

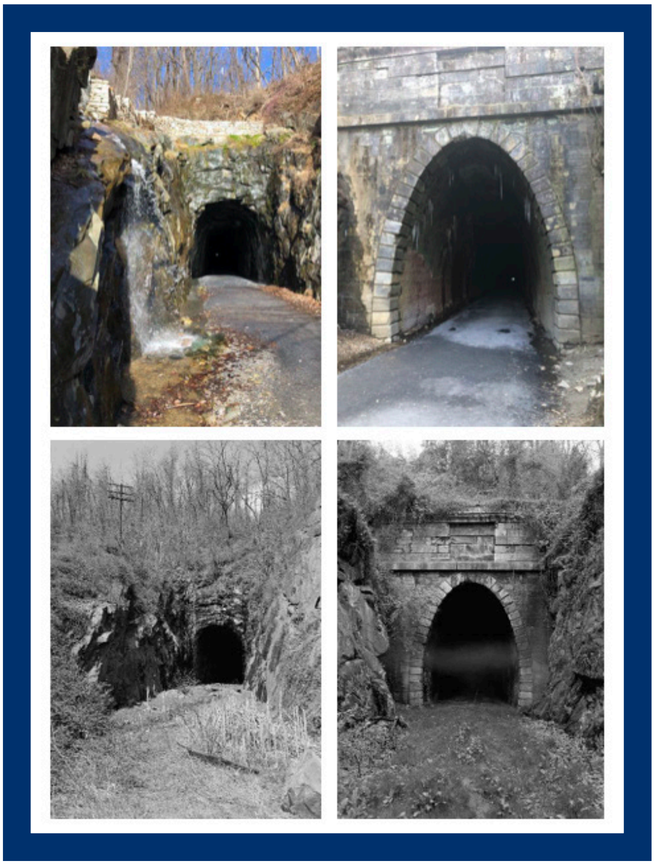
<table>
<tr><th colspan="3">Why Is There a Tunnel Here?
A Planning Walkthrough for Place-Based Elementary Inquiry</th></tr>
<tr><td>C3 Disciplinary Focus
Geography, Economics, and History</td><td>C3 Inquiry Focus
Developing Questions and Planning Inquiries</td><td>Content Topic
Tunnels and transportation</td></tr>
<tr><td colspan="3">C3 Focus Indicators
D1.5.3–5. Determine the kinds of sources that will be helpful in answering compelling and supporting questions, taking into consideration the different opinions people have about how to answer the questions.
D2.Geo.2.3–5. Use maps, satellite images, photographs, and other representations to explain relationships between the locations of places and regions and their environmental characteristics.
D2.Eco.3.3–5. Identify examples of the variety of resources (human capital, physical capital, and natural resources) that are used to produce goods and services.
D2.His.6.3–5. Describe how people's perspectives shaped the historical sources they created.
D3.4.3–5. Use evidence to develop claims in response to compelling questions.
D4.6.3–5. Draw on disciplinary concepts to explain the challenges people have faced and opportunities they have created, in addressing local, regional, and global problems at various times and places.</td></tr>
<tr><td colspan="3">Pedagogical Approach
Inquiry inspired by local places</td></tr>
<tr><td>Suggested Grade Level
3–5
(can be adapted for all grades)</td><td>Resources
Library of Congress Historic American Engineering Record (HAER); See Appendices</td><td>Time Required
Variable</td></tr>
</table>

Introduction and Connections to the C3 Framework

The Blue Ridge Tunnel in Afton, Virginia, was supposed to be a unique spot for a casual weekend walk (see Figure 1). But upon visiting for the first time, it was hard to ignore the pull of the place or to think about anything besides how to frame inquiry there.

After a short stroll on the gravel path, a bend in the trail revealed a gaping hole in the mountainside, with water cascading down on one side of the opening (Figure 2, top left). This was not a cave; there was clear evidence of human influence. A stone retaining wall bordered a rocky yet symmetrical fissure, which suggested that an unnatural event had carved this hole in the side of a mountain. Visitors who passed through the portal followed a mile-long path in the darkness with only flashlights to illuminate the way, and a small dome of light in the distance slowly grew larger and larger as the light from the entrance grew smaller and smaller.

Figure 2. *Blue Ridge Tunnel Entrances*



Note. East entrance (left) and West entrance (right). Author-contributed photographs above and Library images below. www.loc.gov/item/va0253/

At the other end of the tunnel, the opening was surrounded by a tidy brick façade that seemed very out of place amid the wooded mountainside (Figure 2, above). The informational placards along the path provided a broad overview of the tunnel's history, but being there prompted many questions: Where were the train tracks? Why did the east and west entrances look so different? Why was part of the tunnel lined in brick and the rest uneven rock? What was it like to build this? How did people almost 200 years ago manage a project at this scale without the mountain collapsing on top of them? *Why is there a tunnel here?*

This experience at the Blue Ridge Tunnel was a reminder that places have an immense power to spark inquiry. Place-based inquiry supports authentic learning by centering classroom activities around spatially relevant topics. Combined with a collection of high-quality sources, such as those available in the Library of Congress collections, teachers can curate rich learning experiences aligned with the goals of the C3 Framework. Whenever possible, teachers should design learning opportunities connected to local places that spark authentic questions for inquiry.

Purposeful and powerful social studies instruction is *meaningful, active, and integrative* (National Council for the Social Studies, 2016). This chapter outlines an approach to designing purposeful and powerful instruction through place-based inquiry. The approach is illustrated with a planning walkthrough for an inquiry about a 19th-century regional railroad tunnel, with examples of how to prepare maps, architectural drawings, and historical records for *meaningful* analysis by elementary students. The approach is broadly transferable: Readers can follow along by identifying and preparing sources related to local examples.

In the featured place-based inquiry, students *actively engage* with sources related to the tunnel and ideally visit the site itself. Maps, architectural drawings, and photographs from the Historic American Engineering Record provide rich insight into transportation structures. Analysis of these sources provides opportunities to *integrate* content by exploring the historical context in which the structure was built, considering geographical benefits and constraints, interrogating the treatment of laborers, and questioning environmental impacts. Then, students can take action to locate and share information that is missing from existing sources.

Inquiry Arc

Dimension 1: Planning Inspired by Local Places

The C3 inquiry arc reorients a fact-based approach to social studies by using questions, sources, and tasks to drive learning (National Council for the Social Studies, 2013). Dimension 1 highlights the development of questions and planning of inquiries. Questions are at the heart of inquiry, and there are multiple entry points to developing a question and associated inquiry. Teachers are often encouraged to begin with grade-level standards they are tasked with teaching and then conduct a "deep dive" of the associated content to identify an angle for an inquiry (Swan et al., 2018).

Local places can also serve as an entry point to developing compelling questions that are both "intellectually meaty" and "student-friendly" (Grant, 2013, p. 325). Teachers might start with a place that is already meaningful to them or their students, a point of interest near their school, or browse their state's national parks, historic sites, monuments or entries in the National Register of Historic Places. Library of Congress photos, prints, and drawings can also be a resource for identifying potential places (see Appendix C for links to source sets for a selection of historically significant tunnels across North America). Then, teachers should visit the physical site with the purpose of gathering possible questions to guide inquiry. Certainly, a general idea of potential grade-level standards will support this work, but it need not be the starting point. This chapter provides an example of planning an IDM inspired by a local place using tunnels specifically, but the ideas can be generalized to any meaningful site of natural, historical, or cultural significance.

After identifying a place of interest, designers should consider possible questions and content angles. For an inquiry about the Blue Ridge Tunnel, there are potential entry points across the social studies disciplines, from geographic questions about the regions and resources that the tunnel connected, to historical and civic questions about the decision to build the tunnel and how it came to be. Designers might use local grade-level standards to help narrow down options. In Virginia, for example, two applicable upper elementary standards are:

- VS.9: The student will apply history and social science skills to understand the ways in which Virginia became interconnected and diverse by a) explaining the importance of railroads, waterways, new industries, and the growth of cities to Virginia's economic development in the late 1800s.
- USI.8: The student will apply history and social science skills to explain westward expansion and reform in America from 1801 to 1861 by… e) explaining technological advancements and innovations on changing life in America, including but not limited to the cotton gin, the reaper, the steam engine, and steam locomotive.

Even if designers do not immediately identify an aligned content standard, many states' social studies skills standards promote interpreting sources, analyzing the impact of geographic features on people, and recognizing points of view (to name just a few). This means that the skills associated with inquiry approaches are usually standards aligned.

During the planning process, it can be fruitful to gather many possible questions related to the standards and teacher (or student!) observations about the local place. Overall compelling questions for an inquiry should be provocative and have multiple potential answers (Caffrey & Adu-Gyamfi, 2022). Designers might keep a running list:

- How is a tunnel like a time machine?
- How do you get through a mountain?
- Where did the railroad take us?

While considering possible questions, designers might refer to physical signage or other documentation to learn more about the place of interest. At the Blue Ridge Tunnel, interpretive signage along the trail and the foundation website provide a brief history of the 4,273-foot passage, which was the longest tunnel in the United States at the time of its completion in 1858. The tunnel was excavated by Irish immigrants and enslaved laborers over almost nine years, with at least 17 recorded accidental deaths and countless more lost to disease (Blue Ridge Tunnel Foundation, n.d.). These facts spark new questions, including some that challenge master narratives that legitimate systems of oppression and power (Crowley & King, 2018):

- What did it take to make the Blue Ridge Tunnel?
- Who should we thank for the Blue Ridge Tunnel?
- Should Virginians have "moved mountains" to build the Blue Ridge Tunnel?

- *Why is there a tunnel here?*

With a list of ideas in mind, a designer might select a tentative question and begin to identify potential sources that would help students acquire knowledge, practice target skills, and develop understandings needed to respond to the question. Finalizing the compelling question usually requires a process of "stress-testing" (Swan et al., 2018) by thinking through the summative task, available sources, and grade-level accessibility.

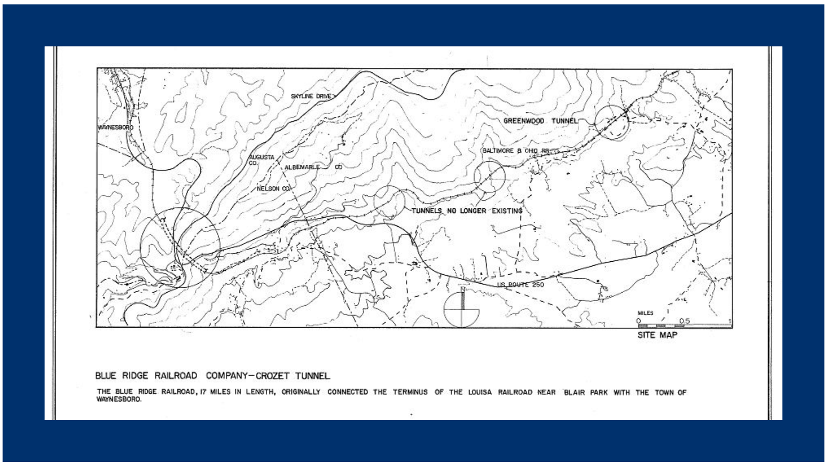
Dimension 2: Engineering Record Sources as Disciplinary Tools

After selecting a local structure and brainstorming questions, the next step in planning for place-based inquiry is to gather sources that upper elementary students could use to answer the compelling questions. Identifying sources is one of the more challenging components of inquiry design for younger children (Quinn, 2021; Thacker et al., 2017). One benefit of the Library of Congress collection is the sheer volume of images available. The Historic American Engineering Record items include bundles of photographs, maps, and architectural drawings, as well as narrative descriptions for the featured sites, which can serve as pre-made source sets (see Appendix C). These sources also have the potential to support skill-building with disciplinary tools that elementary students might not have been exposed to previously, such as interpreting site maps and architectural drawings.

Preparing and Analyzing Site Maps

A map is a representation of a place drawn to scale, usually on a flat surface. There are many different types of maps, and each is designed to feature certain kinds of information. The Blue Ridge Tunnel site map (Figure 3) served as an overview of the engineering project and similarly might provide a visual overview for students. Analyzing maps promotes spatial thinking for young children (Bednarz et al., 2006; National Geographic, n.d.), and analyzing this source would help students build skills in this domain in alignment with NCSS Theme 3: People, Places, and Environments. In an inquiry with the compelling question "Why is there a tunnel here?" a site map might be used alongside other sources to answer the supporting question "Where is this tunnel?"

Figure 3. ***Blue Ridge Tunnel Site Map***



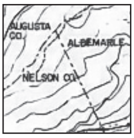
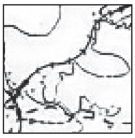
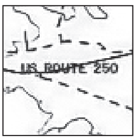
Note. Prycer, D. G. (1850–1858). Site map. *Blue Ridge Railroad, Blue Ridge Tunnel, U.S. Route 250 at Rockfish Gap, Afton, Nelson County, VA* [Architectural drawing]. Library of Congress. www.loc.gov/resource/hhh.va0253.sheet/?sp=1

To use a source like this in an elementary classroom, a teacher might first orient the students to the map by helping students locate a known landmark or comparing the map to a current physical or political map of the same area. The teacher might ask students to locate map features, such as the compass rose (Figure 3, bottom center) and map scale (bottom right), and help students distinguish between and make sense of all the different kinds of lines (Figure 4).

Then, a teacher might give students a copy of the map and scaffold further analysis with targeted questions, beginning with additional probing about map features:

- What do the circles represent? [Sites of tunnels on the Blue Ridge Railroad]
- Locate the Blue Ridge Tunnel on the map. What do you notice about it? [Much longer than any of the others; one of two remaining (other shown is Greenwood Tunnel); connects Albemarle to Augusta County; goes under a mountain according to contour lines and positioning under Skyline Drive]

Figure 4. *Potential Graphic Organizer: Keeping the Lines in Line*

	Thin curvy lines	Contour lines: they connect points of equal elevation; show the steepness/grade of the landscape. More lines, close together = steep mountain!
	Dashed lines	[Students might be asked to fill these rows in] [Dashed lines show the boundaries of different counties]
	Notched lines	[Train tracks]
	Thick solid lines	[Roads]

Students could practice using map scales by determining the length of the Blue Ridge Tunnel [about a mile, the tunnel representation on map is about the same as the scale]. Students might also be asked to apply their skills by interpreting whether this map shows the entirety of the Blue Ridge Railroad [no; the caption says it is 17 miles in length, and this map shows about ten miles, according to the map scale].

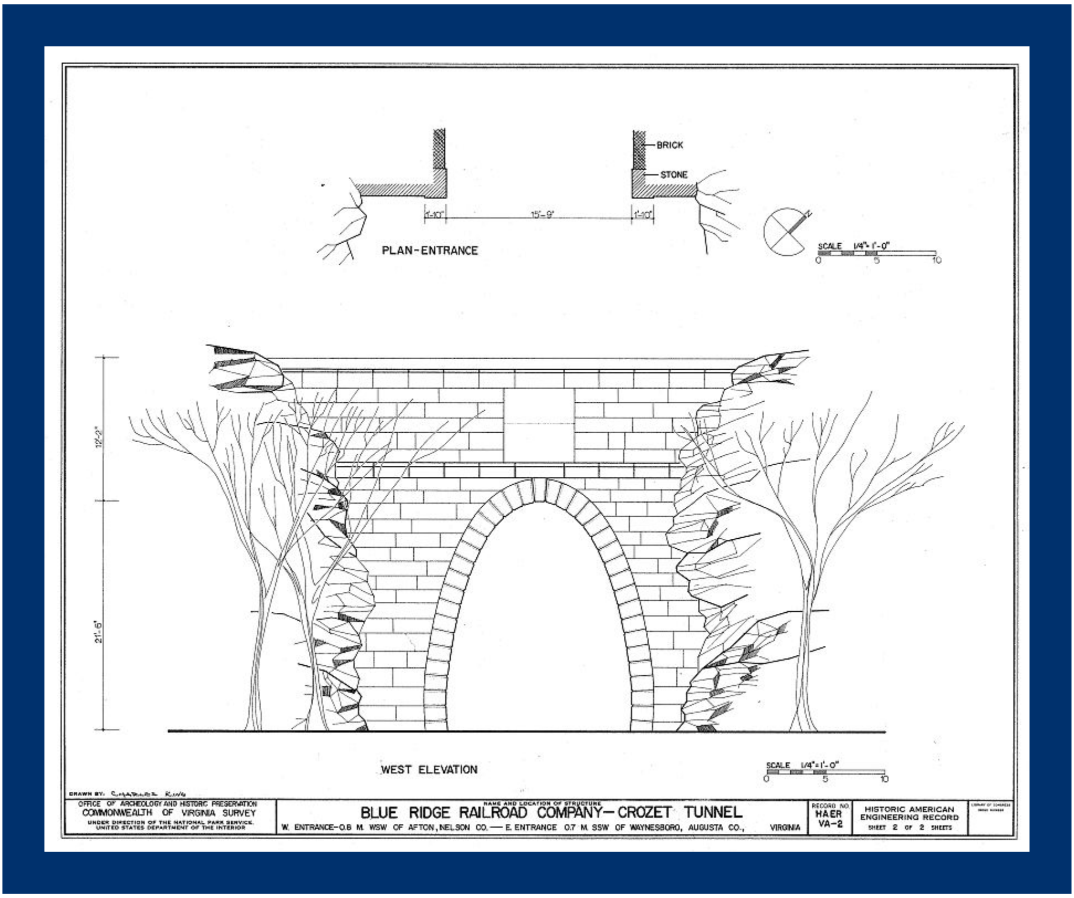
Finally, engaging with the site map is a chance for teachers to reinforce the idea that there is no such thing as a "neutral" map (Segall, 2003). Maps, like any other text, have authors who bring their own perspective and purpose for creating. A teacher might make this point (and connect to ELA standards) by asking about the main or most important idea the author of this map was trying to convey. For example, students might suggest that the main idea of this map is that there were multiple tunnels along the Blue Ridge Railroad and that the Blue Ridge Tunnel was the longest.

Preparing and Analyzing Architectural Drawings and Photographs

Inquiry design also provides opportunities for educators to engage in ongoing learning. Planning for inquiry does not require teachers to already be experts about a topic or a local place; teachers can learn immediately ahead of or alongside their students! Designing an inquiry can invite and inspire new learning about a local place, and as a result, local history. In the current inquiry, for example, the architectural drawing source (Figure 5) is likely to provide disciplinary learning opportunities for elementary educators.

As a teacher begins to prepare a source for use with students, they might realize there are some aspects of architectural drawings (for example) that they are unfamiliar with. Online reading about the different types of architectural drawings might help the teacher learn the difference between a "plan," "section," and "elevation," two of which are displayed in the drawing of the Blue Ridge Tunnel (Figure 5).

Figure 5. ***West Elevation and Entrance Plan***



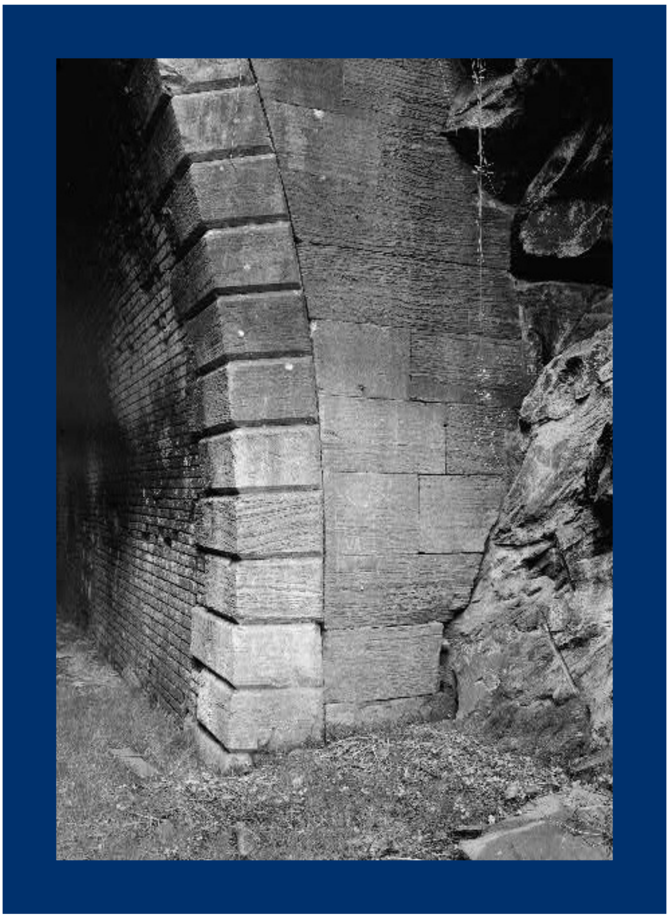
Note. King, C. (1850–1858). West elevation and entrance plan. *Blue Ridge Railroad, Blue Ridge Tunnel, U.S. Route 250 at Rockfish Gap, Afton, Nelson County, VA* [Architectural drawing]. Library of Congress. www.loc.gov/resource/hhh.va0253.sheet/?sp=2

The top diagram shown in this source is a plan, often referred to as a "floor plan" when it is created for a building. A plan displays a structure as seen from above. This plan shows the tunnel entrance, which is 15 feet, 9 inches wide. The exterior is built from stone, and the interior of this entrance is lined in brick. This can be seen in the detail photograph (Figure 6).

The drawing below the plan is called an "elevation" (see Figure 5). In this usage, "elevation" refers to an architectural drawing that displays a structure as seen from the side (and shows its height, or "elevation"). This source does not include a "section," which would cut the front or side off the tunnel to show what lies within. Like the site map, these architectural drawings indicate the scale and include a compass rose. In an inquiry with the compelling question "Why is there a tunnel here?" architectural drawings might be used alongside other sources to answer the supporting question "*How* is there a tunnel here?"

To use an architectural drawing like Figure 5 in an elementary classroom, a teacher might choose to present students with both drawings alongside the photograph in Figure 6 and ask students to explain how they are connected, what each drawing represents [seeing the orientation of the stone and brick in the photographs provides evidence that the "plan" shows the view from above], and/or what new information each drawing provides [the elevation shows what the entrance looks like and the way that the stone was built into the rock; the plan shows the width and that brick was used to line the inside of the tunnel]. Students might also use these sources in combination with photographs of the tunnel interior to make inferences about how the tunnel was constructed: by blasting through solid rock and reinforcing the opening with human-made materials.

Figure 6. ***Detail View of Portal Arch***



Note. Boucher, J. E. (1850–1858). Detail view of portal arch. *Blue Ridge Railroad, Blue Ridge Tunnel, U.S. Route 250 at Rockfish Gap, Afton, Nelson County, VA* [Photograph]. Library of Congress. www.loc.gov/resource/hhh.va0253.photos/?sp=3

Figure 7. *Blue Ridge Tunnel Written Historical and Descriptive Data*

HAER No. VA-2
Page 2

The Blue Ridge Tunnel, also known as the Rockfish Tunnel and the Crozet Tunnel, is the longest tunnel (4,264 feet) engineered by Claudius Crozet. The mid-19th century tunnel is the longest of four tunnels designed for the Blue Ridge Railroad Company. The maximum degree of curvature is 10 degrees, 30 minutes and the maximum grade is 75 feet to the mile going westward.[1]

Construction of the tunnel began on Febuary 14, 1850 with an estimated cost of $200,000.00.[2] In 1853, after 900 feet of progress had been made digging in from the west side, a vein of water was breached.[3] Crozet helped elivіate the problem with a siphon some 2000 feet long. Crozet had tunneling begun at both ends with work proceeding toward a common middle. This was a unique way to tunnel and many critics thought the two shafts would never meet. But, on December 25, 1856, the Blue Ridge Tunnel was "holed through".[4] Although trains did not start running through the tunnel until April 13, 1858, the tunnel was seen as an amazing feat of engineering. In his book Tunneling, [New York, John Wiley & Son Inc., 1978], Henry S. Drinker proclaimend the Blue Ridge Tunnel to be the first long distance tunnel to be driven without the utilization of vertical shafts. Drinker also characterised the ventilation and drainage facilities as being of novel design.

Specifications for the Blue Ridge Railroad, which included the Blue Ridge Tunnel, were prepared by Crozet and a copy of the original fifteen page draft is located in the Library of Congress.[5] In there Crozet describes the shape of the tunnels as elliptical (in cross section) and states he calculated the resistance of the eliptical tunnel to be about double the resistance of a semicircular tunnel. Where loose rock required it the tunnel was arched with brick or sandstone.[6]

16

HAER No. VA-2
Page 3

According to R. C. Tench P.E., a senior engineer of the present Chesapeake and Ohio Railway Company/ Baltimore and Ohio Railway Company stationed in Huntington, West Virginia, the Blue Ridge tunnel was closed in the early 1940's The tunnel no longer provided the clearances required by the newer larger cars which were much more economical to operate on the line.

Note. Historic American Engineering Record. (1850–1853). [Data pages from Survey HAER VA-3]. *Blue Ridge Railroad, Blue Ridge Tunnel* [Data pages]. Library of Congress. https://www.loc.gov/item/va0253/

Dimension 3: Preparing Written Sources for Elementary Students

Text sources can be used alongside photographs, drawings, and prints to ensure a robust variety of sources in elementary inquiry. Alongside the images, the HAER data pages include historical and descriptive data about each structure, including the construction date(s), location, designer, owner, and significance (see Figure 7). For example, the report for the

Blue Ridge Tunnel would also be a valuable source to support students in answering the supporting question "*How* is there a tunnel here?" because there is a detailed description of the engineering process. A teacher might consider options for preparing the text for students: extracting a few paragraphs or sentences, modifying the text to be accessible to elementary students, or scaffolding access with annotations or guiding questions (Wineburg & Martin, 2009).

A teacher could decide to use the full source, thinking that students might be excited to work with the official report. Given the technical nature of the document, a teacher should read in advance to prepare. An important step to take while reading as a teacher is to determine which details to ask students to make inferences about and which to make sure the teacher understands and can briefly explain as the class reads together. For example, a note in the Blue Ridge Tunnel report about a vein of water being breached and Crozet's use of a siphon to "eliviate [sic] the problem" involves a variety of technical vocabulary and is not central to answering the targeted supporting question. A teacher might plan to quickly explain this rather than ask students about it. At the same time, a teacher might jot down other text-based questions to discuss during class:

- What was unique about this tunneling project? [The engineer, Crozet, "had tunneling begun at both ends with work proceeding toward a common middle"]
- What do you think it means that the Blue Ridge Tunnel was "holed through" on December 25, 1856? [The two ends connected, so now the tunnel went all the way through the mountain.]
- Why was the tunnel arched with brick or sandstone in some places? [There was loose rock.]
- Why was the tunnel designed in an elliptical shape? [Crozet calculated that the resistance of the elliptical tunnel would "be about double the resistance of a semicircular tunnel."]

Concurrent to drafting questions is a good time for a teacher to notice vocabulary or sentence construction that might be challenging. This is likely to vary based on the strengths and needs of the students in any given classroom. For the last question, a teacher might plan to return to the architectural drawing to show the elliptical shape. They might also note that the detail about the "resistance" of the elliptical tunnel is likely to require an explanation that this refers to the tunnel's strength. Taking time to engage with the source prior to sharing it with students is a vital step in lesson preparation to support access to complex text.

Dimension 4: Taking Informed Action through Memorialization

Communicating conclusions and taking informed action following an inquiry is a core pillar of the C3 Framework. However, especially in elementary classrooms where social studies is often competing for time, this element of the inquiry arc is the most likely to be cut short or omitted entirely (Quinn, 2021). When considering the role of social studies in preparing future citizens who are actively pursuing a more just society, it is problematic that students are missing out on opportunities to develop their sociopolitical consciousness (Ladson-Billings, 2017) and practice skills of justice-oriented citizens (Westheimer & Kahne, 2004). Importantly, taking informed action can be as straightforward as noticing what information is missing and taking steps to seek it out.

For example, a teacher might notice that the engineering records from the HAER could not and did not capture important elements of the story of the Blue Ridge Tunnel. A consideration when drawing on sources from the HAER is the fact that maps, architectural drawings, and photographs taken years after construction have the potential to obscure the people involved in massive construction projects like the excavation of the Blue Ridge Tunnel.

In the HAER record for the nearby Greenwood Tunnel, there is more content about the purpose of the tunnel system (to overcome the barrier posed by the "mountainous terrain of western Virginia" and connect tidewater Virginia to the Ohio River Valley) and extensive information about Claudius Crozet, the engineer who "played an important role in this development." A paragraph is dedicated to his biography, while a mere sentence acknowledges that at the nearby Greenwood Tunnel, excavation conditions were of a "most unfavorable character for tunneling," and "throughout its construction, conditions at the tunnel remained hazardous and there was some trouble keeping laborers at their jobs." The laborers who died, who are mentioned on the Blue Ridge Tunnel foundation website (Blue Ridge Tunnel Foundation, n.d.), are nowhere to be found.

To take action following this inquiry, teachers might ask students to consider who *isn't* included in these sources: the laborers who actually did the work to dig out the tunnel. Students might explore additional sources, such as those cited in the HAER report, websites, or more recent historical analyses to learn about the people who worked over nine years in hazardous conditions to dig out the tunnels. For example, historian Mary E. Lyons (2020) has published about the role of enslaved laborers in constructing Virginia's Blue Ridge Railroad. Students might take action by drafting text or designing artifacts to give credit where credit is due or memorialize those who lost their lives in the effort.

Teachers might also choose to connect to a proposed or ongoing local engineering project for students to act on their learning. For example, students might use the fact that the Blue Ridge Tunnel eventually needed to be replaced to accommodate larger trains to suggest that current structural projects should consider possible future technological changes that might impact the longevity of the design. Or, students might request more information about plans for worker safety. There are many possible avenues for students to take action, and it might make the most sense for students to have a voice in choosing an approach (Muetterties & Swan, 2019). What is most important is that this vital part of the inquiry arc is not skipped.

Conclusion

This chapter provided an overview of one approach to planning place-based inquiry based on primary sources from the Library of Congress collections. There is much potential in using a local place as a starting point for an inquiry. Transportation structures such as tunnels are a widely applicable example with connections to many state and national standards, and there are thousands of sources available through the Historic American Engineering Survey and other Library of Congress collections to support the development of inquiry lessons.

Teachers should plan to learn alongside students when planning for an inquiry. Prior expertise is not a prerequisite. Approaching a local place with curiosity and interest is a strategy for designing inquiries that teachers are excited to implement with elementary students. Students can tell when a teacher is personally invested in new learning opportunities and are likely to be more engaged in co-constructing knowledge about local places.

Finally, taking informed action is fundamental to the inquiry arc and should not be omitted. However, it need not be a complicated and time-consuming project; action might look like identifying information that is missing and seeking it out.

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Appendix A

Primary Sources From the Library of Congress	
Source	**Description**
Cole, G. (1855). *The contractor's book of working drawings of tools and machines used in constructing canals, rail roads and other works* [Lithograph]. Library of Congress. www.loc.gov/item/93504540/	This drawing depicts a canal alongside a railroad and could be used to illustrate the transition from canals to railroads as a main form of transportation during this time.
Crozet, C. (1848). *A map of the internal improvements of Virginia; prepared by C. Crozet, late principal engineer of Va. under a resolution of the General Assembly adopted March 15th 1848* [Map]. Library of Congress. www.loc.gov/item/98688564/	This high-resolution map of Virginia was created by Claudius Crozet. It could be used to illustrate the path of the railroad and intersection with the Blue Ridge Mountains, necessitating a tunnel.
*Prycer, D. G. (1850–1858). Site map. *Blue Ridge Railroad, Blue Ridge Tunnel, U.S. Route 250 at Rockfish Gap, Afton, Nelson County, VA* [Architectural drawing]. Library of Congress. www.loc.gov/resource/hhh.va0253.sheet/?sp=1_	This topographical site map of the Blue Ridge Railroad illustrates the path of the rail line and location of the tunnels. It could be used as a visual overview of the railroad and provide practice interpreting map features.
*King, C. (1850–1858). West elevation and entrance plan. *Blue Ridge Railroad, Blue Ridge Tunnel, U.S. Route 250 at Rockfish Gap, Afton, Nelson County, VA* [Architectural drawing]. Library of Congress. www.loc.gov/resource/hhh.va0253.sheet/?sp=2_	This architectural drawing includes a plan (view from above) and elevation (view from the front) of the Crozet tunnel. It could be used to gather evidence about how the tunnel was constructed.
*Boucher, J. E. (1850–1858). Detail view of portal arch. *Blue Ridge Railroad, Blue Ridge Tunnel, U.S. Route 250 at Rockfish Gap, Afton, Nelson County, VA* [Photograph]. Library of Congress. www.loc.gov/resource/hhh.va0253.photos/?sp=3	This photograph provides a detailed view of an arched entrance to the Crozet tunnel. It could be used to gather evidence about the different resources required to construct the tunnel.
*Historic American Engineering Record. (1850–1858). *Blue Ridge Railroad, Blue Ridge Tunnel, U.S. Route 250 at Rockfish Gap, Afton, Nelson County, VA* [Data set]. Library of Congress. www.loc.gov/item/va0253/	This is a collection of seven images that includes interior and exterior photographs of the tunnel. Students could use these sources to practice corroboration by analyzing the images alongside the architectural drawings and written records.
*Historic American Engineering Record. (1850–1853). [Data pages from Survey HAER VA-3]. *Blue Ridge Railroad, Greenwood Tunnel* [Data pages]. Library of Congress. www.loc.gov/item/va0065/	The data pages from the HAER survey of the nearby Greenwood tunnel provide additional details about the project, including challenges faced by the lead engineer Claudius Crozet.
*Resource is pictured/described in this chapter.	

Appendix B

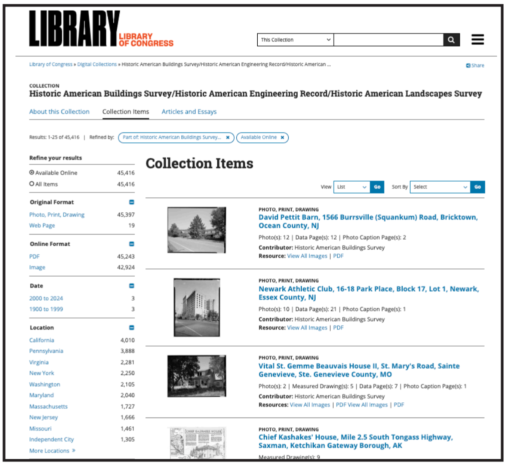
Try it Out: Find Your Tunnel

The Library of Congress maintains an invaluable collection of sources highlighting achievements in architecture, engineering, and landscape design from the Historic American Buildings Survey (HABS), the Historic American Engineering Record (HAER), and the Historic American Landscapes Survey (HALS), with over half a million drawings, photographs, and written histories of tens of thousands of historical structures and sites. Inquiry designers might search these collections for any local place, but to stay aligned with the example outlined in this chapter, the steps below show a search for transportation structures, with a focus on tunnels.

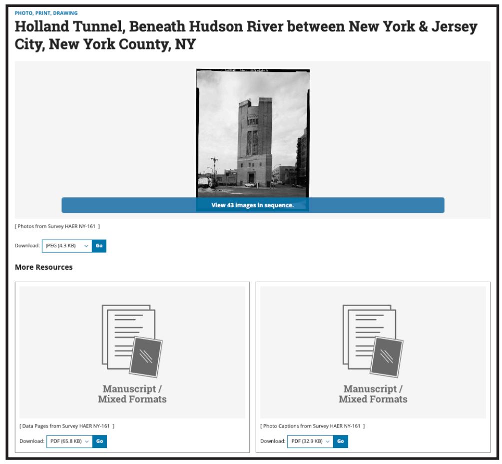
1. Search the HABS/HAER/HALS collection for "tunnel" (or "bridge," "canal," etc.) and your home city or state. (Image A below)
2. If you identify a local structure in the search results, click the title link or thumbnail image to view the item details. (Note: The thumbnail image is usually just the first in a sequence of images for the structure, and more are likely available.)
3. On the item page (Image B below), you will see "More Resources" with downloadable documents including the following:
    a. Data Pages, which contain a written narrative and architectural drawings;
    b. Captions, which describe each image in the sequence associated with the item; and
    c. Drawings, which are sometimes included in data pages, and at other times are grouped on their own.
4. Also on the item page (Image B below), you will see a thumbnail image with text that says "View X images in sequence" with a link to a gallery (Image C below) of all the images related to the survey of the structure.
5. Clicking on a thumbnail in the gallery will bring you to a larger version of the specific image (Image D below) and details about the item with which the image is associated. You can use the arrows to click through each image in the sequence or use the dropdown menu to change the view to a list or gallery.
6. Browse the sources and keep a running log of the questions that come to mind.

HABS/HAER/HALS Collections Search Images

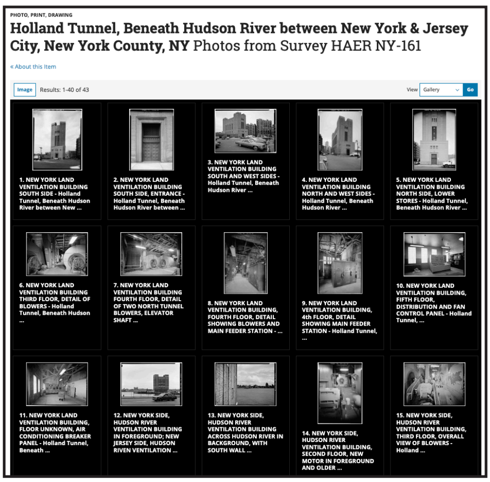
A



B

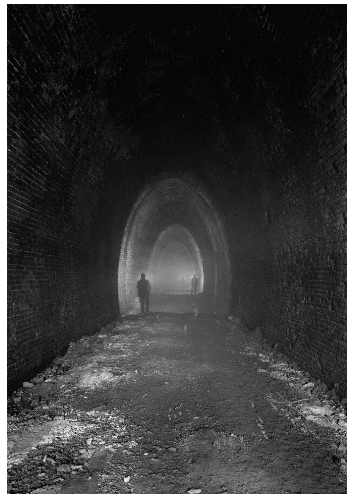


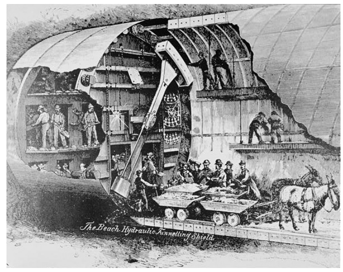
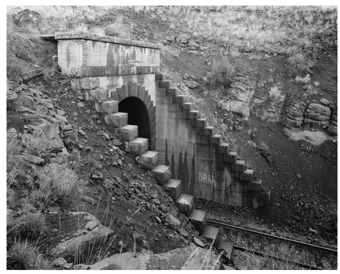
C



D

Appendix C

Tunnels Across North America		
Tunnels Across North America	**Description**	**Featured Source**
Blue Ridge Tunnel U.S. Route 250 at Rockfish Gap, Afton, Nelson County, VA Initial Construction: 1850—1858 Engineer: Crozet, Claudius	The Blue Ridge tunnel was the longest tunnel in the United States upon completion. It is also the first tunnel in the U.S. driven without vertical shafts. The tunnel was constructed to connect transportation lines on either side of the Blue Ridge Mountains to allow the movement of goods and people from the tidewater to the Ohio River. Crozet, the chief engineer on the project, resigned his position after numerous petitions blamed him for project delays. The featured source is an interior photograph of the tunnel.	 Interior of Blueridge (Crozet) tunnel. (1850—1858). *Blue Ridge Railroad, Blue Ridge Tunnel, U.S. Route 250 at Rockfish Gap, Afton, Nelson County, VA* [Photograph]. Library of Congress. www.loc.gov/item/va0253/
Holland Tunnel Beneath Hudson River between New York & Jersey City, New York County, NY Initial Construction: 1920—1927 Engineer: Clifford M. Holland	At the time of construction, it was the longest and largest underwater vehicular tunnel, with 29.5-foot twin tubes. Every subsequent vehicular tunnel has used a ventilation system based on the one developed for the Holland Tunnel. The featured source is a photograph of the air supply duct beneath the roadway.	 Lowe, J. (1968). New York tunnel, air supply duct beneath roadway. *Holland Tunnel, Beneath Hudson River between New York & Jersey City, New York County, NY* [Photograph]. Library of Congress. www.loc.gov/item/ny1516/

Tunnel	Description	Featured Source
St. Clair Tunnel Under St. Clair River between Port Huron, MI & Sarnia, ON, Canada Initial Construction 1888—1891 Engineer: John Hobson	First full-sized subaqueous tunnel built in North America. Eliminated a major bottleneck in the rail transportation system lining the Midwest with eastern markets. The featured source is an illustration from *Scientific American* that shows novel technology: tunnel shield driven by hydraulic rams.	 Drawing showing the tunneling shield at work, with segment hoist and workmen. (1890). *St. Clair Tunnel, Under St. Clair River between Port Huron, MI, & Sarnia, ON, Canada, Port Huron, St. Clair County, MI* [Drawing]. Library of Congress. www.loc.gov/item/mi0363/
Tunnel #17 Southern Pacific Railroad Natron Cutoff, Tunnel No. 17, Milepost 408, Dorris, Siskiyou County, CA Initial Construction: 1905—1927 Engineer: E. H. Harriman	The Natron Cutoff replaced the original Central Pacific route over the Siskiyou Mountains into Oregon. Construction had to overcome many natural and political obstacles. Reached completion in 1927 at an ultimate cost of nearly $40 million. The featured source is the east portal of the tunnel. View shows the protection provided by the stepped concrete wingwalls and fitted stone.	 East portal of Tunnel 17. (1905—1927). *Southern Pacific Railroad Natron Cutoff, Tunnel No. 17, Milepost 408, Dorris, Siskiyou County, CA* [Photograph]. Library of Congress. www.loc.gov/item/ca2461/

Tunnel	Description	Featured Source
Short Tunnel Passing through Rock Spur on Zion-Mount Carmel Highway, Springdale, Washington County, UT Initial Construction: 1930 Engineer: O C Lockhart	The Short Tunnel in Zion National Park was integral to the construction of a new highway that connected four U.S. national parks. Access to Bryce Canyon, Grand Canyon, Cedar Breaks and Zion National Park was greatly improved with the building of the highway. The featured source shows a photograph of the east portal facing west. The natural chiseled-rock appearance has been maintained with a sprayed concrete covering of the natural rock.	 Lowe, J., & Thallheimer, A. (ca. 1930). Short tunnel, east portal facing west. *Zion-Mount Carmel Highway, Short Tunnel, Passing through Rock Spur on Zion-Mount Carmel Highway, Springdale, Washington County, UT* [Photograph]. Library of Congress. www.loc.gov/item/ut0421/