



Tunnels Rock: How Humans and Nature Change Earth



Spanning across the state of Maryland and bordering the Potomac River, the Chesapeake and Ohio Canal National Historical Park has an estimated 1,000,000 school-aged children within a 45-minute drive. In Canal Classrooms students explore natural and historical resources in a setting that provokes thought, inspires wonder and ignites understanding.

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Need to reach us? Call 301-714-2213 (the park’s education line) or 301-722-8226 (visitor center desk in Cumberland) or email cocanaleducation@nps.gov

Go digital. Find teacher resources including field trip reservations and pre- and post-visit classroom activities at www.nps.gov/choh/forteachers

Like us. Find us on Facebook at *Chesapeake and Ohio Canal National Historical Park*.

Tunnels Rock: How Humans and Nature Change Earth

Students explore the history and engineering of the C&O Canal as they consider manmade and natural changes to the environment.

At the end of the activity, students should be able to...

1. Identify rocks types
2. Label and identify features of a map
3. Differentiate between man-made and natural changes on Earth

The park partnered with Allegany County Public Schools to develop this field trip along with pre- and post-visit activities for your classroom. Completing the classroom activities will enhance student learning. The lessons include a canal orientation and a STEM activity. See appendices or our website for the materials:

<http://www.nps.gov/choh/forteachers/classrooms/2pawpaw>.

Duration	3.25 hours
Arrival Time	9:45 AM (or call to schedule another time)
Best Time to Plan Trip	Spring or Fall
Cost	Free
Group size	up to 60 in two groups of 30
Rotations	Three (Tunnel Hike, History Hunt, and Fossil Fun) plus lunch
Grade	Second Grade
Chaperone to Student Ratio	1 to 10 (maximum); 1 to 15 (minimum)
Maryland Common Core Standards	<p>CCSS.ELA-Literacy.CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.</p> <p>CCSS.ELA-Literacy.CCRA.W.7 Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.</p> <p>CCSS.ELA-Literacy.W.2.1 Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., because, and, also) to connect opinion and reasons, and provide a concluding statement or section.</p>

	<p>CCSS.Math.Content.2.MD.A.1 Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.</p> <p>CCSS.Math.Content.2.MD.A.4 Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.</p>
<p>Maryland State Curriculum Standards</p>	<p>SC2a1a Rock Classification- Classify a collection of rocks based on the properties that distinguish one type from another.</p> <p>SC2a1c Earth Materials Change Caused by Humans and Nature - Use examples of observations from places around the school and neighborhood to describe ways Earth materials can change.</p> <ul style="list-style-type: none">• Changes caused by humans and other animals• Changes caused by water, wind, etc.

During this extended outdoor experience, students will learn about the geology of the Paw Paw area and compare and contrast man-made and natural changes. They will take a hike through the Paw Paw Tunnel, a total of approximately two miles. After the hike, they will gather evidence of change over time like archeologists and paleontologists.

Welcome (15 minutes)

Children will meet the ranger at the parking lot for the Paw Paw Tunnel. We will walk to the amphitheater together and review our canal vocabulary and learn about human and man-made changes to the landscape.

Tunnel Tour (90 minutes)

We will walk through the tunnel, a two mile round trip, making some stops along the way. Students should bring their cameras to document their hike and the unique natural and cultural objects they will see.

Fossil Fun (30 minutes)

Students will return to the amphitheater to study fossils that might be found along the C&O Canal in the Brallier Shale formation found near the tunnel.

History Hunt (30 minutes)

Students will spend time in the campground, investigating the history to be uncovered there. Students will learn about archeology and how layers of history form.

Wrap Up (15 minutes)

Students will summarize the effects of humans and nature on the environment and share their observations.

Tunnels Rock (Paw Paw Second Grade)

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Itinerary	
9:45 Arrive at the Tunnel, Welcome Activity at Amphitheater	
Group A (30 students maximum)	Group B (30 students maximum)
10:00 Tunnel Tour	10:00 Tunnel Tour
11:30 Lunch	11:30 Lunch
12:00 Fossils	12:00 Brick Hunt
12:30 Brick Hunt	12:30 Fossils
1:00 Wrap up at Amphitheater	
1:15 Departure	

A Letter to Students

Teachers, please distribute or read to your students

Dear Students,

We rangers, teachers, and volunteers in the Canal Classroom Corps look forward to meeting you and spending a few hours exploring the Paw Paw Tunnel together.

A canal is a manmade channel of water used to move goods and people on long cargo boats pulled by a team of mules. The C&O Canal is 184.5 miles long and goes from Georgetown (near Washington, D.C.) to Cumberland, Maryland. Though the canal no longer operates, you can still hike or ride your bike the entire length. You can even ride in a canoe or kayak in some areas of the canal.

On your field trip, we will be visiting the only tunnel on the canal. It is 3,118-feet long (about half the length of a freight train) and you will get to hike through it! The tunnel is very dark, since there is no electricity or lights in it. The towpath that runs through the tunnel is muddy and wet. The air inside the tunnel stays at 55° F all year.

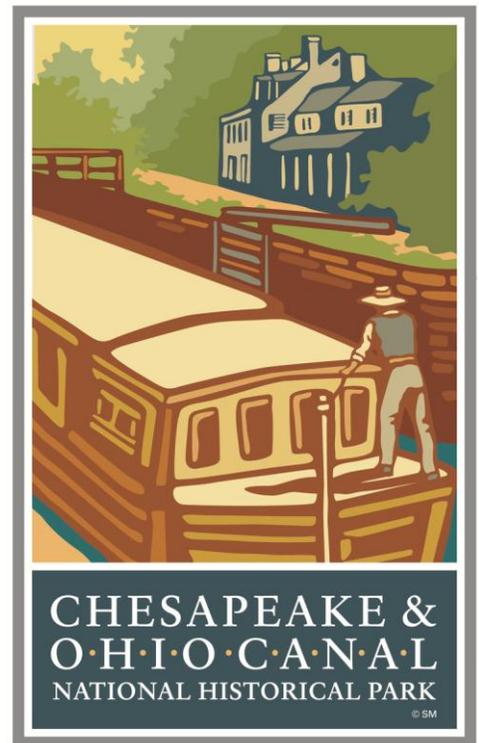
We will be outside the entire day, so dress appropriately! Bring a rain or warm coat and hat. Wear sturdy closed-toe shoes like hiking boots or old tennis shoes. Please bring your lunch and a water bottle.

We can't wait for your visit.

Happy Trails,

Hollie

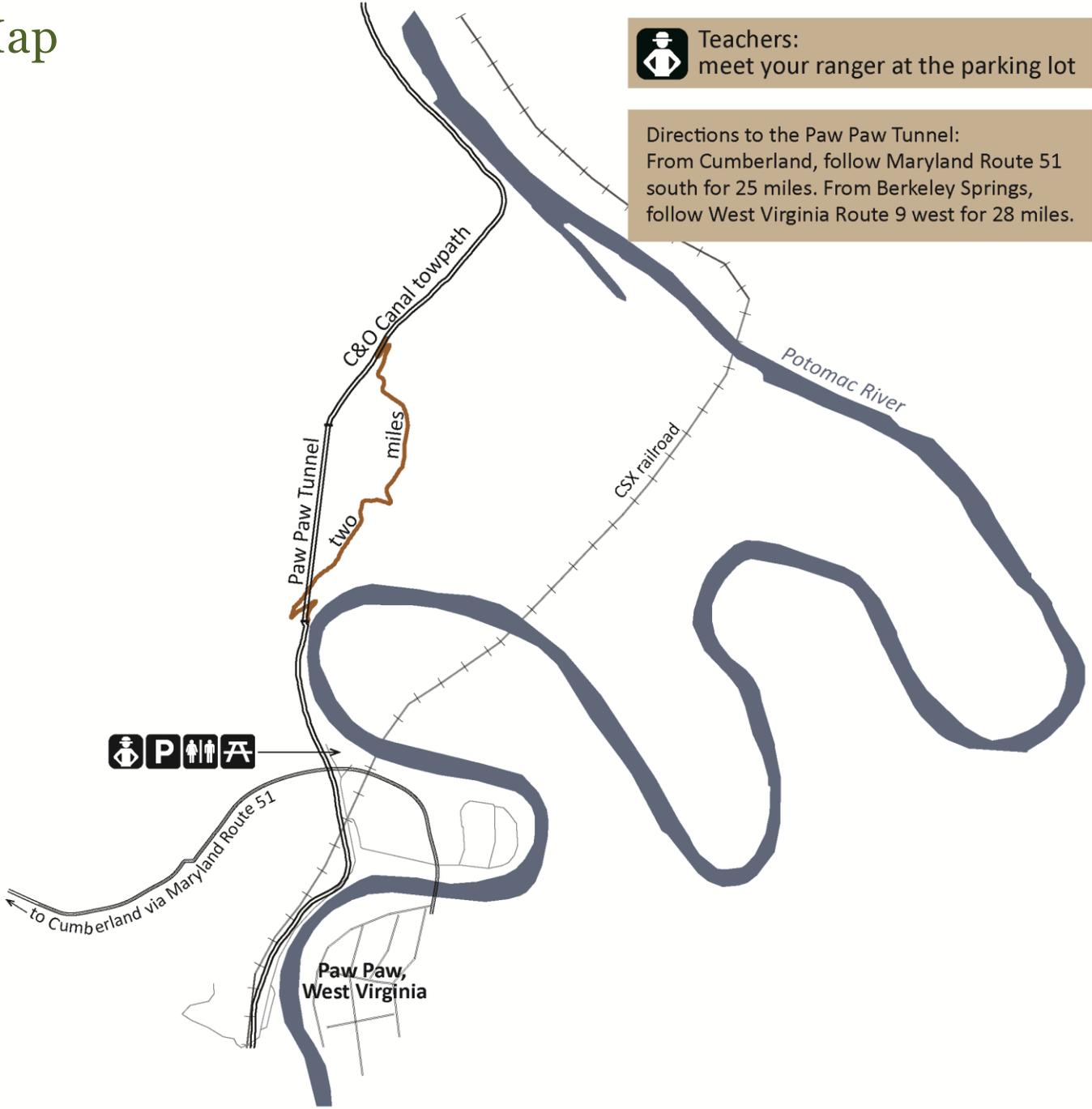
Ranger Hollie



Map

 Teachers:
meet your ranger at the parking lot

Directions to the Paw Paw Tunnel:
From Cumberland, follow Maryland Route 51 south for 25 miles. From Berkeley Springs, follow West Virginia Route 9 west for 28 miles.



Planning a Successful Visit

What to Wear

- The towpath in the tunnel is wet and muddy. Remind students to wear closed-toe shoes. Flip flops, slip-on shoes, or sandals are not appropriate. Old sneakers or boots are best.
- The tunnel remains at 55° F year-round. Every student should bring a jacket.
- We suggest wearing layers. Pants are the best precaution against cool temperatures, bee stings, and the usual outdoor hazards.
- Students may wear hats for sun protection and/or warmth.
- Programs will go on in light rain or snow. Encourage everyone to have proper outerwear such as a rain or warm coat.

What to Bring

- It is suggested each group of 3-5 students will need to bring a digital camera or smart phone, or the chaperone/teacher assigned to each group – for purposes of taking photos to document trip/post-visit activity. Cameras are also typically available through the school or district.
- There is no running water at the tunnel; bring hand sanitizer.
- Drinking water is not available at the tunnel; each student should bring at least one water bottle.
- Students should bring flashlights.
- The park has no trash receptacles. Please bring bags to take your garbage back to the school.

Communication

- There is no cell phone coverage at the Paw Paw tunnel.
- Buses must stay at the Paw Paw tunnel parking lot the entire length of the field trip.

Chaperones

- At minimum, please have one chaperone (teacher or other adult) for every fifteen students. In order to keep programs



Tunnels Rock (Paw Paw Second Grade)

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manageable, do not exceed one chaperone for every four students.

- Chaperones will be an active part of the activities. We will call on chaperones to assist (leading small groups).
- Some chaperones may need to stay with kids that do not want to enter the tunnel.
- During programs, refrain from holding conversations with other chaperones.
- No smoking during the trip.

Directions

From Cumberland, follow Maryland Route 51 south for 25 miles. From Berkeley Springs, follow West Virginia Route 9 west for 28 miles. The tunnel is located in Maryland near the town of Paw Paw, West Virginia.

Arrival

- Please arrive on time at 9:45.
- There are port-a-potties at the parking lot.

Special Needs

Let us know if any of your students have special needs. Please note that while a student with mobility impairment can get through the tunnel, the towpath is uneven and wet.

Protect Your Park

The Chesapeake & Ohio Canal National Historical Park is a federally protected public use area. Please be good stewards during your visit. Do not pick the plants or take anything from the park.

Cancellations

Field trips may be cancelled in very cold weather or heavy downpours or storms. If flooding or severe inclement weather is predicted, a Canal Classroom Corps member will call to reschedule your field trip.

If you need to cancel, please call (301) 722-8226 (C&O Canal Cumberland visitor center).



Safety Considerations

The Tunnel is Dark, Wet and Cool

There are no lights or electricity in the tunnel. The temperature inside will be 55° F. The park will lend each student a flashlight and a small backpack to carry their things. The towpath inside the tunnel will have spots with standing water. Students and chaperones must obey all safety instructions, given by park staff.

Ticks

Students will be in areas where ticks are found. Remind them to take precautions such as wearing insect repellent, staying on the towpath, and checking frequently and thoroughly for ticks.

Snakes

Two species of poisonous snakes are found in the park: the Northern Copperhead and the Timber Rattlesnake. Students should be cautious where they place their hands and feet.

Stinging insects

Students may be in areas with hornets, wasps, and bees, which can cause severe allergic reactions in sensitive individuals. Chaperones should carry epinephrine pens with them.

Rabies

All animals in the park are wild and their behaviors are unpredictable. Treat all animals with caution.

Poisonous plants

You will be visiting an area with poison ivy and other noxious plants. Stay alert and stay on the towpath or in mowed areas.

Sun and Heat Exposure

Remind students to wear sunscreen and a hat to avoid exposure to sun. Students are invited to carry a water bottle and stay in the shade to avoid heat exposure.

Wind and Inclement Weather During the Program

If severe storms are predicted, we will call to reschedule your program. The bus must stay at the Paw Paw tunnel parking lot in case the weather deteriorates during our field trip.

Additional On-line Resources about the C&O Canal and the National Park Service

Description		Website URL
C&O Canal NHP	The park's website for teachers hosts classroom materials and on-line resources	www.nps.gov/choh/forteachers
C&O Canal Trust	The park's partner in education provides 50 short stories about places along the C&O Canal for students to read	www.canaltrust.org
National Park Service	Learn more about the NPS mission, history, and organization	www.nps.gov/aboutus/index.htm
National Park Service America's Best Idea	More facts about the NPS, including an excellent timeline and movies	http://www.nps.gov/americasbestidea/

Pre Visit Activity: Meet the C&O Canal

Use at least one of these lessons as a pre-visit classroom activity to introduce students to the tunnel.

Option A (Recommended): Paw Paw Tunnel Video

Students will watch a three-minute video describing history of the Paw Paw Tunnel including problems with construction, challenges with the environment and turmoil among canal workers. Give the students a copy of the video guide (Appendix A) to help them take notes. Then discuss the answers. Video is available at <http://www.youtube.com/watch?v=331D-aVZxSQ>.

Option B – To Build or Not To Build Reading and Math Activity (STEM)

Read aloud the To Build or Not to Build Real-life Dilemma (Appendix B). It describes the dilemma that the canal company faced when it reached the Paw Paw bends: construct five miles of canal or tunnel through the mountain. Provide students with a copy of the map, 12 inches of yarn, and a ruler. Ask them to measure the length of the tunnel versus the length of the river. Using mathematical skills students will add/subtract the extra miles if the canal followed the river to determine the total length of the canal towpath with and without the tunnel. Discuss the pros and cons of constructing a tunnel versus building to follow the river through the Paw Paw Bends.

Option C – Review Vocabulary

Artifact: An object produced or shaped by human craft, especially a tool, weapon, or ornament of archaeological or historical interest

Canal: a manmade waterway used to move goods, people

Deposition is the process by which sediments are deposited in a new location.

Erosion: carrying away of weathered soil, rock, and other materials on the earth's surface by gravity, water, ice, and wind.

Fossil: the remains or impression of a prehistoric organism preserved in rock

Landslide: the sliding down of dirt or rock from a mountain or cliff

Natural agents: water, wind, and ice.

Navigate: to travel by water

Sediment: small pieces of rock, shell, and plant and animal matter that is moved and deposited by water, wind, or ice.

Shale: soft, finely stratified sedimentary rock that formed from mud or clay and can be split easily into fragile slabs

Towpath: a dirt path alongside a canal where mules would walk and tow canal boats

Transport: move from one place to another

Tunnel: an artificial underground passage, esp. one built through a hill or under a building, road, or river

Weathering: wear away or change the appearance or texture of (something) by long exposure to the air.

Post Visit Activity: Tunnel Activities

Use these lessons as a post-visit or stand-alone classroom activity.

Option A: STEAM Activity Tunneling Through

Students will build a tunnel using simple materials, STEM Lesson (see Appendix C). This project works best as collaboration between the classroom teacher and art teacher. If completing this activity please let ranger know in advance if you are interested in displaying students STEAM projects at Canal Place for part of Downtown Cumberland Arts Walk open to parents and community.

Option B: Photo Map

Utilizing digital images taken during the field trip, students will arrange photos on a map to locate/identify natural and man-made features as well as examples of weathering and erosion. Discuss effects of weathering and erosion. Use the base map (see Appendix D).

Option C: Writing

Students write an opinion piece (see Appendix E) on whether or not the C&O Canal Company should have built a tunnel based on observations from their field trip.

Appendix A: Paw Paw Tunnel Video (pre-visit)



C&O Canal Paw Paw Tunnel Video Guide

Name _____

Answer these questions as you watch the video.

What year was the Paw Paw Tunnel supposed to be complete?

What was the dollar amount of the bid from the contractor to build the tunnel?

\$ _____

List some complications during the construction of the tunnel.

1. _____

2. _____

3. _____

How many years did it actually take to complete the tunnel?

How much did the tunnel **actually cost to build**?

\$ _____

Appendix B: To Build or Not To Build Reading and Math Activity (pre-visit)



To Build or Not to Build: A C&O Canal Dilemma

Name _____

It is April 1836 and the building of the Chesapeake and Ohio Canal from Georgetown, Washington, D.C to Cumberland, Maryland continues. Your name is Charles B. Fisk and you are an engineer for the Chesapeake and Ohio Canal Project. You have been helping build the canal since John Quincy Adams, our sixth president, held a groundbreaking ceremony on July 4, 1828 in Georgetown. Now almost ten years later, an important decision must be made about the building of the Chesapeake and Ohio Canal.

Near a small town called Paw Paw, the Potomac River takes three huge back and forth loops across the land. The banks along these three long river loops are steep and treacherous. It will be very difficult for the workers to dig out the canal along the banks of the Potomac River like you have been doing since Georgetown. The loops are a total of five miles long and building the canal alongside of the Potomac River will take about two years. After looking at the geography of the land, you also believe that you will need to build at least three locks to help lift the boats up and down where the land rises and falls in elevation. Each lock costs about fifteen thousand dollars. To build the canal and all of these locks you estimate that it will cost about one hundred fifty thousand dollars. You are certain that while this work will be difficult, it will be successful and allow boats to travel easily in both directions from Cumberland to Georgetown.

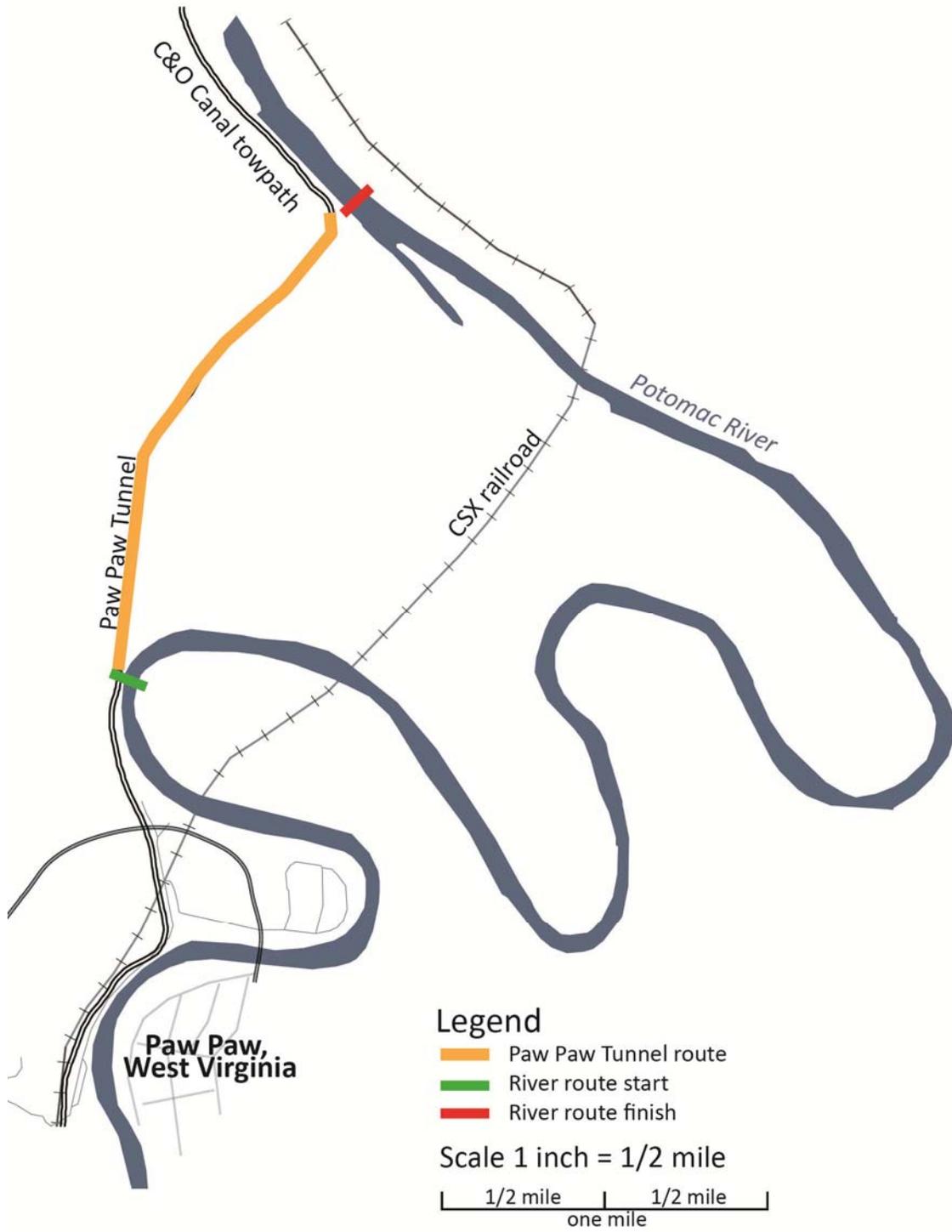
To avoid the long and difficult five mile loops of the Potomac River, you consider building a tunnel through the nearby Paw Paw Mountain. The tunnel would be much shorter, less than a mile long (3,118 feet), and would not require any expensive locks. However, from your past experience as an engineer you know that building a tunnel is slow and dangerous work. Tunnels usually take at least two years to build and some tunnels take over ten years to build. You are certain that this tunnel will take at least five years to build since you have to dig through the solid shale rock that makes up the Paw Paw Mountain. To remove all of the rock you will need to use dynamite which is very dangerous and can easily injure your workers. The last time you helped build a tunnel, you also witnessed multiple cave-ins that injured and even killed some of the workers. You also know that tunnels are extremely expensive to build

and can cost over two hundred thousand dollars to complete. Lastly, because of how difficult the tunnel will be to build, you are certain that there will only be room for boats to travel in one direction at a time through the tunnel. However, you know that if you are successful at building this tunnel, you will be seen as one of the greatest engineers of all time.

Questions to think about:

- 1) What important information do you need to know to make the best decision possible?
- 2) Besides the ones stated in the dilemma, what are some other possible consequences and/or considerations that you need to keep in mind when making before making your decision?

Using this map, yarn, and a ruler, measure the length of the tunnel (orange line) and the river (the gray, curvy line) between the green and red start/finish points. Record your measurements below.



River length _____

Tunnel length _____

How many miles did the tunnel save canal workers from building? _____

Write two pros (good things) and two cons (bad things) about building the tunnel and the canal on the charts below.

 Tunnel Pro	 Tunnel Con

 River Pro	 River Con

Would you have built a canal along the river or a tunnel through the mountain?

Why do you feel this is the best decision?

Appendix C: Tunneling Through Allegany County Public Schools STEM Guide (post-visit)



C&O Canal Paw Paw Tunnel STEM Post-visit Activity

Tunneling Through Time

In order to save distance in travel, engineers often use tunnels to go through mountains instead of over or around them. Students in groups of 2-3 will construct a mountain using plaster of paris, clay, or play dough. Ask each group to draw a design for a tunnel through their mountain. After the mountain is set, teacher/students will drill a tunnel through it that a toy car or boat will be able to pass through. Your tunnel should be able to withstand the weight of the land on top of it and not collapse.

Teacher provides following materials: Plaster of Paris, clay or play dough (teacher's choice – plaster of paris will be the most authentic for the purpose of "chipping away" rock when tunneling), flathead screwdriver, hammer, drywall screws (to be "drills"), toy car or boat, paint is optional

Group Name _____

Use the space below to design your mountain and tunnel.

Appendix D: Photo Map (post-visit)



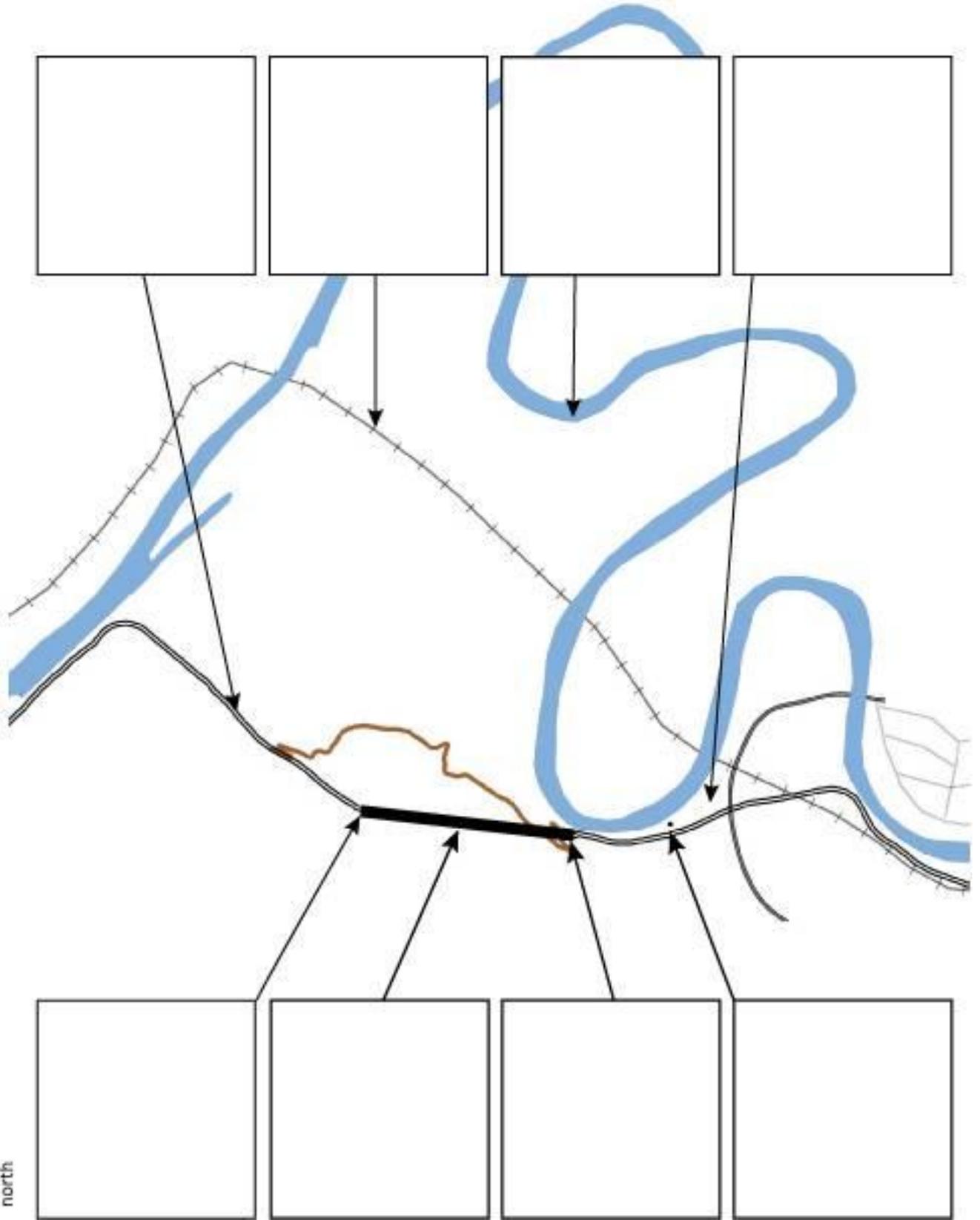
C&O Canal Photo Map of the Paw Paw Area

Name _____

Use the map on the next page to document your trip to the Paw Paw Tunnel. Cut out your photos and paste them to this map. If you didn't take photos, try to sketch what you recall seeing at each location. Use the space below to make notes and record data about your observations.

Paw Paw Area Photo Map

Name: _____



Appendix E: Writing Piece (post visit)

Appendix F: Transportation Scholarship Application



Canal Classrooms Transportation Scholarship Fund

This grant is made possible through the park's partners in education, the C&O Canal Association and the C&O Canal Trust, by their generous members and donors. In addition, the National Park Foundation provided funding through the Ticket to Ride Grant Program. If you have questions, please contact cocanaleducation@nps.gov or call (301) 714-2213.

Eligibility

- Public, private, and charter schools.
- Students may be pre-kindergarten through grade 12. University and colleges are not eligible.
- Field trips must take place within the boundary of the C&O Canal National Historical Park and students must participate in curriculum-based (Canal Classrooms) programs or Bridging the Watershed (BTW) programs. Independent Teacher-led field trips are not eligible for funding.
- Schools will be required to complete pre-visit activities and/or post-visit activities to receive funding.
- Schools will be required to send a thank you letter, addressed to partner organizations (more details provided upon confirmation of funding).
- Funding is prioritized for Title I schools.
- Classes are eligible for reimbursement once per school year.

Deadlines

- Requests for reimbursement must be received at least two weeks prior to your field trip date. Confirmation of your application status will be sent via email within one week of submitting the application request.

Other information

- An invoice from the bus company, the district transportation office, the principal's office, or the school board is required as part of the reimbursement request.
- Reimbursement checks will be mailed within 30-days following the field trip and upon receiving the completed reimbursement request and invoice.
- As a condition of funding, park staff and partners may photograph students in the park. Park staff will contact you in advance of the field trip and send a photo release form.

Instructions

1. Complete the reimbursement request form before your field trip.
2. Attach an invoice.
3. Submit the form and invoice via email to cocanaleducation@nps.gov.
4. We will respond via email confirming or denying the reimbursement request within 5 business days.



Office Use Only

Date rec'd: _____

Reviewed by: _____

Approved by: _____

CT

CA

NPF

Check mailed: _____

Transportation Scholarship Application

Today's date _____

School name _____

Type Public school Private school Charter school

Title I? Yes No

Grade(s) _____

e-mail for bus reimbursement _____

Sponsoring teachers _____

(list all homeroom or subject teachers participating in the field trip)

Program date _____

(if the date is dependent on funding or has not been finalized, please provide the anticipated date)

Program location _____

(must be in the park)

of students _____

	\$	X	\$	=	
--	----	---	----	---	--

of buses X Cost per bus = Amount of reimbursement requested

(Contact your bus company or district transportation coordinator for an invoice. You must attach an invoice to this application.)

Check payable to _____

Mail check to _____

For marketing purposes only:

Has your school received a C&O Canal bus reimbursement in the past year?

Yes No

How did you hear about this grant?

Previous user NPS website Partner website Ranger

Other: