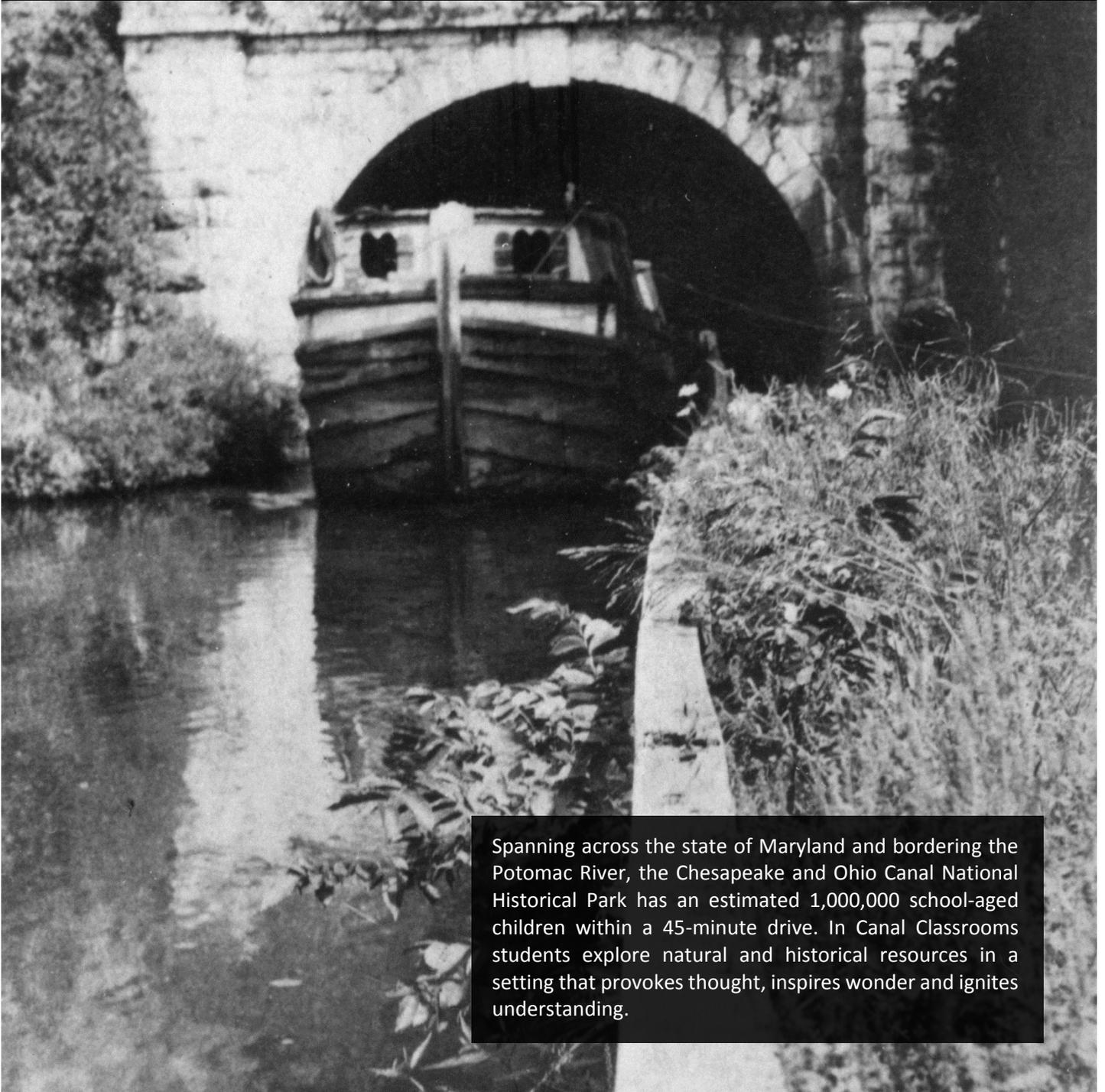




## Around the Bends: A Case Study of the Paw Paw Tunnel



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.

# Table of Contents

Around the Bends: A Case Study of the Paw Paw Tunnel.....	1
A Letter to Students.....	4
Map.....	5
Planning a Successful Visit.....	6
Safety Considerations.....	8
Additional On-line Resources about the C&O Canal and the National Park Service.....	9
Pre Visit Activity: Tunnel Background.....	10
Post Visit Activity: Tunnel Activities.....	11
Appendix A: Paw Paw Tunnel Video (pre-visit).....	12
Appendix B: To Build or Not To Build Case Study (post-visit).....	13
Appendix C: Transportation Scholarship Application.....	14

**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](mailto: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](http://www.nps.gov/choh/forteachers)

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

# Around the Bends: A Case Study of the Paw Paw Tunnel

Students form an opinion on whether or not building the Paw Paw Tunnel was worth the costs.

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

1. Calculate, compare and convert distances
2. Support an opinion about cost efficiency of building the tunnel
3. Describe a day in the life of an immigrant worker at the tunnel

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/5pawpaw.htm>.

<b>Duration</b>	3.5 hours
<b>Arrival Time</b>	9:45 AM (or call to schedule another time)
<b>Best Time to Plan Trip</b>	Spring or Fall
<b>Cost</b>	Free
<b>Group size</b>	up to 60
<b>Rotations</b>	One
<b>Grade</b>	Fifth Grade
<b>Chaperone to Student Ratio</b>	1 to 5 (maximum); 1 to 10 (minimum)
<b>Maryland Common Core Standards</b>	<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.6 Use technology to produce and publish writing and to interact and collaborate with others.</p> <p>CCSS.ELA-Literacy.W.5.1a Introduce a topic or text clearly, state an opinion, and create an organizational structure in which ideas are logically grouped to support the writer's purpose.</p> <p>CCSS.Math.Content.5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system, and use these conversions in solving multi-step, real world problems.</p>

<p><b>Maryland State Curriculum Standards</b></p>	<p>SS2.B2.a Analyze how the influx of immigrants led to economic growth and cultural diversity</p> <p>SS 3.B.1.c.- Explain how geographic characteristics affect how people live and work, and the population distribution of a place or region</p> <p>(SS2C1a) Analyze how conflict affected relationships among individuals and groups, such as early settlers and Native Americans, free and enslaved people-</p> <p>(SS4.A1a.)- Identify the opportunity cost of economic decisions, such as whether or not to buy products on which British taxes were imposed</p> <p>(SS4.A.2.) a. Describe how limited resources and unlimited economic wants caused colonists to choose certain goods and services</p> <p>b. Describe how available resources affected specialization and trade</p> <p>c. Analyze how changing from a British colony to an independent nation affected economic resources, production, and economic wants</p> <p>(SS4.A.3)a. Explain how the development of new products and new technologies affected the way people lived</p> <p>examine how technology has changed production such as wheat/grist mills</p> <p>(SS.4.A.4.)a. Analyze examples of regional specialization and how it contributed to economic growth through the colonies</p> <p>b. Explain specialization and interdependence using the triangular trade routes</p> <p>(SC6.B.2.) a. Explain how human activities may have positive consequences on the natural environment.</p> <p>Native plantings</p> <p>Good farming practice</p> <p>b. Explain how human activities may have a negative consequence on the natural environment.</p> <p>Damage or destruction done to habitats</p> <p>Air, water, and land pollution</p> <p>c. Identify and describe that an environmental issue affects individual people and groups of people differently.</p> <p>(SC5a1) Describe the motion of objects using distance traveled, time, direction, and speed.</p>
---	---

## Around the Bends (Paw Paw Fifth Grade)

Page 3

On their hike, students compare and contrast the various options that engineers considered when constructing the C&O Canal through the Paw Paw bends. Students form an opinion on whether or not it was worth the costs.

### Welcome (25 minutes)

Ranger will greet students at the campground amphitheater (adjacent to the parking lot), review safety rules and canal history.

### Tunnel Hike (150 minutes)

Students will take a 4 mile hike with a ranger. Along the way, we will stop and talk about the tunnel's social, economic, and cultural history. The students will collect data and participate in an Eye Spy activity. Lunch will be along the trail.

### Wrap Up (15 minutes)

Students will summarize their experience, sharing their data collection and drawing conclusions on the dilemmas that plagued the canal and tunnel workers. Students will be given an index card to record their favorite part of the field trip and the most surprising thing they learned.

Itinerary	
9:45 Arrive at the Tunnel, Welcome Activity at Amphitheater	
Group A (60 students maximum)	
10:10	Tunnel Hike
11:30	Lunch (during hike)
12:00	Tunnel Hike, cont.
12:40 Restroom Break and 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.

On your field trip, we will visit 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 also hike over the top of the tunnel where we will share stories about the men who built the tunnel.

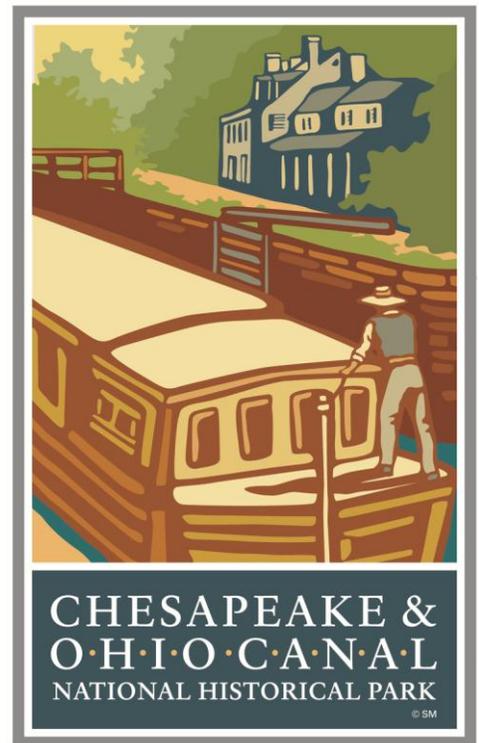
We will be outside the entire day, so dress appropriately! Bring a rain or warm coat and hat. Wear sturdy closed-toe shoes like hiking boots or tennis shoes. Please bring your lunch and a water bottle.

We can't wait for your visit.

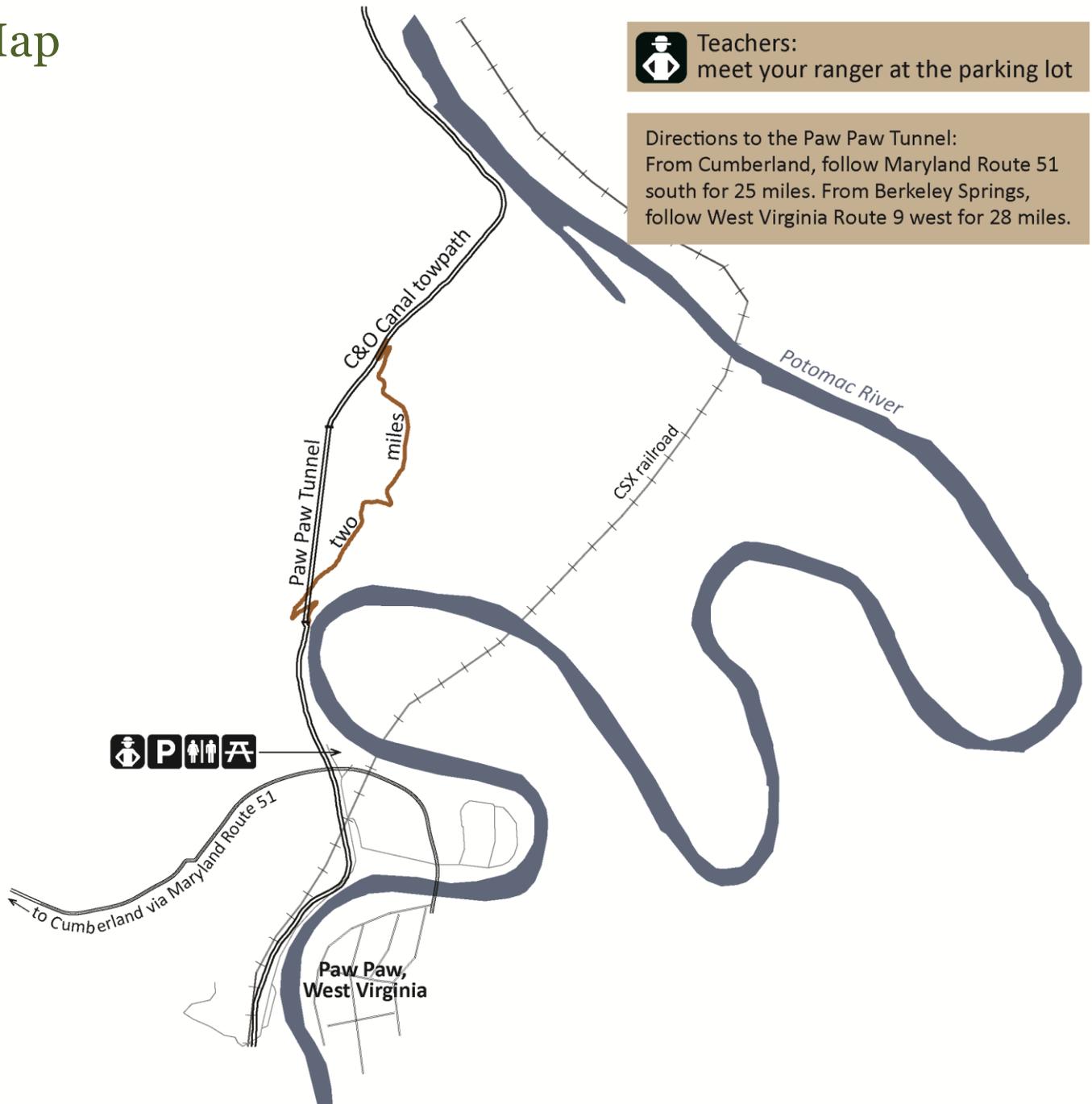
Happy Trails,

*Hollie*

Ranger Hollie



# Map



## 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.
- The tunnel remains at 55° F year-round. Every student should bring a jacket.
- We suggest wearing long pants and 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.
- It is extremely helpful to rangers leading the program for students to wear clearly labeled name tags with first names only.

### What to Bring

- Students may bring a digital camera or digital video camera. Beginning in 2014-15 school year, the park will provide one iPad per group of 10 students.
- There is no running water at the tunnel; bring hand sanitizer.
- Drinking water is not available at the tunnel; each student should bring a 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 for the duration of the visit.

### Chaperones

- At minimum, please have one chaperone (teacher or other adult) for every ten students.



## Around the Bends (Paw Paw Fifth Grade)

Page 7

In order to keep programs manageable, do not exceed one chaperone for every five students.

- Chaperones will be an active part of the activities. We will likely call on chaperones to assist (leading groups).
- 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 near the town of Paw Paw, West Virginia.

### Arrival

- Please arrive on time at 9:45.
- The Canal Classroom Corps staff will be waiting for your bus.
- 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. The trail is steep and narrow in some places.

### 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, let us know as soon as possible by calling (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.

## **The Hike is 4 Miles Long**

Please prepare the students for the hike. The trail is steep and narrow in some places.

## **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	<a href="http://www.nps.gov/choh/forteachers">www.nps.gov/choh/forteachers</a>
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	<a href="http://www.canaltrust.org">www.canaltrust.org</a>
National Park Service	Learn more about the NPS mission, history, and organization	<a href="http://www.nps.gov/aboutus/index.htm">www.nps.gov/aboutus/index.htm</a>
National Park Service America's Best Idea	More facts about the NPS, including an excellent timeline and movies	<a href="http://www.nps.gov/americasbestidea/">http://www.nps.gov/americasbestidea/</a>

# Pre Visit Activity: Tunnel Background

Please complete the following pre-visit activities in your classroom.

## **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 – Assign Field Trip Roles (Required)**

Please pre-group and assign these jobs to your students before the day of the trip. Students will work in groups. Each student in the group will be responsible for a separate job: GPS (trip computer), mapping, math calculations and recording (writing the group data down on the provided worksheet), and pictures/video. The whole class will take the hike together, but students are responsible for their job within their group.

## **Option C – Review Vocabulary**

*Canal: a manmade waterway used to move goods, people*

*Clash: a violent confrontation*

*Economic terms (goods/services/opportunity costs)*

*Immigrant: a person who comes to live permanently in a foreign country*

*Keystone: a central stone at the summit of an arch, locking the whole together*

*Navigate: to travel by water*

*Prism: shape of the watered canal sections*

*Riot: a violent disturbance of the peace by a crowd*

*Rope burn: a groove in the wooden railing of the tunnel caused by friction from a rope adhered to a canal boat and pulled by a team of mules*

*Rub rail: a piece of wood adhered to a stone structure to guard canal boats from bumping into or damaging*

*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*

## Post Visit Activity: Tunnel Activities

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

### **Option A: Writing Opinion Piece**

Students describe whether or not it was worth the cost of construction to build the Paw Paw Tunnel. Use the To Build or Not to Build Case Study (Appendix B) as a preamble. Opinion writing will also be used for STEM iMovie Activity, see below.

### **Option B: STEM iMovie Activity**

Utilizing the footage captured during the field trip, students create an iMovie of the Paw Paw Tunnel and surrounding location. Students narrate the video by reading their opinion piece (Option A) describing the costs of construction and supporting their argument regarding whether or not it was worth building the Paw Paw Tunnel.

## 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 Case Study (post-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?

# Appendix C: 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](mailto: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](mailto: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: