YALE NATIONAL INITIATIVE
to strengthen teaching in public schools®

Curriculum Units by Fellows of the National Initiative
2025 Volume I: Art, Design, and Biology

Exploring Earth's Natural Resources through Art

Curriculum Unit 25.01.03, published September 2025
by Katie Franzel

Introduction

On a 6-day backpacking trip along Virginia's Appalachian Trail, I was struck with awe by the diversity beneath my hiking boots. At times, I walked on white sand, soft dirt, coal and other rocks, and through tall grasses. As I looked beyond the trail, I could imagine the tectonic plates breaking beneath Earth's surface and pushing the land into the dramatic and beautiful mountain-scape before me millions of years ago, while in others, I could see fertile pastures manicured by humans with cows grazing for miles. All the while, I was hiking through a heat wave, just hoping to come across a water source with enough flow to filter water for my own hydration[1] .

Exploring Earth's Natural Resources through Art explores how the planet Earth's resources contribute to past, current and future landscapes. The unit will integrate science and art as students investigate how the planet earth's resources can be used responsibly.

This interdisciplinary unit will focus on understanding the Virginia Earth Resources Standards while strengthening and emphasizing close observation and language skills. Two further enduring understandings of this unit include:

1. Close observation provides the opportunity to deeply understand and describe Earth's natural resources, such as air, water, minerals, and undeveloped land.
2. Human actions can positively or negatively impact the resources we have. Small everyday changes can make local or global impacts.

I teach First Grade in Richmond, VA, a small city with a complex history and geological landscape. Richmond, VA sits on the fall line of the James River, which served as an important waterway for the Native Americans and the British colonists, and which will form a central element in the unit. Richmond, VA also sat as the capital of the confederacy and continues to grapple with the telling of its own history as a major trading post of enslaved people after the termination of the Atlantic Slave Trade. Today, the river divides the city into the north side and south side and is often referred to as the city's playground. Students and families picnic, enjoy swimming and sitting on rocks, and raft along the river.

My school sits in a neighborhood less than a mile away from the banks of the river. We serve a population that is about 60% Black, 20% White, and 20% Hispanic. While this unit will hold a special significance to students

familiar with Virginia and the James River in Richmond, it contains important critical thinking opportunities for students anywhere to consider their role in understanding and conserving earth's resources. Educators can modify images and case studies to reflect their local landscapes or to discuss the global implications of conserving and protecting Earth's natural resources. This unit is designed for First Grade but can be easily adapted to K-12 classrooms. In addition, this unit focuses on the observation and discussion around paintings and images, making it especially applicable and useful in classrooms with diverse, multilingual learners.

Through the close study of nature through painting and realia, material objects to supplement teaching and learning, students will explore how descriptive language more thoroughly represents their observation and understanding of a topic. Students will focus on the natural resources of Virginia's water, air, and undeveloped land across time, with a particular emphasis on the James River, Chesapeake Bay, and the mountain region. Students will use artwork to inspire inquiry into different causes of changing landscapes, from human trash to human technology, and consider the ways in which they have agency to protect and conserve the earth's resources.

Throughout First Grade, students in Richmond Public Schools study the skills of close observation through the EL Education curriculum. This unit will directly connect the skills of close observation to the importance of early science discovery. Prior to the emergence of scientific classification in the Enlightenment, at the end of the eighteenth century, species and landscapes were documented in descriptive language and representational art. The use of adjectives by early scientists, mirrors the ways in which First graders learn to manipulate and use vocabulary to strengthen their descriptive skills. This unit expects students to strengthen their use of descriptive language as they closely observe art and nature in order to appreciate the specificity language provides.

Rationale

This unit is timely and essential given the continued impacts of climate change on the global society. Record high temperatures were observed across all areas studied by the World Meteorological Organization (WMO) in 2024. Extreme weather events in 2024 led to the highest number of human displacements since 2008. Greenhouse gases reached their highest levels in 800,000 years with human actions as the largest driver of climate change, such as burning fossil fuels and deforestation. In addition, the Earth as a whole saw its warmest year, record sea level rise, and record sea level temperatures[2] . These changes could lead to catastrophic changes to the existence of current ecosystems and organisms, including humans, on the planet Earth.

This unit supports the central idea provided in the Virginia Curriculum Framework which states that "our natural resources, including clean water, clean air, and undeveloped land, are limited. If we want to enjoy these resources in the future, we need to take care of them now"[3] .

Through close observation, students will gain a contextual understanding of natural resources within their own communities, the state, and the globe. Students will think critically about the ways in which humans have contributed to the conservation and destruction of natural resources. Through this study and discussion, students come to understand, through their own investigation, the ways in which they can appreciate and impact Earth's resources.

This unit will provide an opportunity for students to go beyond simply naming Earth's resources. By connecting deeply with the resources in their own communities, students will develop a sense of ownership and accountability of their own impact on the world around them. First Graders are often expected to name reducing, reusing, and recycling as primary modes of conserving. While these are important daily tasks that students should learn and engage with, students need to understand the interconnectedness of Earth's natural resources and the need for bigger actions, such as advocacy and technology change, in order to make a global change toward conservation. They can also explore the small ways in which they can influence bigger change such as talking with neighbors, submitting writings to local newspapers, writing to elected officials, and volunteering with local environmental organizations.

Background Knowledge

In Kindergarten, students gain a basic understanding that humans use resources, that materials can be recycled, and that humans make choices that impact the air, water, land, and living things. The First Grade standards expand upon this basic understanding by teaching that most natural resources are limited and place greater emphasis on the ways in which human actions affect the availability of natural resources. The First Grade standards also expound on the ways in which humans can conserve natural resources[4] .

Natural Resources: Land, Water, Air

Virginia's land consists of important rocks and minerals. The Appalachian Mountains of Central Virginia formed more than 400 million years ago as a result of continental collisions leaving behind a variety of minerals and rocks. One such resource, Devonian Black Shale, was formed by shallow sea deposits that were deprived of oxygen. This resource lies below valleys of poor farmlands. On the contrary, the Sinking Creek Valley is one example of an Appalachian section with limestone, a rock formed by fossilized marine animals, which contributes to fertile farmland with underground drainage through caves[5] .

Coal, an organic sedimentary rock formed by fossilized plants, is an important rock in Virginia. When thinking about natural resources, it is important to acknowledge Virginia's contribution to the coal and mining industry. Coal has been mined as a fossil fuel to generate electricity and make steel[6] . Virginia's rocks and minerals not only support the soil, but are also critical to Earth's land and parks. Parks provide space for recreation and animal habitats. They are natural spaces that are intentionally set aside to preserve natural resources[7] .

Clean water is essential for survival. "We cannot live without it"[8] . First Grade students often identify drinking water, showering, and cooking as reasons water is an important resource to conserve. While these are essential uses of water, there are additional reasons to conserve and invest in water resources.

The James River, a critical Virginia river that runs through Richmond City, sources drinking water for about 2.7 million people, yet was considered failing in the 1970s. Through sustained environmental efforts and improvements, the river has gained status as one of the most improved of the Chesapeake Bay rivers[9] .

In addition to drinking water, rivers and waterways provide important habitats and ecosystems to fish, birds, and other species. Native fish species that sustained the Native Americans are at-risk due to human-made obstacles, sewage, and the introduction of non-native fish species, such as catfish[10] . Fish provide a key

element in the aquatic ecosystem, an important food source and economic benefit to the local population and beyond. In 2022, 4.1 million pounds of commercial fish and shellfish were harvested with a total value of $11.9 million[11] . When the Environmental Protection Agency banned the use of DDT in 1972, a chemical used in agriculture that had environmental and health harms, bald eagles along the James River made a comeback from being endangered[12] .

The James River feeds into the Chesapeake Bay Watershed, one of the largest and most important estuaries in the world. When European settlers arrived at the mouth of the bay at Jamestown, they took note of the great wealth of natural resources the bay provided, including oysters, blue crabs, sturgeon, striped bass, and waterfowl. The bay also includes foundational habitats, called submersed aquatic vegetation, which work to protect shorelines from erosion and other threats. Submersed aquatic vegetation consists of natural grasses on the river floor that provide important notice of degradation and water quality[13] .

Air is another critical natural resource that First Graders learn. While studying plants and animals, First Graders learn that animals, including humans, and plants depend on air for survival. It is important for students to understand that life depends not just on air, but on clean air. Air pollution happens when small particles, called aerosols, enter the air, threatening the clean air on Earth. Air pollution can lead to high rates of disease and chronic and acute respiratory diseases, such as asthma[14] .

Students should understand the interconnectedness of Earth's resources, rather than understanding each resource in isolation. Mining contributes to the destruction of landscapes and to the creation of fossil fuels. Burning fossil fuels and exhaust from cars generates ground level ozone. Not only are ozone gases bad for human health, they combine with particles to create smog, the smoky haze that makes it hard to see. Smog degrades vegetation and ecosystems. Local air pollution can lead to acid rain which acidifies lakes, rivers, and other bodies of water that can kill fish and other aquatic organisms[15] .

Intersection of Art and Natural Resources

Educators and students can look to art to think critically about the ways in which natural resources are interconnected and the impact humans can have on them. Alexander von Humboldt created a taxonomy of plants and their relation to the varying latitudes, elevations, and climates[16] . In his "Diagram of a cross section of the Earth's crust", Humboldt shows the interconnectedness of Earth's resources by indexing different rocks, waterways, and the forms of life along a mountain's crest and valley. Humboldt believed that art could be used to help a wide public understand about the environment. While the diagram takes on a scientific approach, students could compare the diagram with Frederic Church's painting, *Heart of the Andes*[17] to see a visual representation of the full climate range, showing the life forms and geological structures, depicted in Humboldt's diagram and described in his publications, which Church keenly read.

Similarly, the artist and naturalist John James Audubon's use of close observation to document and create detailed and life-size watercolor drawings for his book *Birds of America* help tell a story of North American landscape and ecology. In his writings and paintings, Audubon documents his observations of birds' migratory patterns. From his drawings and writings, ornithologists have also been able to question how the environment has changed to lead toward new or extinct birds in America. Birds such as the ivory-billed woodpecker, Carolina Parakeet, Bachman's warbler, Eskimo curlew, and passenger pigeon are now extinct or near-extinction whereas Audubon described the chestnut-sided warbler as rare even though in present day, it follows a consistent migration and is frequently seen[18] .

In Audubon's depiction of "Common Buzzard, plate 372" he shows a common buzzard preying on a hare in the grassy, untouched foreground. The background of the painting shows a home beside a logging operation. The viewer of the painting is left wondering if the natural, undeveloped land will remain for the buzzard and hare to survive. Educators can look to Audubon's painting to help students contextualize the natural surroundings the birds inhabit. Students can look at the paintings to evaluate what the birds need to survive and how the natural resources around them support their habitats.

Minerals and rock play an important part in creating landscape and energy. George Brewerton and Flavius Fisher painted Natural Bridge in Virginia in two different seasons. Educators can point to the upright nature of these paintings to show how the paintings highlight the geological complexity of these natural landscapes. These paintings show the depth of natural rock and the interesting structure that has been created over time from slow erosion. 215 miles Southwest of Natural Bridge lies Natural Tunnel which began forming over a million years ago as "groundwater containing carbonic acid leaked through crevices of surrounding limestone and dolomite bedrock to form a cavity"[19] . The Natural Tunnel carved through a limestone ridge serves as a railroad that continues to operate and transport coal[20] . Students can then look at depictions of coal mines, such as "*The Mine,*" *Petersburg, Virginia*[21] by the important early photographer Timothy H. O'Sullivan or the photographic print of Toms Creek Mine, Wise County, Va[22] to discuss how minerals are used, how humans have impacted their landscapes, and the impact on air quality. These photographers can help students evaluate different ways that humans change landscapes and impact natural resources.

Given that Earth's natural resources do not exist in isolation, students should notice the interconnectedness of each resource within a landscape. Landscapes provide an opportunity for educators to have students evaluate and better understand this interconnectedness as it shows various resources in context. Students can compare and contrast what they see while making connections to the modern-day landscapes they live in. Scottish artist Joseph Noel Paton's watercolor *Study from Nature: Inveruglas* (1857) provides a beautiful landscape of a clear stream flowing through a natural and complex scene of rocks and vegetation. In the foreground sits a pair of binoculars and a pencil while off in the distance, a figure is looking off. This painting shows the beauty and enjoyment of nature preserved and the ways in which the stream feeds the ecosystem around it. This can be contrasted with Henry Dawson's *London from Greenwich Hill*[23], 1869 to 1870, a painting that shows industrialization and development of waterways by depicting children playing and birdwatchers pointing off to the distance in the foreground. In the background, the painting shows smokestacks along the water's edge and into the distance with thick smoke blending into the gray clouds of the sky. "Wharf, South Side of James River, Opposite Richmond, Virginia"[24] shows the James River operating as a port during the civil war presenting students the opportunities to discuss the relationship between how natural resources and humans have interacted across time. Ross Merrill's collection of three Chesapeake Bay paintings could be placed side by side for a chance to consider how the depiction of air and water differ and the impact it has on an understanding of the resource[25] . Students can also look at local artists' depictions and photographs of the waterways in their areas.

Eighteenth-century English painter Joseph Wright of Derby created works of arts that depicted scientific experiments. One in particular, *An Experiment on a Bird in the Air Pump* (1768) shows the effects of using an air pump to take the air, and thus the life, away from a bird. The viewer is left to question science, morality, and enlightenment[26] . Joseph Wright's painting of the air pump experiment demonstrates the complexity and emotion involved with humans impacting, manipulating, and changing natural resources, in this case, air, through the painted emotion and power structures of the onlookers to the experiment. This painting shows at the most drastic level, the impact humans can have at removing access to air from a living thing and through

this, helps to highlight the need to maintain clean air.

To consider the impacts of pollution on clean air, students can look to landscape art from the industrialization period. In addition to Henry Dawson's "London from Greenwich Hill" discussed above, educators can highlight Joseph Mallord William Turner's "Staffa, Fingal's Cave" (1832) which depicts a steam boat approaching the cave of Staffa Island. Pollution from the boat seems to overtake the painting and blend in with the air, water, and land. In the middle of the boat, a small orange dot shows the burning of coal used to power the boat. Both of these landscapes show the threat that air pollution poses and the greater question of how that will impact human access to natural resources.

John Ruskin, a nineteenth century thinker and artist, believed that nature inspired the most meaningful art. He was inspired by an approach of environmental preservation and respect for the natural world. As he said, "If you can paint one leaf, you can paint the world"[27] .

Historical Context

While this unit will focus on science standards, the educator should adopt a cross-disciplinary mindset in order to better understand and discuss the ways in which the land and water have shaped civilization in Virginia over time and the ways in which humans have adapted to and impacted natural resources. Virginia's Native peoples depended on Earth's natural resources as their way of life. From foraging berries, to hunting turkey, deer, and bear, the Native Americans relied on the earth for their way of being. The "melt-back-into-the-forest character of their wood-and-bark homes" of the local Indigenous people were built from saplings, bark, and animal skins (Deans 2008, 19). The Fall Line of the James River served as an important barrier between two major Native American tribes - the Powhatan and the Monacans. This natural border served as a trading post and warzone at times. It also marked a distinction between Virginia's Piedmont region to the west and Tidewater region to the east. With resources such as copper to the west and Tidewater fisheries to the east that supplied protein through oysters, clams, and crabs - Virginia's first people already understood the value and importance of utilizing, conserving, and sharing Earth's natural resources.

While Virginia's Native people deeply understood how to utilize and maximize the natural resources surrounding them, a stark contrast occurred when English colonists came into the Chesapeake Bay and settled at Jamestown. The colonists did not have an understanding of the North American Earth and the ways in which regions can be different. They arrived amidst a drought and with little understanding of the impact of the water salinity of the bay, the natural heat of Virginia, or the crops of native Virginia. Without a deep understanding of the land, the colonists suffered heat stroke, death, and famine throughout the Virginia summer[28] .

At the time of colonization, many expeditions, such as the efforts to colonize what is now known as North America, were occurring across the globe. Explorers set out to document and create taxonomies about the world. Captain John Smith and the Jamestown leaders believed that if they crossed the Appalachian Mountains, they would find gold and the Pacific Ocean. While the Native Americans had a deep understanding of the land on which they inhabited, early explorers did not[29] .

Educators should keep in mind the historical perspective of Earth's natural resources and help students make connections to previous learnings on the Powhatan Indians and English colonists. These connections can help serve as a grounding point as students consider the modern ways in which natural resources are used and depleted and the implications of conserving natural resources.

Human impact on Natural Resources

Natural resources are limited and at risk due to human action. However, legislation, such as the Clean Air Act, have been effective, as monitored through tracking fish populations in Virginia streams[30] . The Clean Air Act is a comprehensive federal law enacted in 1970 that regulates air emissions to seat and achieve certain standards that address public health and welfare risks. A study by the National Park Service to assess the impact of the 1990 amendments to the Clean Air Act found that the average haze across the United States decreased by about 50% from 1992-2018. The 1990 Amendment's success was a result of a significant reduction in sulfur dioxide and nitrogen oxide, shifts in energy use away from coal-fired power, and changes due to economic and human activities[31] .

When Dominion Energy proposed the Atlantic Coast Pipeline as a natural gas solution, it threatened Virginia's mineral rocks as it crossed the Appalachian Mountains, waterways, and land. The pipeline was slated to go through Roberts Mountain - home to a fatal and devastating rainfall event. It seemed that the push for development was occurring not just at the expense of the Earth's core resources but at the safety and health of those that lived in its path. In order to build a pipeline, mountains would be bulldozed, trees blazed, and herbicides sprayed to prevent all future growth. All of this would be done across unprecedented terrain for a project such as this[32] .

Through this case-study, students understand the interconnectedness of Earth's resources. The Appalachian Mountains, some of the oldest mountain ranges in the world, trace the western edge of Virginia. Soil helps stabilize the slopes and the mountains remain home to threatened and endangered species, such as the Cow Knob salamander. The presence of fish provides evidence of clean water and can help scientists understand the impact of power plant developments. In Elkins, West Virginia, a town about 40 miles away from the Virginia border also in the proposed path of the pipeline, streams had been destroyed by mining[33] .

In June 2016, a rainstorm hit West Virginia mountains, just west of Virginia, along the route for the Atlantic Coast Pipeline that caused "roads buried by slides or with gaping holes in them, exposing metal culverts and drainage pipes. Entire hillsides had given way, leaving scars hundreds of feet long and exposing bedrock"[34] . The pipeline would have had a profound impact on Virginians and their access to clean air, water, and land as well as an impact on the plants and animals that call Virginia home.

Recycling is often proposed to students as a solution to helping the Earth. Students should also be taught the risks associated with recycling and consider more efficient ways toward conservation. "Oil, gas, and coal are the fossil-fuel building blocks of plastics" and thus continuing to invest in natural gas pipelines, such as the Atlantic Coast Pipeline, paves the way for more plastics. Many plastics are dumped into the environment and enter waterways. "Research from the Ellen MacArthur Foundation suggests that only 2% of plastics are recycled into products with the same function. Another 8% are "downcycled" to something of lower quality. The rest is landfilled, leaked into the environment, or incinerated"[35] .

The Atlantic Coast Pipeline never laid pipe in Virginia. The Friends of Nelson, an advocacy group formed by neighbors, successfully halted the building of the Atlantic Coast Pipeline and avoided the negative impacts to their land and waterways as a result. Similar advocacy efforts have led to legislation, such as the Clean Water Act, that promote and enforce more sustainable ways to source energy that do not deplete the Earth's resources.

Efforts to restore submersed aquatic vegetation and efforts to protect river sheds have led to better water

quality in the Chesapeake Bay. Land settlement and tropical storms have negatively impacted water quality of the Chesapeake Bay. Agriculture, development, sewage, and fossil fuel combustion have disrupted the natural ecosystem of the Bay. These led to legislation changes, such as the 1983 Chesapeake Bay Agreement, to help restore the bay. Between 1950 and 2015, the population within the watershed more than doubled leading to a loss of farmland and protected forests[36] . However, advances in wastewater treatment and efforts to transplant seeds in previously vegetated areas of the bay suggest that environmental policy that reduces excess nutrients in the water can have a positive impact. In addition, media coverage and research expanded during this time to support efforts to clean the bay.

A more recent example highlights the impact an individual can have when taking advantage of local and state resources. Vanessa Sandin is a farmer who has worked to protect the streams in her area that lead into rivers, and ultimately the Chesapeake Bay. She moved her cattle away from the streams and planted riparian buffers. Riparian buffers are intentional vegetation grown along streams and waterways to create a natural filtration system, ultimately enhancing water quality by catching runoff before entering the water and by reducing erosion and sedimentation[37] .

Impact Students Can Have

First Grade students learn about the 3 R's: reduce, reuse, and recycle. They should engage in these practices in their daily lives. They also learn that to conserve water, and that they can take shorter showers and use the tap only when needed. To improve air, students learn to save energy by turning off the lights and riding a bicycle when possible[38] .

This unit hopes to expand student's ability to see themselves as agents of change. In addition to these individual actions, students can begin to understand their place within the broader community and the impact that closely observing their surroundings can teach them and better advocate. As with the Friends of Nelson who came together to stop the building of the Atlantic Coast Pipeline, students can understand that they can advocate through conversation and letter writing. With a deeper understanding of the interconnectedness of resources, students will feel a greater sense of ownership and understanding. Reducing and throwing away garbage properly not only creates a better landscape, but also protects the waterways in their communities and beyond.

Teaching Strategies

Close Observation:

This unit will draw on close observation skills. Throughout reading and science, students are asked to engage in close observation in order to deeply understand topics. In reading, this close observation and analysis of text helps even the youngest learners critically think about the topic and its applications. By closely observing in science, students are able to focus on key details to broaden their learning.

Small Group Discussions:

Students will compare and contrast images and paintings to develop their own understanding of the content. They will discuss the similarities and differences they see in small groups, allowing them to learn from their

peers and adjust their own learning based on that of their peers.

Direct Instruction:

Following peer discussion, the educator will provide direct instruction on each of the Earth's resources using anecdotes, real life examples, and any required text for the course.

Co-teaching:

If available, the educator can engage in coteaching activities by having one educator lead the discussion while the other charts the student response. In addition, students may describe the painting or image while the educator records exactly as the student shares in order to further push student vocabulary and description.

Additionally, coteaching could be used to have more directed discussion groups based on student need.

Art:

During the unit, students will be asked to engage in an artistic exercise of close observation. They will complete a drawing at the start of their study and at the end. Just as they have considered how landscapes and resources change over time, they will be able to evaluate if there has been local change based on their own drawings.

Classroom Activities

Day 1 – Introduction:

Students will review the definition of close observation and recall where they have practiced close observing throughout the school year. They will consider how the strategy has aided their learning. Educators will present close observation as a skill of early scientists for recording taxonomies of plants and animals. After a brief classroom discussion, educators will have students engage in close observation.

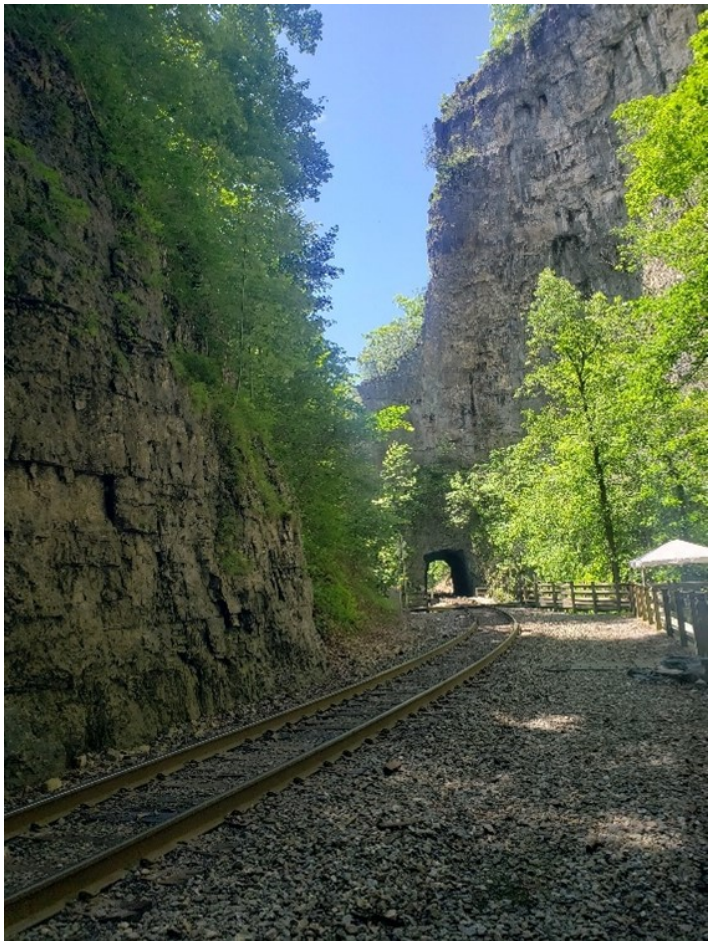
The educator can preselect an element from nature, for instance two leaves from the school yard, or have students collect them. Once the objects are selected, the educator will ask students to sit and silently draw each object one at a time for 4 minutes each. After completing the activity, the group may discuss what elements stood out to them and what made the activity difficult or easy. The educator should keep the objects throughout the unit so that students can come back to them on the last day.

Part 1 – Minerals and land:

Day 2:

Display James John Audubon's depiction of "Common Buzzard, plate 372" – ask students what do they see in the picture. Have students discuss in partners, challenging students to ask their partner, "What else do you notice in the painting?" Come back together as a full class to discuss the painting, draw student attention to the logging in the background and ask them what they notice. Ask them how the logging might impact the buzzard and the hare shown in the picture.

Display George Brewerton's "Natural Bridge" and Flavius Fisher's "Natural Bridge" (Virginia Museum of History and Culture) – ask students to look closely at what they see. Push students to use descriptive language to describe the rocks and geological formation. The educator should share background knowledge about Natural Bridge and make a connection between natural bridge and natural tunnel. The educator should also point to the upright nature of the artworks.



1. Photograph, Natural Tunnel, VA[39]

Display "*The Mine, Petersburg, Virginia"* by Timothy H. O'Sullivan and photographic print, Toms Creek Mine, Wise County, Va. – ask students to describe how the land and minerals have been used in these pictures. Share background knowledge on mining, the connection to energy, and the impact on land and minerals.

2. Photographic print, Toms Creek Mine, Wise County, Va[40]

Day 3:

Synthesize learning with a field experience. First, review the artwork from Day 2 and anchor chart notes that the educator took. Have students share definitions they uncovered related to minerals and land. After discussion, present students with various rocks found within the community and local parks, sand, and metals. Have students discuss the objects in groups and record their observations in notebooks. Students can then make a close observation drawing in their notebooks. Educators may also consider bringing students outside to build their own collection of mineral and land resources.

Part 2 - Water:

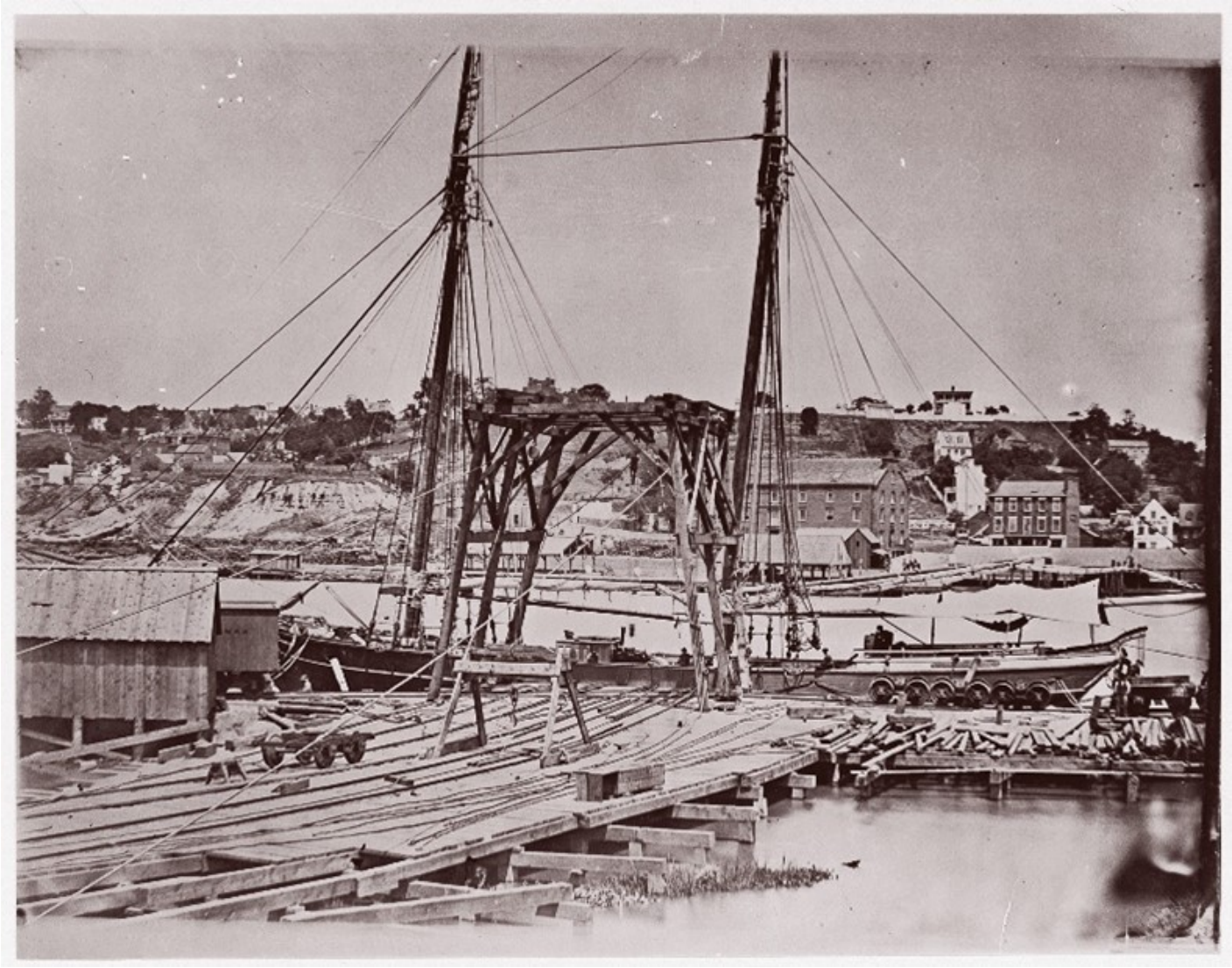
Day 4:

Begin by having students list the ways in which they use water while charting on the board. Ask students where does water come from and why is it important. Display images such as “Study from Nature: Inveruglas” (1857) and “London from Greenwich Hill” (ca1865) can be used to initiate conversation around water as natural resources. Explain to students that cities such as Richmond, were developed on rivers. Ask students

why that might be the case. Ask students to look at the images and describe the ways in which the water resources are serving the community. Next, display “Wharf, South Side of James River, Opposite Richmond, Virginia” and Ross Merrill’s three depictions of the Chesapeake Bay (National Gallery of Art), or other images from your community, to guide a discussion on local waterways.

3. Study from Nature: Inveruglas (1857)[41]

London From Greenwich Hill



4. Wharf, South Side of James River, Opposite Richmond, Virginia [42]

Day 5:

Synthesize learning with a field experience. Students can consider water conservation in a variety of ways. Using educator resources from the James River Association, educators can guide students to create wetlands in a bottle. As students conduct the experiment, ask them what they observe and why preserving wetlands could benefit water quality. Students could also conduct water quality testing at storm drains or local water ways.

Part 3 – Air

Day 6:

Begin by having students review in small groups what they already know about air and why it is important. As students are discussing, the educator can build an anchor chart. Display three paintings, "London from Greenwich Hill," "*An Experiment on a Bird in the Air Pump* (1768)", and "Staffa, Fingal's Cave". In small groups, students describe what they see and build connections with what they already knew about air. If the students do not notice the smokestacks and factories on their own, the educator should point these out and

have students consider how that impacts the air. Finally, the educator should ask how air is connected to minerals, land, and water by using evidence from the paintings, pointing out the sublime effect created in “Staffa, Fingal’s Cave” of the burning smokestack melding into the air as the boat approaches the land.

London from Greenwich Hill

Joseph Wright of Derby, Air pump

5. Joseph Mallord William Turner’s “Staffa, Fingal’s Cave” (1832)

Day 7:

Synthesize learning with an experiment such as planting in a jar with no air and a jar with holes and creating an air pollution catcher by placing Vaseline on a paper plate and hanging it up. Alternatively, educators can bring students outside and have them closely observe the environment and how the air is working through it. Students can draw what they see in their notebooks and write about how the impact of air.

Part 4 – Advocacy

Day 8 and Day 9: Project Based Learning

Students should discuss the 3 R's in small groups. Afterwards, the educator should make a list of the different ways students can reduce, reuse, and recycle. The teacher should ask the students which method they think is the most effective and why. After a whole class discussion, the educator can provide background knowledge around the limitations of recycling. Students should discuss other ways that they can help conserve natural resources. The educator can point to the advocacy efforts of the Friends of Nelson in stopping the construction of the Atlantic Coast Pipeline.

Next students should work in teams to identify a local problem in environmental conservation, such as trash in the school yard or by the local waterways, planting pollinator plants, or limiting energy use by adjusting thermostats or turning off lights. Students should determine how they want to communicate the issue with the broader public. They can consider making signs to hang up, reaching out to local officials, or writing letters to stakeholders such as teachers, principals, and elected officials. Students should be given time to complete their project and display as appropriate.

Finally, students should wrap up their learning by writing "letters to the editor" that describes what they learned about natural resources, why they are important to conserve, and the change their team would like to see. The educator should consider various ways to share students' message such as submitting to local newspapers, displaying the letters along the dismissal pick-up line, or sharing on the school's website.

Day 10 – Close Observation

On the final day of the unit, students will celebrate their learning by firsts reviewing the artwork explored and the anchor charts they created. They can discuss their learning in small group and whole group. Then, each team of students should present their advocacy project to the class and the impact it will have. Finally, students will revisit close observation and discuss the ways in which close observation helps tell the story of natural resources and how it helped them learn.

The educator should present students with the same objects they drew on Day 1 and ask students to sit and silently draw each object one at a time for 4 minutes each. After completing the close observation, the educator should pass out the drawings from Day 1 and have students consider the ways in which the objects changed over two weeks.

Resources

Home Page - Virginia School Quality Profiles - Virginia School Quality Profiles. Accessed July 11, 2025. https://www.schoolquality.virginia.gov/. This website shares demographic and academic information about every school in Virginia.

Bauman, Brooke. 2019. "How plastics contribute to climate change » Yale Climate Connections." *Yale Climate Connections*, 20 August. https://yaleclimateconnections.org/2019/08/how-plastics-contribute-to-climate-change/. This article describes some of the complications assosciated with recycling and makes recommendations about stopping plastic use at the source.

Byko, Maureen. 2007. "Shedding a light on 18th century science: The works of Joseph Wright of Derby." *JOM* 59: 13-16. This source provides information about Joseph Wright of Derby's artworks that depict various scientific experiments in the 18th century.

Cummings, Mike. 2015. "Audubon's 'Birds of America' at Yale: creating a masterwork one feather at a time." *Yale News*, 30 June. Accessed July 13, 2025. https://news.yale.edu/2015/06/30/audubon-s-birds-america-yale-creating-masterwork-one-feather-time. This resource provides insight into the Audubon collection housed at the Yale Beinecke Library. The author had the opportunity to visit and view the collection during the 2025 Yale National Initiative.

Deans, Bob. 2008. *The River Where America Began: A Journey Along the James.* Lanham, Maryland: Bloomsbury Academic. This book provides a geological histrory of the James River as well as a social-political story of the James over time.

Graf, Irma. 2019. *Appalachian Trail Central Virginia Guide Book Map Set.* Edited by Irma Graf. Appalachian Trail Conservancy. This resource provides a detailed overview of navigating the Appalachian Trail as well as different facts about its geology and history. This resource could be used by any educator looking to lead a day hike with students or looking to hike themselves.

Graziano, Amanda Curry. 2021. *Exploring Science: All Around Us: Teacher's Edition.* 2nd. Windsor, CT: Five Ponds Press. This resource is used by Virginia schools to supplememt the Virginia standards.

Hand, J L, A J Prenni, S Copeland, B A Schichtel, and W C Malm. 2020. "Thirty years of the Clean Air Act Amendments: Impacts on haze in remote regions of the United States (1990–2018)." *Atmospheric Envionment* 243.This resource provides an update on the impacts on the clean air act. The study was done with funding by the National Parks Service.

James River Association. 2023. *State of the James.* Accessed July 29, 2025. https://thejamesriver.org/about-the-james-river/state-of-the-james/. This website provides a report on water quality and recommendations for improving the James River.

Kaine, Timothy M. 2024. *Walk, Ride, Paddle: A Life Outside.* Harper Horizon. This book tells about Senator Tim Kaine's Virginia triatholon – hiking the Appalachian Trail, riding the Blue Ridge Parkway and Skyline Drive, and paddling the James River. It includes context about Virginia's geological background and provides inspiration for conserving and enjoying the outdoors.

Mingle, Jonathan. 2024. *Gaslight: The Atlantic Coast Pipeline and the Fight for America's Energy Future.* Island Press. This book details the harms that natural gas has on greenhouse emissions, constructing a pipeline has on the land, and the efforts that residents took to successfully halt the construction of the pipeline in Virginia.

National Gallery of Art. n.d. "Ross Merrill." *National Gallery of Art.* https://www.nga.gov/artists/33080-ross-merrill. The National Gallery of Art showcases three depictions of the Chesapeake Bay on it's website.

n.d. "Natural Tunnel State Park | Virginia DWR." *Virginia Department of Wildlife Resources.* Accessed July 15, 2025. https://dwr.virginia.gov/vbwt/sites/natural-tunnel-state-park/. This website tells about the Natural Tunnel State Park.

2024. "Natural Tunnel State Park." *DCR.Virginia.gov.* 21 October. Accessed July 15, 2025.

https://www.dcr.virginia.gov/state-parks/natural-tunnel. This website tells about the Natural Tunnel State Park.

Orth, Robert J, William C Dennison, Jonathan S Lefcheck, Cassie Gurbisz, Michael Hannam, Jennifer Keisman, Brooke Landry, et al. 2017. "Submersed Aquatic Vegetation in Chesapeake Bay: Sentinel Species in a Changing World." *BioScience* 67 (8): 698-712. https://www.jstor.org/stable/90011441. This article discusses the effects of submersed aquatic vegetation and considers ways in which to preserve the Chesapeake Bay through planting and maintaining vegetation.

Sabas, Matt. 2025. "Riparian buffers on Pohick Farm." *Virginia Department of Conservation and Recreation.* 10 July. https://www.dcr.virginia.gov/insights/riparian-buffers-on-pohick-farm. This article highlights a recent example of a Virginia farmer taking advantage of a state program that encourages water runoff protection.

Urban, Frauke. 2020. *Energy and Development.* 1st. Routledge. Accessed July 11, 2025. This resource provides information about air pollution.

Virginia Department of Education. 2018. "Science Standards of Learning for Virginia Public Schools." https://www.doe.virginia.gov/teaching-learning-assessment/k-12-standards-instruction/science/standards-of-learning. This document details the Virginia standards of learning.

2024. "Virginia Energy - Geology and Mineral Resources - Rocks of Virginia." *Virginia Department of Energy.* Accessed July 10, 2025. https://www.energy.virginia.gov/geology/rocks.shtml. This resource provides details about different rocks in Virginia. This would be a good resource to share with children.

von Humboldt, Alexander. 2014. *Views of Nature.* Edited by Stephen T. Jackson and Laura Dassow Walls. Translated by Mark W. Person. University of Chicago Press. Accessed July 13, 2025. This resource helps draw connections between biology, nature, and art.

n.d. "What Causes Air Pollution?" *NASA Climate Kids.* Accessed July 11, 2025. https://climatekids.nasa.gov/air-pollution/. This resource could be used with children to learn more about air pollutiion and climate change.

World Meteorological Organization. 2025. "State of the Global Climate 2024." Geneva: WMO. 42. https://library.wmo.int/idurl/4/69455. This resource provides a global update on efforts to curb climate change.

Yale Center for British Art. 2019. "Yale Center for British Art presents “Unto This Last: Two Hundred Years of John Ruskin”." 14 August. https://britishart.yale.edu/news-and-press/yale-center-british-art-presents-unto-last-two-hundred-years-john-ruskin. This resource provides details about the artist, John Ruskin.

Appendix on Implementing District Standards

This unit is based on the First Grade Virginia Science Standards of Learning for Virginia Public Schools. This unit centers the Earth Resources strand. While this unit focuses on the First Grade standards, the Virginia Standards of Learning are designed in vertical progression of content. Therefore, this unit could be easily adapted for any grade-level as they study Earth’s Resources.

The First Grade science standards help students grow their awareness of the factors that affect their daily lives and the need to respond to factors in their environment.

This unit was designed with Earth Resource Standard 1.8 which states that “the student will investigate and understand that natural resources can be used responsibly” and includes the following sub strands, “a) most natural resources are limited; b) human actions can affect the availability of natural resources; and c) reducing, reusing, and recycling are ways to conserve natural resources”[43] .

Richmond Public Schools utilizes the Five Ponds Press books and resources to support teaching. These books were created in alignment with the Virginia standards. This unit considers the information included in Five Ponds Level 1 book, *Exploring Science: All Around Us*, and expands on it by providing more context and background knowledge to help students better understand the ways in which Earth Resources affects their lives and how their own agency in advocating for and within their environment.

This unit could be taught alongside provided resources, such as Five Ponds Press, or as a standalone unit.

Notes

---

[1] Based on a 6-day, 5-night backpacking trip taken by the author from June 18-June 23, 2025 beginning at Pearisburg, VA on the Appalachian Trail.

[2] World Meteorological Organization. 2025. State of the Global Climate 2024, The publication provides a summary on the state of the climate indicators in 2024 with sections on key climate indicators, extreme events and impacts. Geneva, Switzerland: WMO. https://library.wmo.int/idurl/4/69455.

[3] Virginia Department of Education. 2018. “Science Standards of Learning for Virginia Public Schools.” Virginia Department of Education. https://www.doe.virginia.gov/teaching-learning-assessment/k-12-standards-instruction/science/standards-of-learning.

[4] (Virginia Department of Education 2018)

[5] Graf, Irma. 2019. Appalachian Trail Central Virginia Guide Book Map Set. Edited by Irma Graf. 234,: Appalachian Trail Conservancy.

[6] “Virginia Energy - Geology and Mineral Resources - Rocks of Virginia.” 2024. Virginia Department of Energy. https://www.energy.virginia.gov/geology/rocks.shtml.

[7] Graziano, Amanda Curry. 2021. Exploring Science: All Around Us: Teacher's Edition. 2nd. Windsor, CT: Five Ponds Press.

[8] (Graziano 2021, 90)

[9] Kaine, Timothy M. 2024. Walk, Ride, Paddle: A Life Outside. 239.: Harper Horizon.

[10] (Kaine 2024, 240)

[11] (James River Association 2023)

[12] (Kaine 2024, 257)

[13] Orth, Robert J., William C. Dennison, Jonathan S. Lefcheck, Cassie Gurbisz, Michael Hannam, Jennifer Keisman, Brooke Landry, et al. 2017. “Submersed Aquatic Vegetation in Chesapeake Bay: Sentinel Species in a Changing World.” BioScience 67 (8): 698-712. https://www.jstor.org/stable/90011441.

[14] (Virginia Energy - Geology and Mineral Resources - Rocks of Virginia 2024)

[15] Urban, Frauke. 2020. Energy and Development. 1st ed. 165.: Routledge.

[16] von Humboldt, Alexander. 2014. Views of Nature. Edited by Stephen T. Jackson and Laura D. Walls. Translated by Mark W. Person. N.p.: University of Chicago Press.

[17] (New York: Metropolitan Museum of Art, 1859)

[18] Cummings, Mike. 2015. “Audubon's 'Birds of America' at Yale: creating a masterwork one feather at a time.” Yale News, June 30, 2015. https://news.yale.edu/2015/06/30/audubon-s-birds-america-yale-creating-masterwork-one-feather-time.

[19] “Natural Tunnel State Park.” 2024. DCR.Virginia.gov. https://www.dcr.virginia.gov/state-parks/natural-tunnel.

[20] (Natural Tunnel State Park | Virginia DWR n.d.)

[21] (New York: Metropolitan Museum of Art, 1864)

[22] (VHMC Collections, Late 19th century)

[23] (Yale Center for British Art, 1869-1870)

[24] (New York Metropolitan Museum of Art, 1865)

[25] National Gallery of Art. n.d. “Ross Merrill.” National Gallery of Art. https://www.nga.gov/artists/33080-ross-merrill.

[26] Byko, Maureen. 2007. “Shedding a light on 18th century science: The works of Joseph Wright of Derby.” JOM 59:13-16. https://doi.org/10.1007/s11837-007-0070-z.

[27] Yale Center for British Art. 2019. “Yale Center for British Art presents “Unto This Last: Two Hundred Years of John Ruskin.”” (New Haven), August 14, 2019. https://britishart.yale.edu/news-and-press/yale-center-british-art-presents-unto-last-two-hundred-years-john-ruskin.

[28] Deans, Bob. 2008. The River Where America Began: A Journey Along the James. Lanham, Maryland:

Bloomsbury Academic. 55-65

[29] (Deans 2008)

[30] Mingle, Jonathan. 2024. Gaslight: The Atlantic Coast Pipeline and the Fight for America's Energy Future. 23: Island Press.

[31] (Hand, et al. 2020)

[32] (Mingle 2024, 53)

[33] (Mingle 2024, 100)

[34] (Mingle 2024, 103)

[35] Bauman, Brooke. 2019. “How plastics contribute to climate change » Yale Climate Connections.” Yale Climate Connections, August 20, 2019. https://yaleclimateconnections.org/2019/08/how-plastics-contribute-to-climate-change/.

[36] Orth, Robert J., William C. Dennison, Jonathan S. Lefcheck, Cassie Gurbisz, Michael Hannam, Jennifer Keisman, Brooke Landry, et al. 2017. “Submersed Aquatic Vegetation in Chesapeake Bay: Sentinel Species in a Changing World.” BioScience 67 (8): 698-712. https://www.jstor.org/stable/90011441.

[37] Sabas, Matt, and John Marshall Soil and Water Conservation District. 2025. “Riparian buffers on Pohick Farm.” Virginia Department of Conservation and Recreation. https://www.dcr.virginia.gov/insights/riparian-buffers-on-pohick-farm.

[38] (Graziano 2021)

[39] Photograph by author, Katherine Franzel, Natural Tunnel, 2024

[40] (New York: Metropolitan Museum of Art, 1864) shared in public domain

[41] (Yale Center for British Art, 1857)

[42] Metropolitan Museum of Art, ca 1865

[43] (Virginia Department of Education 2018)

---

https://teachers.yale.edu
©2025 by the Yale-New Haven Teachers Institute, Yale University, All Rights Reserved. Yale National Initiative®, Yale-New Haven Teachers Institute®, On Common Ground®, and League of Teachers Institutes® are registered trademarks of Yale University.
For terms of use visit https://teachers.yale.edu/terms_of_use