Field Trip Guide

School Program: Forensic Mysteries

- Welcome to Q?rius
- Field Trip Logistics
- Getting the Most from Q?rius
- Class Overview
- Connections to Curriculum Standards

Part lab, part collections vault, part DIY garage, part hangout, and all fun. Q?rius – Unlock your world.

qrius.si.edu
Welcome to Q?rius

Welcome to a New Kind of Field Trip

Thank you for choosing Q?rius at the Smithsonian’s National Museum of Natural History as your field trip destination! We think of Q?rius as both a place and an experience. We are excited to offer your students the chance to explore science, nature, and culture in a whole new way while supporting your curriculum needs.

We share your passion for learning! We have designed this Q?rius field trip to stimulate your students’ curiosity and to inspire them to better understand the world and their place in it.

The Q?rius Learning Lab

Q?rius is a first-of-its-kind interactive and experimental environment - part lab, part collections vault, part DIY garage, part hangout, and all fun and inspiring. We call it Q?rius because it is designed to inspire curiosity in a whole new way in the next generation of scientists and science-minded citizens. It is an exhibit-sized interactive space filled with resources that are available only to your students at the world’s largest natural history museum. The lab includes:

• A collection of 6,000 objects – fossils, bones, insects, cultural artifacts, pressed plants, and more – all accessible for investigations, carefully selected to support learning goals connected to curriculum for your specific class experience
• A suite of digital tools, including videos, virtual objects, and references to maximize learning from objects and link objects to core science ideas and the people who study them
• Scientific tools integrated with all school experiences
• Student materials based on scientists’ field books to guide the Q?rius experience

The Q?rius Approach

All classes and self-guided experiences:
• Feature the work and amazing discoveries of Smithsonian scientists
• Link real-world research of Smithsonian scientists to curriculum standards for a unique approach to inspiring your students
• Use inquiry-based, team-oriented approaches to key questions similar to those addressed by Smithsonian scientists
• Reflect the input of teens and teachers with whom we partnered so that we could guarantee program appeal for students and relevance for teachers
• Integrate objects, data, scientific equipment, and digital assets to investigate core ideas

Questions? Please feel free to contact us at (202) 633-4039 or NMNHSchoolPrograms@si.edu.
FIELD TRIP LOGISTICS

We look forward to your visit to Q?rius. The logistical information provided below will help you prepare for your visit and ensure a smooth arrival. **Please see page 9 for information on introducing your students to field trip content.**

| GETTING READY | • Carefully review your confirmation letter. To make any changes to your reservation, e-mail us at NMNHSchoolPrograms@si.edu or call us at 202-633-4039. Or, visit http://www.mnh.si.edu/calEvents/programs-for-school-groups.htm, click on the “Wait List” button for the event you registered for, and select “Overwrite Previous Response” if you have already registered for this event” on the registration form.  
• Review all information in this packet so that you know what you can expect from your visit. Contact us at NMNHSchoolPrograms@si.edu if you have questions or concerns.  
• Prior to arriving at the Museum, please divide students into no more than 6 teams of 3-5 individuals who will pursue the class investigation together.  
• Arrange for the proper number of chaperones (see below) and distribute the Chaperone Guide to them. |
| ARRIVAL AND DEPARTURE | ADDRESS: 10th Street NW and Constitution Avenue NW, Washington, DC 20013  
HOURS: School groups can enter the Museum anytime after 10:00 a.m.  
ENTRANCES: The best entrance for school groups is at 10th Street and Constitution Ave., NW, which is also the accessible entrance. You also may choose to enter through the main doors on the National Mall.  
CLOSEST METRO STATIONS: Federal Triangle or Smithsonian on the Blue or Orange Lines. Archives-Navy on the Green or Yellow Lines.  
BUS DROP-OFF LANE: Beginning at 9:30 a.m., Monday-Friday, the curb lane of Constitution Avenue adjacent to the Museum is reserved for school bus drop-off.  
STUDENT PICK-UP LANE FOR BUSES: Please board buses on Madison Drive NW (the Museum exit on the Mall side).  
SECURITY: For the safety of your students, all bags will be inspected upon entry to the Museum. We encourage students to leave their backpacks/bags on the bus or at school to speed up the entry process. |
| RESTROOMS AND LUNCH | RESTROOMS: Restrooms are located near Q?rius on the Ground floor in the Constitution Avenue Lobby and also on the First floor, just off the Sant Ocean Hall.  
LUNCH: The Atrium Café is open to groups and individuals who purchase their lunch at the Museum. If your students bring their own lunches, they are welcome to eat outside the Museum on the National Mall. |
| CHAPERONES | • To guarantee the best learning experience, we require 1 chaperone for every 10 students in grades 6-8 and 1 chaperone for every 15 students in grades 9-12.  
• Please share the Chaperone Guide and lesson plans with your chaperones in advance so that they will be fully prepared to accompany and guide students in their learning. |
An Invitation to Experience Science

This School Program will engage your students in an immersive 60-minute program led by a highly curious Museum Educator. Students will use objects, data, scientific equipment, and digital assets to investigate core ideas of natural history science and to gain skills in the practices of science. Students will complete a series of activities, document their results, and discuss their conclusions with each other and with the class.

In School: Starting the Experience

• Research shows that students who are oriented to the logistics of a field trip typically learn more from their experience than those who are not. Be sure to discuss schedule, lunch plans, restroom availability, and – most importantly – your expectations for students before arrival.
• Collaboration and communication are central components of science. You can prepare your students for collaboration by assigning them to teams of 4-6 individuals in advance and asking them to brainstorm ways in which they will work as a team, learn as a team, and achieve consensus.
• Before your visit, go to Q?rius online at qrius.si.edu and check out fun and intriguing virtual self-guided activities and science stories.
• Invite your students to practice their scientific inquiry skills by completing some of our online activities. These activities will introduce them to the types of investigations they will do on their field trip and get them exploring even before they arrive at the Museum!
• Remind students in advance that they will be working with valuable scientific equipment and collections, just like Museum scientists behind the scenes. These are important resources for learning more about the world and our place in it, and we ask that students treat equipment and collections with care and respect, just as our scientists do.

In Q?rius: Behind-the-Scenes Access

• Experienced Museum Educators and volunteers will lead your class. Students also will benefit significantly if their teachers and chaperones actively engage in the program, so please join in, remind them of the directions/instructions provided at each station, and support their learning.
• Just like scientists, students will work together in teams to complete an investigation, using real Museum specimens and sophisticated equipment.
• Equipment and objects are more accessible in Q?rius than anywhere else in the Museum. Students may need gentle reminders to treat objects and equipment carefully while investigating!
• To keep clutter to a minimum, personal items such as backpacks, lunches, and outerwear should be stored away from work tables.
School Program: Forensic Mysteries

<table>
<thead>
<tr>
<th>CLASS DESCRIPTION</th>
<th>Students will collaborate to reconstruct an individual’s life history and offer hypotheses on possible cause of death, based on evidence gathered from the scene. While collecting and analyzing data to complete the case, students will employ tools and problem-solving skills used by Smithsonian scientists Doug Owsley and Kari Bruwelheide.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUMMARY OF STUDENT EXPERIENCE</td>
<td>Students will hone their powers of observation while using forensic tools and techniques to examine human bones, objects, and artifacts. Students will work in teams to develop their hypotheses, using a case file and data collection sheet to record observations, measurements, and other evidence gathered or observed. A Museum Educator will facilitate discussion to help students reconstruct this individual’s life history and compare their findings to those documented in the case report written by Smithsonian scientists.</td>
</tr>
<tr>
<td>GRADE RANGE</td>
<td>Grades 6-12</td>
</tr>
<tr>
<td>DURATION OF PROGRAM</td>
<td>60 minutes</td>
</tr>
</tbody>
</table>

Scientist Focus

*Forensic Mysteries* gives students first-hand experiences with the skills and practices used by Smithsonian scientist Doug Owsley, division head for Physical Anthropology, and research colleague Kari Bruwelheide. Every skeleton has a unique biological profile. In a forensic or archaeological investigation, a bone biography combined with evidence at the scene of the excavation or crime can answer many questions about an unidentified person. Bones may reveal significant information regarding age, diet, illness, injury, ancestry, height, sex, and cause of death. Owsley and Bruwelheide, along with their team of researchers, treat each new skeleton as a time capsule that can speak volumes for peoples and communities no longer able to speak for themselves.

Goals & Outcomes

**GOAL**
Applying their knowledge of human anatomy and their familiarity with scientific practices such as asking questions, gathering evidence, and building conclusions, students will solve a real-world forensic mystery case. They will employ scientific tools, techniques, and problem-solving skills similar to those used by forensic anthropologists to learn about an individual’s life from skeletal remains and other evidence.

**STUDENT OBJECTIVES**
In this Investigation students will:
- Examine skeletal remains and objects found with those remains
- Gather data about the bones and objects/artifacts by comparison to various reference materials, including other human bones, growth and development charts, databases, and historical references
- Use x-ray technology and measuring tools as a method for collecting data
- Analyze and synthesize collected data
**STUDENT OUTCOMES**

Students who demonstrate understanding can:
- Use tools and techniques to gather data from human remains (skeletons)
- Ask questions and interpret data relevant to the context in which skeletons are found
- Cite relevant evidence to explain their analysis
- Explain how forensic anthropologists examine bones and describe the tools that they use when working real-world cases

**Central Questions and Concepts**

- What can we tell about a person from the remains found at a site?
- What can we tell about the person’s age, sex, height, and health?
- What can we tell about the way that person lived?
- What can we tell about how that person died?
- What can we tell about time of death?

**Case**

**CASE 1: MYSTERY AT YORKTOWN CREEK**

Erosion along a river bank near Yorktown, Virginia produced a startling discovery – a human skeleton! Local law enforcement officials ruled out the possibility of a modern crime. Archaeologists arrived at the scene to perform salvage archaeology, recording and recovering as much evidence as possible before the rising river destroyed the site.

After carefully documenting the skeletal remains and other artifacts at the site, the archaeologists transferred the case to the National Museum of Natural History for examination and report.

There is no historical documentation to suggest that a cemetery ever existed at the site. Could the bones or trappings or burial offer clues to help identify the remains?

The Yorktown area actually has a rich history of settlement. In the 1600’s, some of the earliest English settlements in the colonization of America occupied the area. Over the next two centuries, Yorktown became a bustling port and mercantile town focused on the growth and sale of tobacco. It also was a significant slave port, providing much needed labor to the tobacco industry. In 1781, the last battle of the American Revolution was fought at Yorktown. During the Civil War, both Union and Confederate troops occupied the town at one time or another.

Students will move through six stations containing skeletal remains and objects from the Yorktown site. Each station will focus on one of the following themes: age, sex, stature, pathology (changes in the bone), historical context, and scientific context. With a Museum Educator facilitating discussion, students will study the skeletal remains, reconstruct the life history of the person, and then place that person in historical context based on their knowledge of colonial America.
CASE 2: A GRIZZLY DISCOVERY
In the spring of 2008, police were called to a wooded area in rural West Virginia. Hikers believed that they had found a human skeleton beneath the leaf litter. Police searched the area for clues and evidence. A person had been reported missing from a nearby city—an adult female, about 65 years of age. Police carefully recorded the positions of bones and other objects found at the scene and then collected all for further analysis.

The Chief Medical Examiner assigned to the case forwarded all items collected at the scene to the National Museum of Natural History’s forensic anthropologists for identification and analysis. Among the items found were a cartridge casing and other items, adding to the complexity of the case.

Students will move through six stations containing evidence found at the crime scene as well as a carefully recorded site map of the scene. Students will collect and assemble data to help reconstruct the person’s life history and offer hypotheses on possible cause of death.

With a Museum Educator facilitating discussion, students will understand the research methods used by forensic scientists and recognize the crucial importance of evidence gathering and analysis.

Program Format

ARRIVAL
You can find the entrance to Q?rius in the Constitution Avenue lobby on the Ground Floor of the Museum. If your class begins at 10:15 a.m., please enter the Museum at Constitution Avenue and 10th Street beginning at 10:00 a.m. If you will be exploring the Museum before your Q?rius class, please bring your students to the Constitution Avenue lobby 15 minutes prior to the start of your class.

A Museum Educator will meet your group and escort you to a Q?rius classroom. The educator then will introduce students to the forensic case, explain what is expected of them as scientists, teach them the techniques for handling evidence, and show them the available tools. Every team will receive a case file that will include a data collection sheet that students can use to record their observations, measurements, and any other data gathered or observed.

INTRODUCTION (10 MINUTES)
Through a classroom discussion led by a Museum Educator, students will explore forensic practices and concepts. As a team, students will review the overall case file.

INVESTIGATION (30 MINUTES)
Working in small teams of 4 – 6 individuals, students will rotate among six investigation stations. Teams will have five minutes at each station to examine the evidence, make observations, collect data, and analyze it. At each station, students will use reference bones, books, charts, and measuring tools to aid them in their investigation.

Program activities can be adjusted for grade level and with consideration to experience with forensic practices and concepts. Additional human skeletal remains and objects requiring more observation, offering
Before Your Visit

GRADES 6-8

**Scientific Terms**
The *Forensic Mysteries* class will use these terms in the context of natural history scientific investigations. Please review these terms with students before arrival.

ancestry  preservation  radiograph  
cranium  excavate  calipers  
forensic  osteology  eruption

**Preparation Questions**
1. What can forensic anthropologists learn from bone analysis that we cannot learn from other kinds of historical sources?
2. Forensic anthropologists closely examine the DNA evidence from bones and other artifacts to learn more about how people lived in different time periods. What are the various methods and tools forensic anthropologists use to examine and collect information from bones?
3. What are some of the ways forensic anthropologists determine the history of the people whose bones they discover?
4. How would a forensic anthropologist determine whether a skeleton was buried 400 years ago or four years ago?

GRADES 9-12

**Scientific Terms**
antemortem  postmortem  innominate  
perimortem  osteons

**Preparation Questions**
1. What features of a person’s skeleton change over time? How can forensic anthropologists use that information to establish identity?
2. Other than the bones themselves, what do forensic anthropologists look at for clues to wealth and social status? What can archaeological evidence tell us that we cannot learn from other sources?
3. Would you expect there to be significant differences between our skeletons and those of people born 100 years in the future? What sort of differences?
4. Why are teeth studied so closely? How can they suggest a person’s age? What evidence can teeth provide...
about diet, and what conclusions might be drawn from that evidence? How might the teeth of men and women of similar age differ in other ways, as a result of pipe smoking or cosmetic cleaning for example?

**Related Resources**

**PERMANENT EXHIBITS AT THE NATIONAL MUSEUM OF NATURAL HISTORY**

The *Egyptian Mummies* exhibit provides another application of forensic anthropology skills and practices.

**SUGGESTED ACTIVITY:** In the exhibition, students can gather examples for post-visit classroom discussion of practices and skills used by anthropologists in studying mummified remains.

The *Bones* exhibit displays a skeletal collection representing all animal groups.

**SUGGESTED ACTIVITY:** In the exhibition, students can complete a comparative anatomy observation lab by examining similarities and differences of skeletal structures of different classes of animals.

**Back in School: Curiosity Continues**

The Q?rius website at qrius.si.edu offers a variety of different follow-up opportunities for your students. Students can conduct an investigation with an online activity, jump into science stories, create a digital field book, complete a natural history badge challenge, or explore science in action.

<table>
<thead>
<tr>
<th>PARTICIPATE IN LIVE WEBCASTS</th>
<th><em>Smithsonian Science How</em> delivers real-world science into classrooms through free, interactive, live webcasts and supporting classroom resources. The 25-minute programs feature the research and personalities of the Smithsonian’s National Museum of Natural History, providing your students with positive STEM role models, information about science careers and pathways, and connections to current research. Every webcast includes a package of standards-aligned lessons, activities, and other resources that highlight science content and practice.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO AN ACTIVITY</td>
<td>Are your students predisposed to the super science skill of pattern recognition? In the “Decoding Mars” activity, students can look for geologic features that indicate evidence of water on Mars. Other online activities invite students to measure coral reef diversity in Bali or examine human bones.</td>
</tr>
<tr>
<td>JUMP INTO SCIENCE STORIES</td>
<td>Delve into the same topics being explored by Smithsonian scientists, such as volcanoes, genomics, extinction, and human evolution. Read about the cutting-edge work and adventures of Smithsonian scientists, watch videos of them in action, hear them talk about what inspires their curiosity, and manipulate digital objects similar to the ones they use.</td>
</tr>
<tr>
<td>CREATE A DIGITAL FIELDBOOK</td>
<td>Just like a scientist records their observations, students ages 13 and over may record the results from their experiences with Q?rius activities and collections online. Create an account to save objects, stories, images, and notes to a Digital Field Book.</td>
</tr>
</tbody>
</table>
## EARN A NATURAL HISTORY BADGE
Field Book accounts also enable students over age 13 to earn points for their activities online that they can share through their own social media networks. Complete multiple activities online or while exploring Q?rius on subsequent visits, get enough points, and earn a digital badge that you can share through social media.

## EXPLORE SCIENCE IN ACTION
Watch videos of real-life scientists explaining their work, how they got started in their careers, and how they balance and integrate their work, passions, and everyday lives.

## KEEP EXPLORING SCIENCE
Even more Web-based science learning activities can be accessed through the Museum’s main webpages, including a forensic mystery webcomic and interactive maps. Activities cover topics such as the Earth and solar system, human culture and diversity, and life’s diversity.

### RECOMMENDED RESOURCES FROM SMITHSONIAN SCIENTISTS
**WRITTEN IN BONE**
http://anthropology.si.edu/writteninbone/index.html
The *Written in Bone* website offers a wealth of teaching resources. Explore Forensic Case File, the Webcomic The Secret in the Cellar, and Skeleton Keys - the basics of “reading” bones.

**ANTHRONOTES**
http://anthropology.si.edu/outreach/anthnote/anthronotes.html
http://anthropology.si.edu/outreach/outrch1.html
Issued twice a year, this publication contains articles on current anthropological research by leading anthropologists, teaching activities and strategies, and reviews of teaching resources.

**HUMAN CULTURE AND DIVERSITY**
http://www.mnh.si.edu/education/teachersandclassrooms.html
Human Culture and Diversity offers links to varied resources that can be used in classroom units and lessons or shared with students to learn more about a topic.

**LESSON PLANS**
**DEPARTMENT OF ANTHROPOLOGY**
http://www.mnh.si.edu/exhibits/ocean_hall/reef_interactive/reef_interactive.html
The Smithsonian Institution’s National Museum of Natural History Department of Anthropology provides resources of over 20 lessons for pre-visit or post-visit classroom activities.
### CROSSCUTTING CONCEPTS

#### Patterns
- Use patterns to identify cause and effect relationships

#### Scale, Proportion and Quantity
- Observe patterns in systems at different scales (and cite patterns as empirical evidence for causality in supporting their explanations of phenomena - assessment)

#### Systems and System Models
- Observe patterns in systems at different scales (and cite patterns as empirical evidence for causality in supporting their explanations of phenomena - assessment)

### SCIENCE AND ENGINEERING PRACTICES

#### Asking Questions and Defining Problems
- Specifying relationships between variables, and clarifying arguments and models
- Formulating, refining, and evaluating empirically testable questions and design problems using models and simulations

#### Analyzing and Interpreting Data
- Analyze and interpret data to provide evidence for phenomena
- Consider limitations of data analysis
- Analyze and interpret data to determine similarities and differences in findings
- Consider limitations of data analysis

#### Constructing Explanations and Designing Solutions
- Apply scientific ideas, principles and evidence to construct an explanation for real-world phenomena or events
- Apply scientific reasoning to show why the evidence is adequate for the conclusion
- Apply scientific reasoning to show why the evidence is adequate for the conclusion

#### Engaging in Argument from Evidence
- Respectfully provide and receive critiques from peers about an explanation by citing relevant evidence and posing specific questions
- Respectfully provide and receive critiques from peers about an explanation by citing relevant evidence and posing specific questions
<table>
<thead>
<tr>
<th>STANDARDS</th>
<th>GRADES 6-8</th>
<th>GRADES 9-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEXT GENERATION SCIENCE STANDARDS (CONTINUED)</td>
<td></td>
<td>• Make and defend a claim based on evidence about the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence</td>
</tr>
<tr>
<td>DISTRICT OF COLUMBIA PUBLIC SCHOOLS</td>
<td>SCIENTIFIC INVESTIGATION AND INQUIRY</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.1 Asking questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.7 Draw conclusions</td>
<td></td>
</tr>
<tr>
<td>MARYLAND COMMON CORE STATE CURRICULUM</td>
<td>1.A. Construct Knowledge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.B. Applying Reasoning</td>
<td></td>
</tr>
<tr>
<td>MARYLAND STEM STANDARDS OF PRACTICE</td>
<td>1.B. Apply STEM content to answer complex questions and to develop solutions for challenges and real world problems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.A. Analyze interdisciplinary connections</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.B. Apply appropriate vocabulary when communicating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.E. Develop an evidenced-based argument</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.A. Ask questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.A. Engage in critical thinking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Collaborate as a STEM team</td>
<td></td>
</tr>
<tr>
<td>VIRGINIA STANDARDS OF LEARNING</td>
<td>1. Use science language</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Investigate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Collaborative quest</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Develop scientific dispositions</td>
<td></td>
</tr>
<tr>
<td>21ST CENTURY SKILLS GLOBAL</td>
<td>• Learning and Innovation Skills - Work creatively with others</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Critical Thinking and Problem Solving - Use systems thinking, Solve problems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Communication and Collaboration - Communicate clearly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Collaborate with others</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Information Literacy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Access and Evaluate Information</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Initiative and Self-Direction - Manage goals and time and Be self-directed learners</td>
<td></td>
</tr>
</tbody>
</table>