

Secrets of the Parthenon

PROGRAM OVERVIEW

NOVA explores the ambitious, three decade-long restoration of the Parthenon and reveals a number of surprising secrets that help explain how the ancient Athenians constructed this unique architectural icon.



The program:

- specifies that the Acropolis Restoration Project team's goal in repairing the Parthenon is to consolidate the structure, correct damage inflicted by previous restorations, and identify—and where possible restore—the thousands of fragments from the structure that have been found scattered on the Acropolis.
- recounts the history of Athens before the Parthenon was built, including Greece's victory over Persia, the rule of Pericles, and the golden age of Greece that heralded the beginning of democracy.
- shows how the Greeks deliberately incorporated subtle architectural refinements that enhanced the Parthenon's appearance and may have been intended to correct optical illusions.
- seeks answers to central questions about how the builders were able to construct the Parthenon so quickly, so precisely, and most likely without an overall architectural plan.
- reveals some of the techniques that modern restorers have reconstructed and borrowed from the ancient builders, including the use of a variety of hand tools not found today and the application of red clay to make a perfect alignment match between an ancient damaged fragment and a fresh marble block.
- explains how ancient Athenians may have found a way to standardize different units of measure used by the Parthenon's large, diverse workforce.
- reports how ancient Greeks viewed the proportions of the ideal human body as inspiration for architectural dimensions.
- points out that some of the Parthenon's proportions correspond to a ratio of 4:9.
- demonstrates how ancient builders were able to create extremely precise marble surfaces and joints, level to within fractions of a millimeter.
- identifies the scale drawing technique that ancient Greek architects probably used to create the architectural refinement known as *entasis*—the slightly curving profile of the Parthenon's columns.
- recounts the turbulent history of the Parthenon after its creation.

BEFORE WATCHING

- 1 The Parthenon was conceived to embody the greatness of Greece and to celebrate Athens as the apex of that culture. Show students a picture of the Parthenon and pictures of some of the buildings in Washington, D.C., such as the White House, the U.S. Capitol, and the Thomas Jefferson Memorial. How do the buildings compare and contrast?
- 2 Assign groups of students to collect information as they watch the program, using the viewing guide provided in the activity "A Monumental Puzzle" on page 2. See the activity procedure section for instructions.

AFTER WATCHING

- 1 Ask students to list buildings in their city that have elements of the Parthenon in them. Which elements show up the most? Which elements show up the least? Why do students think some elements are used more than others?
- 2 Ancient Greek scientists contributed to the fields of medicine, astronomy, chemistry, mathematics, and more. Organize students into five groups and assign each group one of the following scientists to research: Eratosthenes, Archimedes, Bolos (Democritus), Daedalus, and Hippocrates. Have students research and report to the class about when the scientist lived, what field(s) he worked in, and what he contributed to each field. Create a time line on the board for students to use to record when their scientist lived and what each scientist's major accomplishments were.

Taping rights: Can be used up to one year after program is recorded off the air.

CLASSROOM ACTIVITY

Activity Summary

Students use a viewing guide while watching a program about the reconstruction of the Parthenon and discuss answers to questions related to the monument after watching.

Materials for each Student

- copy of “A Monumental Puzzle” student handout

Background

Built as a temple for the goddess Athena, the Parthenon was constructed during the Classical Period (circa 490–323 BCE), which began upon the defeat of the reigning Persian Empire. This period encompassed the golden age of Greece, a time when literature, art, theater, and philosophy flourished.

With its many iconic features, the Parthenon—designed to symbolize the ideals of art, science, and democracy—was the first building ever to be constructed entirely of marble. The Parthenon includes subtle architectural refinements that together make it appear visually perfect, although there has been much debate about just why the builders incorporated these refinements. A year after the Parthenon was completed in 432 BCE, however, Pericles went to the citizens for funds to equip an army against the threat of Sparta. He suggested that, if necessary, the statue of Athena could be stripped of gold to provide the funds. The Spartans later turned the Parthenon into an army barracks. For the next two millennia, the iconic building was taken over by Romans, barbarians, Christians, Muslims, and Turks. In the 18th and 19th centuries, Europeans plundered its sculptures.

Efforts made to restore the building during the late 19th and early 20th centuries resulted in the catastrophic installation of iron clamps that would later rust. Rather than rebuild the structure to its original state, the current restoration team chose to preserve what has survived of the building. This has so far taken three decades and continues.

For more information on the Parthenon’s history, see “The Parthenon’s Many Lives,” at www.pbs.org/nova/parthenon/timeline.html

LEARNING OBJECTIVES

Students will be able to:

- recount the Parthenon’s history.
- describe methods being used by architects and masons to restore the Parthenon.
- report how the original Athenian builders were able to complete the job so precisely and efficiently.

STANDARDS CONNECTION

The “A Monumental Puzzle” activity aligns with the following National Science Education Standards (see books.nap.edu/html/nse).

GRADES 5–8

History and Nature of Science

- Science as a human endeavor
- Nature of science

GRADES 9–12

History and Nature of Science

- Science as a human endeavor
- Nature of scientific knowledge

*Video is required
for this activity.*

CLASSROOM ACTIVITY (CONT.)

Procedure

- 1 Organize students into five teams. Assign each team a set of four questions. The questions generally follow the sequence of the film. You can assign the questions in their current sequence, choose a mix of simple and more complicated questions for each team, or allocate them by themes (i.e., history of the Parthenon, tools and techniques used by the original builders, steps taken to restore the structure).
- 2 Distribute a copy of the student handout to each team before viewing. Discuss appropriate background information with students.
- 3 Show the program and have students individually take notes on the questions their team has been assigned.
- 4 After watching the program, have students meet in their teams to discuss their notes. Beginning with the first question assigned, ask teams to come to a consensus on an answer and record their response. Have each team continue this process until all of its assigned questions are answered.
- 5 Have teams share the questions and answers that came out of their teamwork. (See *Activity Answer* on page 4 for possible answers. Accept all reasonable answers.) Ask the rest of the students in class if they agree with what the team has presented. If students don't agree, ask them to explain why and provide evidence from the program that will support their opinions. When possible, expand upon a question or provide additional historical background for students.
- 6 To conclude, discuss with students how the restoration team determined how the Parthenon was built. Discuss the nature of science and how team members recreated or discovered how the ancient Greeks were able to build the Parthenon so quickly, achieve such precision, and construct the Parthenon without overall architectural plans.
- 7 As an extension, organize students into groups to research other temples of the Acropolis. Have students create posters that include a photo or drawing of each temple, when it was originally built, what its purpose was, and what happened to it. Find a map and description of all the temples at plato-dialogues.org/tools/acropol.htm

Classroom Activity Author

Developed by WGBH Educational Outreach staff.

ACTIVITY ANSWER

Suggested answers to the questions listed on the student handout:

- 1 What was the name of the team assigned to restore the Parthenon?
the Acropolis Restoration Project
- 2 How long did it take the ancient builders to construct the original Parthenon? *less than nine years*
- 3 What was the goal of the restoration team? *To create the most accurate restoration by correcting damage inflicted by previous restorations and restoring, where possible, the thousands of fragments from the structure that have been found scattered on the Acropolis.*
- 4 How many pieces did the restoration team have to work with?
more than 70,000
- 5 What is architecturally unique about each of the 46 columns?
Each one has a unique curve.
- 6 What did the restoration team do to determine which blocks belonged where in the structure? *Team members first catalogued and put in a database a number of variables for more than 5,000 pieces of the Parthenon and executed a computer program to determine what went where. When that failed, an architect hand-drew each stone and used trial and error to place them in the correct order.*
- 7 Who was the leader who directed the effort to rebuild the temples of the Acropolis? *Pericles*
- 8 During what period of Greece's history was the Parthenon built?
the golden age
- 9 What role did democracy play in the reconstruction of the temples of the Acropolis? *The rebuilding of the temples was put to a vote of the people, who chose to rebuild the structures.*
- 10 In what way did the ancient builders use red clay to ensure that their pieces would fit together precisely? *They applied red clay to the inside surface of one of the blocks to ensure there was a perfect match between pieces.*
- 11 How many different stonemasons were identified from the chisel marks? *about 200*
- 12 How did the original builders make sure that the diverse workforce all used common measurements? *Scientists propose that early builders may have had a way to convert measurements, as shown on a stone found on the island of Salamis depicting all the competing Greek measurements of the time.*
- 13 What role might the human body have played in Greek architecture?
The ancient Greeks viewed the proportions of the ideal human body as inspiration for architectural proportions.
- 14 What ratio was found to be prevalent in the Parthenon? *4:9*
- 15 How were the ancient builders able to sand their marble pieces so precisely? *The builders used a metal plate and sand to grind surfaces to within 1/20th millimeter accuracy.*

ACTIVITY ANSWER

- 16** What device did the ancient builders use to precisely align the Parthenon's marble pieces? *The builders fitted together a block of wood that was placed in each half of the center of two column pieces being joined.*
- 17** How were the builders able to construct the curved columns without overall architectural plans? *They may have used a scaled-down version of the entasis curve as a template for the entire column.*
- 18** What year was the Parthenon completed? *432 BCE*
- 19** What happened in the two years after the Parthenon was completed? *Pericles went to the citizens of Athens for funds to equip an Army against the threat of Sparta, a plague killed off a third of Athens' population, and the Parthenon was turned into army barracks by the Spartans.*
- 20** Name the groups that took over the Parthenon for the next 2,000 years. *The Romans, the barbarians, the Christians, the Muslims, and the Turks. In the early 18th and 19th centuries, Europeans plundered the icon for its sculptures.*

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LINKS AND BOOKS

Links

NOVA—Secrets of the Parthenon

www.pbs.org/nova/parthenon

Provides articles, interviews, interactive activities, and resources in a companion Web site to the program.

Ancient Greece

www.ancientgreece.com/s/Main_Page

Features information about the history of the ancient Greek world from the Neolithic to the Classical Period, including art and architecture, mythology, wars, Olympics, philosophy, and kings and rulers.

Ancient Greek Architecture

www.greatbuildings.com/types/styles/greek.html

Provides locations, building types, construction systems, styles, and more for a number of ancient Greek structures.

Greece: Secrets of the Past

www.civilization.ca/civil/greece/gr1080e.html

Reviews contributions by Greek scholars to the fields of mathematics, astronomy, and the natural sciences.

Books

The Complete Greek Temples

by Tony Spawforth.

Thames & Hudson, 2006.

Includes a map showing the location of Greek temples, photos and diagrams of temple architecture, and descriptions of each site.

Parthenon

by Lynn Curlee.

Athenum, 2004.

Provides an introduction to Athenian history and discusses the Parthenon's purpose, proportions, construction, and slow destruction.

A Monumental Puzzle

The Acropolis Restoration Project team faced a monumental puzzle—thousands of fragments from the Parthenon scattered across the Acropolis and others that had to be recreated because they were missing. In this activity, you will find out more about how the team worked to reconstruct this famous architectural icon.



Procedure

- 1 Read your question set. As you watch the program, take notes on the questions you have been assigned.
- 2 After watching the program, meet with your team members who have been assigned the same questions. Together, come up with an answer you all agree on for the first question. Write this answer on a new sheet of paper. Work with your team members to answer all your assigned questions.
- 3 Divide the questions among team members so that each member is assigned at least one question to present to the class.
- 4 Share answers to your team's questions with the class.

Questions

Write your answers on a separate sheet of paper.

- 1 What was the name of the team assigned to restore the Parthenon?
- 2 How long did it take the ancient builders to construct the original Parthenon?
- 3 What was the goal of the restoration team?
- 4 How many pieces did the restoration team have to work with?
- 5 What is architecturally unique about each of the 46 columns?
- 6 What did the restoration team do to determine which blocks belonged where in the structure?
- 7 Who was the leader who directed the effort to rebuild the temples of the Acropolis?
- 8 During what period of Greece's history was the Parthenon built?
- 9 What role did democracy play in the reconstruction of the temples of the Acropolis?
- 10 In what way did the ancient builders use red clay to ensure that their pieces would fit together precisely?
- 11 How many different stonemasons were identified from the chisel marks?
- 12 How did the original builders make sure that the diverse workforce all used common measurements?
- 13 What role might the human body have played in Greek architecture?
- 14 What ratio was found to be prevalent in the Parthenon?
- 15 How were the ancient builders able to sand their marble pieces so precisely?
- 16 What device did the ancient builders use to precisely align the Parthenon's marble pieces?
- 17 How were the builders able to construct the curved columns without overall architectural plans?
- 18 What year was the Parthenon completed?
- 19 What happened in the two years after the Parthenon was completed?
- 20 Name the groups that took over the Parthenon for the next 2,000 years.