



Chapter 31

The Legacy of Ancient Greece

How did ancient Greece contribute to the modern world?

31.1 Introduction

In this chapter, you will explore the advances made by the ancient Greeks in many aspects of their civilization. You will also discover how these achievements continue to affect us today.

There is an ancient story, still told today, about a Greek thinker named Archimedes (ar-kuh-MEE-deez), who climbed into a bath filled to the top with water. As the water overflowed onto the floor, he realized something. The **volume** of his body could be measured by the amount of water that left the tub. “Eureka!” Archimedes is said to have shouted. In Greek this means, “I have found it!” By being curious and observing events closely, Archimedes had discovered an interesting fact about the natural world.

Curiosity and careful observation are important in the study of science. This way of thinking is one of the gifts that we have received from the ancient Greeks. The Greeks left us valuable ideas in many other fields as well.

Not only have important ideas come from the Greeks, but so have many of the words we use to describe those ideas. The world of the ancient Greeks may seem far away, but it is as close as the thoughts we think and the words we speak. Let’s look at Greek contributions to our lives in the areas of language, government, medicine, mathematics and science, architecture, entertainment, and sports.

◀ Greek architecture influenced the columns of the U.S. Capitol.



Note the Greek architectural features—columns, pediment, and frieze—in the ruins of an ancient Greek temple in Sicily, Italy.



Herodotus is known as the “father of history.” He wrote a history of the wars between the Greeks and the Persians.

31.2 Literature and History

Did you know that the word *alphabet* comes from the first two letters of the Greek alphabet, *alpha* and *beta*? Our alphabet grew out of the one that ancient Greeks used. In addition, many English words have Greek roots. For example, the word *telephone* is made up of the Greek words *tel*, meaning “far off,” and *phone*, meaning “voice.”

Even the way we write sentences comes from the language of ancient Greece. The rules of English grammar, punctuation, and paragraphing are all based on Greek writing. And don’t forget literature. The Greeks created drama, including both tragedy and comedy. They also developed historical writing. Modern historians follow in the footsteps of great Greek writers such as Herodotus (huh-ROD-uh-tuhs), known as the “father of history,” and Thucydides (thoo-SID-ih-deez).

Thucydides was one of the greatest historians of ancient Greece. He wrote *History of the Peloponnesian War*, an account of the conflict between Athens and Sparta in the 400s B.C.E. Thucydides himself took part in the war, serving in the Athenian army. Although he was an eyewitness to history, he was careful to present facts rather than his own viewpoint or opinion. He is remembered today as one of the founders of historical writing.

31.3 Government

Democratic government was a Greek idea. Democracy, or rule by the people, began in Athens. The practice of having citizens serve on juries also began in Greece.

Democratic government in the United States has roots in ancient Greece. There are a number of important differences, however, between American democracy and ancient Greek democracy. For example, in Athens, all citizens debated and voted on every issue. But in the United States, citizens elect representatives to speak for them and make laws. Another difference is that only native-born men could be citizens in Athens. But in the United States, all men and women born in this country are U.S. citizens, and people from other countries can become citizens, too.

Still, the basic **principles** of democracy were developed by the ancient Greeks. Athenians were proud that their government allowed citizens to control their own destiny. This idea remains the basis of democracy today.



Hippocrates emphasized principles of medicine, including ethical conduct. At left, a vase painting shows a Greek doctor treating a patient.

31.4 Medicine

For centuries, the Greeks believed that gods and goddesses controlled natural events, including health and sickness. In fact, the earliest Greeks thought that illnesses and accidents were punishments sent by the gods. Ancient Greeks didn’t know about the natural causes of disease and healing.

A Greek man named Hippocrates (huh-POK-ruh-teez) changed the way people thought about health and medicine. Hippocrates is often called the “father of medicine.” He brought a scientific way of thinking to his work as a doctor. Hippocrates believed that diseases had natural causes. He taught his students to carefully observe their patients and write down what they saw.

Even more important, Hippocrates established principles of medicine that are still followed. Today, people who become doctors take the Hippocratic Oath, based on these ideas of ethical behavior. Doctors promise to be honest, to preserve life, and to keep information about their patients private.

The Greeks loved to participate in and watch competitions in sports. Their interest in athletics gave them some knowledge about how the human body moves. But their understanding of the body was limited, partly because it was forbidden to look inside the body to see how it worked. The early Greeks believed that cutting open a human body offended the gods. As these beliefs changed over time, the Greeks made new discoveries.

Several centuries after Hippocrates, Greek **medical** students were able to name and describe organs inside the body. They discovered that the heart was a pump that sent blood flowing throughout the body. They also learned that the brain was the center of the nervous system.

31.5 Mathematics

The Greeks loved reasoning, or looking for logical answers to nature's mysteries. Greek scientists often found those answers in the field of mathematics.

One such scientist, Pythagoras (pih-THAG-er-uhs), believed that numbers were the key to understanding nature. He started a school where students developed mathematical **theories**.

Like many Greeks, Pythagoras was especially fascinated by **geometry**. *Geometry* comes from a Greek word that means "to measure land." Geometry began as a system for measuring areas of land. The Egyptians could also measure shapes and spaces, but the Greeks created new and improved methods. Using geometry, they could figure out problems such as how much seed to buy for planting a field or how to lay out a city.

Another famous Greek mathematician was Euclid (YOO-klid). His geometry textbook has been used as the basis for the teaching of geometry for more than 2,000 years.

Greek culture produced the first woman to earn fame as a mathematician, Hypatia (hie-PAY-shuh). Born in Egypt in about 370 C.E., she taught Greek philosophy and mathematics in the city of Alexandria.

31.6 Astronomy

Astronomy comes from the Greek word for "star." Astronomy is the scientific study of outer space. Ancient Greeks were pioneers in this field.

People in all civilizations observed the sun, moon, and stars. But a Greek scientist named Aristarchus (ayr-uh-STAIR-kuhs) was the first person to suggest that Earth moves around the sun. This idea upset many Greeks who believed that Earth was the center of the universe.

Another Greek, Hipparchus (hih-PAHR-kuhs), is often called one of the greatest scientists of the ancient world. He studied and named more than 850 stars. He also figured out how to estimate the distances from Earth to both the sun and the moon. His theories allowed later scientists to **accurately** predict eclipses of the moon.

Hypatia was a highly respected philosopher and mathematician in Alexandria, Egypt.

geometry the branch of mathematics involving points, lines, planes, and figures



31.7 Geography

The study of geography has roots in ancient Greece. The word *geography* comes from Greek words that mean "writing about the earth." The Greek historian Herodotus created the first map of the known world, in about 450 B.C.E. To gather the information for his map, Herodotus asked geographic questions. He found some answers to his questions by traveling and talking with other travelers. He organized the information by displaying it on a map.

Another great geographer of ancient times was Ptolemy (TAH-luh-mee), a Greek scientist who lived in Alexandria, Egypt. He wrote a book called *Geographia* that listed about 8,000 places around the world. His book contained maps that showed how to represent the curve of Earth on a flat surface.

Ptolemy also designed a system of lines drawn on a map called **latitude** and **longitude**. With this system, he recorded the specific locations for the thousands of places he listed in his book. Centuries later, Arab scholars would further develop the study of geography, especially in the field of mapmaking.

31.8 Biology

Ancient Greeks developed the science of **biology**. About 600 B.C.E., Greek thinkers believed each event has a cause and an effect. They used this idea to study the natural world.

Curiosity led Greeks to study plants and animals. Scientists learned about the anatomy, or body structure, of animals and humans. This knowledge helped doctors in their medical studies.

The Greeks identified plants and also named their parts. The Greeks learned that plants reproduce by spreading seeds. Greek doctors used plants, such as herbs, as medicines and for pain.

A 15th-century mapmaker created this replica of Ptolemy's map of the world. Compare it with a modern world map. Can you find Africa?

latitude a measure of how far north or south a place on Earth is measured from the equator

longitude a measure of how far east or west a place on Earth is from an imaginary line that runs between the North and South Poles

biology the study of living things; their structure, growth, and function



Greek actors wore masks that showed which character they were playing.

The Greek philosopher Aristotle was fascinated by living things. He collected information about many types of animals and plants. Then he organized animals into groups, such as “those with backbones” and “those without backbones.” He divided plants into such groups as “herbs,” “shrubs,” and “trees.” The way we classify, or group, animals and plants today reflects the work of Aristotle.

31.9 Architecture

The word *architecture* comes from a Greek word that means “master builder.” Greek architecture was one of the achievements of the Golden Age of Athens. One feature was the way that the Greeks used columns to make their temples look balanced and stately. Another feature was the pediments, the triangular shapes where roof lines come together. And a third architectural feature was the decorated bands called friezes.

Today, Greek styles are still used in many buildings. They are common in public structures such as government buildings, schools, churches, libraries, and museums. The U.S. Capitol has elements of Greek architecture, such as columns and pediments. The building that houses the U.S. Supreme Court is another example of a public structure inspired by Greek architecture.

You can also see Greek building styles in homes and stores. For example, many houses have covered porches. The design of these porches reflects a feature of Greek architecture called a *stoa*. This is a covered line of columns.

31.10 Theater

The word *theater* comes from a Greek word that means “a viewing place.” Greek theaters were built as semicircles. The rows of seats rose steeply from the stage so that everyone in the audience could see and hear. These ideas are used in theaters built today.

The Greeks even invented special effects. For example, they used hoists to lift actors off the stage, so that they appeared to be flying. They also created scenery that revolved, or turned. Revolving the scenery let them quickly change where the action in a play was taking place. Perhaps the greatest Greek contributions to the theater are their stories and plays. Writers throughout the ages have been inspired by Greek myths and stories. Greek dramas are still performed all over the world.

31.11 Sports

Many modern sports trace their roots back to ancient Greece. The most famous example is the Olympic Games.

The first Olympics were held in 776 B.C.E. to honor the Greek god Zeus. Today’s Olympic Games reflect ancient Greek customs. During the opening ceremony, an athlete lights the Olympic flame. This custom comes from the time in ancient Greece when the first Olympic athletes lit a fire on the altar of Zeus.

Many modern Olympic events grew out of Greek contests. One example is the pentathlon. *Pentathlon* is a Greek word that means “five contests.” The Greek pentathlon included the foot-race, discus throw, long jump, javelin throw, and wrestling. The Greeks invented this event as a test of all-around athletic skill. Although the five contests are different today, the pentathlon is still an Olympic event.



Two Chinese athletes take part in the torch relay to light the flame for the 2008 Beijing Olympics.

Chapter Summary

In this chapter, you learned how ancient Greek civilization affects today’s world.

Literature, History, and Government The modern alphabet, English grammar, drama and historical writing, and democratic government all trace their roots to the ancient Greeks.

Medicine Hippocrates applied scientific thinking to medicine and established a code of ethics used by doctors today. Centuries later, Greek medical students made discoveries about the heart and the brain.

Mathematics Pythagoras and Euclid made important advances in geometry that are still taught today.

Astronomy and Geography Greek scientists suggested that Earth moves around the sun. They named hundreds of stars and estimated the distances from Earth to both the sun and the moon. Greeks created the first maps and the system of latitude and longitude that is still used today to find locations on Earth.

Biology Greeks developed the scientific study of plants, animals, and humans called biology. The way we classify animals and plants is based on the work of Aristotle.

Architecture, Theater, and Sports Greek building styles, including columns and pediments, are seen today in public and private structures. Greek plays, stories, and myths are read today. Even the Olympic Games first began in ancient Greece.



This is the original marble statue Peplos Kore as she looks today in the Acropolis Museum in Athens. The statue was created around 530 B.C.E.

Painting the Gods

Because the ancient Greeks left behind stone images of their deities, we can see how this ancient culture pictured its gods and goddesses. Classical Greek sculpture is so realistic, the figures so distinct, it is easy to assume that we are seeing these sculptures as they appeared in their original form. But now, experts in the fields of art and archaeology are proving us wrong. How is a German archaeologist challenging our ideas about ancient art? What did these statues actually look like when they were created?

The colors are dazzling. The young woman is wearing a long yellow-gold dress with a detailed design of animals in shades of red, green, and blue. Her hair hangs down in auburn braids. Her red lips are curved in an inviting smile.

The woman (or is she a goddess?) is called the Peplos Kore. A *kore* is a type of ancient Greek statue depicting a female figure. This one was carved in marble by an unknown artist, around 530 B.C.E. She once stood on the acropolis, the hill above Athens, among the temples the Athenians built to honor their gods. She is still in Athens today, in the Acropolis Museum. But if you look for her there, you won't see her in her richly colored dress. The original statue is now plain white marble. The painted copy is made of plastic. It is a creation of two German archaeologists, Vinzenz Brinkmann and his wife, Ulrike Koch-Brinkmann.

People have viewed white marble Greek sculpture for 500 years or more. But Vinzenz Brinkmann believes his brightly colored copies are more similar to what the ancient Greeks created. What's more, art historians think he's right!

Why White Marble?

Few Greek sculptures have survived from ancient times. Wind, rain, and the passage of time have worn away the colors that once brightened them. These same factors have also damaged the buildings in which the sculptures stood. For a thousand years after the fall of the Roman Empire, people didn't care much about ancient art. Temples were torn down to recycle the building stone. Marble statues were burned to produce lime, which could then be used to make mortar, glass, and other useful things.

In the 1400s, interest in ancient Greek art revived. People found ancient statues buried under the ground and pulled them from the sea. When artists such as Michaelangelo saw these statues, they assumed that bare white marble had been the style of the ancient artists. So leaving stone in its natural color became the standard practice.

As more ancient art pieces were uncovered, experts sometimes noted traces of color on their surfaces. But this color faded or disappeared when the sculptures were exposed to light and air. Sometimes art restorers scrubbed the color off because people of this time considered bare stone more beautiful.

But there was evidence showing that the Greeks had not agreed. One example of the Greek preference for color is found in a play by the Athenian dramatist Euripides, who lived in the fifth century B.C.E. In the play, the beautiful Helen of Troy wishes that the gods had made her ugly, "as a statue from which the color has been wiped off."

Many art experts understood that ancient Greek sculpture and buildings had been brightly painted. Now and then, scholars tried to picture how these statues must have looked. A few 19th-century artists made copies of Greek statues and colored them in the current style of the artists' time. These efforts were laughed at or ignored. White marble was how people preferred to think of ancient Greek art. Besides, how could anyone know what the original colors had been?

Enter Vinzenz Brinkmann

Vinzenz Brinkmann believed he could figure out what colors had appeared on pieces of Greek art. Beginning in the 1980s, he and his team of archaeologists researched the pigments that Greek artists had used to color ancient statues. He used special lamps, high-tech cameras, and computers to bring out traces of the original colors. In some cases, the color had completely faded. But even then, Brinkmann's cameras often revealed changes in the chemistry on the surface of the stone.

These changes were like clues in a detective story. They showed what minerals artists had worked with in making the original pigments. The ancients used a mineral called malachite to make green. They used cinnabar to make red. Arsenic traces on the stone showed that the color had been gold or yellow.



This re-creation of Peplos Kore shows how Vinzenz Brinkmann believes she looked in ancient Greece. He figured out the missing colors through scientific research.



The Brinkmanns researched both ancient Greek and Roman art. Above is the original Roman statue, Augustus of Prima Porta, as it looks today, side by side with its color replica.

Behold the Gods!

After years of research, Vinzenz Brinkmann was ready to repaint Greek sculptures, to show them in their original colors. Of course, he would not touch the actual ancient statues. He used laser technology to make reproductions of the statues he wanted to study.

First Brinkmann made three-dimensional scans of the statues. Then he used the data from these scans to create full-size copies. They were made from a kind of plastic that looks like marble.

To paint the reproductions,

Brinkmann chose an archaeologist-artist he knew well—his wife, Ulrike Koch-Brinkmann. She was assisted by other artists. They used only pigments the ancients would have used. There were some details for which Vinzenz Brinkmann could not confirm the original color. Ulrike left these areas white.

When the Brinkmanns had finished more than 20 reconstructions, they decided to present their work. In 2003, the couple opened an exhibit at a museum in Munich, Germany, that specializes in Greek and Roman sculpture. The museum displayed the colored copies side by side with the original ancient white marble statues. The exhibit traveled to other museums in Europe. By 2007, it had reached the United States. The exhibit was called “Gods in Color.”

The colorful sculptures caused a sensation. As one art critic put it, “The exhibition forces you to look at ancient sculpture in a totally new way.”

Several of the sculptures were copied from originals in the temple of the goddess Aphaia on the Greek island of Aegina. There is a battle scene featuring warriors in deadly combat. Eyes are drawn to the figure of a kneeling archer. He wears a full-body tunic with a pattern of diamonds in red, green, blue, and yellow. His gold helmet is decorated with a flower. He shoots gold-tipped blue arrows from a red and gold bow.

Another battle scene is carved on the lid of a sarcophagus, or stone coffin. It depicts the famous king Alexander the Great fighting the Persians. In the center, Alexander wears a red and blue tunic, a gold helmet, and red and gold leggings. His white horse rears up above a fallen warrior who holds a gold shield trimmed in red. Alexander raises his sword to strike. To his left and right, Persian and Greek soldiers fight to the death.

The Brinkmanns’ work is changing the way people think about ancient Greek art—and about the ancient Greeks. Today, when we look at bare white marble statues of Zeus, Apollo, or Aphrodite, we think of how they might have once been painted. And that leads us to wonder what the Greeks *really* thought about their gods and goddesses.

Even Greece itself has embraced these colorful images of its past. When the Brinkmanns’ collection arrived in Athens, many government officials turned out to welcome it. Cameras snapped as Vinzenz Brinkmann posed some of his pieces on the acropolis. It was as if the gods and the heroes of ancient Greece were returning home after a long journey.

Below is the Brinkmanns’ painted replica of an archer posed by the Parthenon on the acropolis in Athens. The original statue was in the Temple of Aphaia in Greece.

