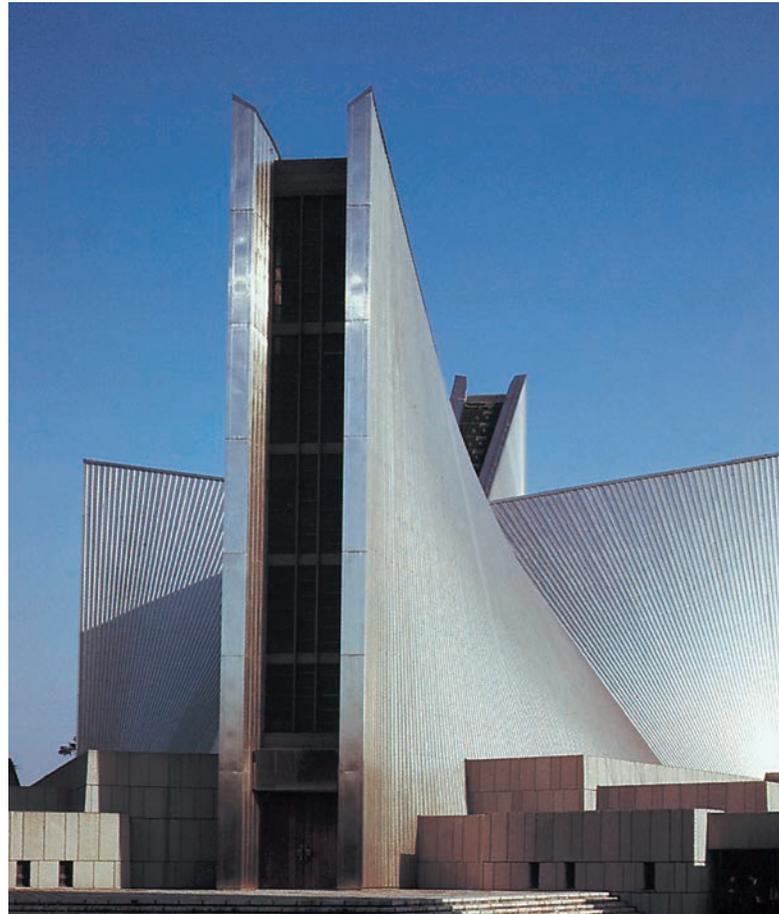




IDS Center (1973), Minneapolis, Minn., designed by Philip Johnson; © Dennis Brack, Black Star

An office building encloses an indoor plaza where workers and shoppers can relax.



Tokyo Cathedral (1965), designed by Kenzo Tange; Orion Press

The Tokyo Cathedral in Japan shows the influence of modern Western architecture in the structure's streamlined design and white concrete walls.

Architecture

Architecture is a term with several meanings, all related to buildings. The term may refer to the art and science of building, which is practiced by artists called architects. Or, *architecture* may mean the buildings themselves. The term may also have a historical meaning referring either to the building style of a particular culture or to an artistic movement. For example, we speak of Greek architecture or Gothic architecture or Islamic architecture.

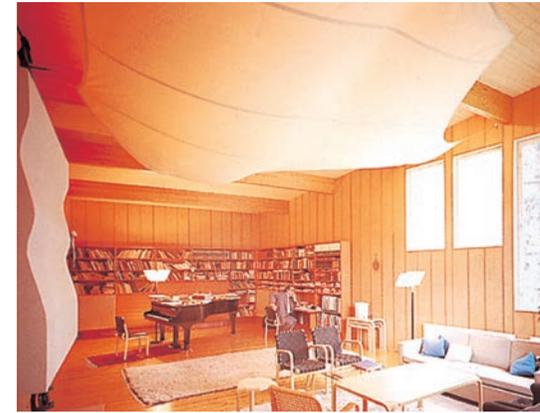
Architects create many kinds of structures. For instance, they design houses, schools, hotels, hospitals, stadiums, factories, office buildings, theaters, and houses of worship. Architects also design monuments dedicated to the memory of important events and people. The beauty of a city or town is largely determined by the quality of its architecture.

Although architecture has artistic qualities, it must

also satisfy a number of important practical requirements. For example, an architect may design an office building that looks beautiful. However, if people cannot work comfortably and efficiently in it, the building fails architecturally.

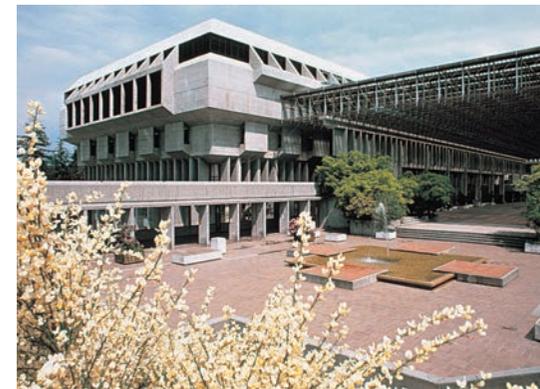
There are unique features of architecture that set it apart from other arts. In most cases, painters, writers, composers, and other artists create their works and then try to sell them. But a building may cost thousands or millions of dollars to construct. In nearly all instances, architects must have a buyer for their work before they create it. For example, rarely can an architect design an office building, afford to have it constructed, and then try to find someone who will buy it.

Unlike some other artists, architects must work with other people to produce their designs. Novelists, for example, can create their stories alone from their own in-



Villa Kokkonen (1969), designed by Alvar Aalto; © Kari Hakli, Dow Press Agency

A country house in Finland has wooden ceilings and walls. Specially made furniture harmonizes with the interior architecture.



Simon Fraser University (1965), Burnaby, B.C., designed by Arthur Erickson; © Koos Dykstra, Image Finders

A university campus in Canada has covered walkways and attractively landscaped courtyards between the various buildings.



Trans World Airlines terminal (1962, now closed) at Kennedy International Airport, designed by Eero Saarinen; Marvin B. Winter, Photo Researchers

An airline terminal in New York City consists of a series of dramatic curved forms that reflect a feeling of flight.



CaixaForum (2007), designed by Herzog and de Meuron; © Trigger Image/Alamy Images

A modern art museum in Madrid, Spain, features a series of flowing staircases in white concrete that connect several floors.

spiration. But almost all architects design a building for a client and must observe the client's wishes and needs. Within the limits of those wishes and needs, architects can make their personal artistic contributions.

Architects work closely with the client throughout the development of a building. They decide how best to fulfill the client's requirements and give advice on probable costs. They make drawings and models that show how the building will look after it is completed. They also work with the many different types of contractors who actually build the structure. Architects supervise the construction and, in many cases, receive a percentage of the construction budget as their fee.

Architecture is one of the oldest art forms. It dates from prehistoric times and is found in almost all societies. A society's architecture reflects the values and ideals of its people. For example, the ancient Greeks stressed discipline and harmony in life, and so they created an architectural style that was balanced and orderly. The beautifully proportioned Greek temple reflects this emphasis on harmony. The Middle Ages was a peri-

od of deep religious faith in Europe. Architects designed majestic cathedrals with *vaults* (arched ceilings) and towers that seemed to soar toward heaven. Like the Greek temple, the medieval cathedral was intended to inspire a mood of reverence among worshipers.

Architects rank among the greatest figures in the history of art. But many architectural masterpieces were created by skilled builders who probably did not consider themselves artists and had no idea that they had created buildings which critics later would praise as important works of architecture. During the 1600's, for example, colonists in New England built houses that were not primarily designed to be beautiful. Some of these houses have been preserved and are admired today for their skilled carpentry and handsome outlines.

This article describes the basic elements of architecture and discusses the history of architecture throughout the world from its beginnings to the present. The article also surveys the education and training needed to become an architect as well as the various careers available in architecture.



Portrait photography in a studio

© Image Source/SuperStock



Nature photography

© Image100/SuperStock



Amateur photography

© Jeff Greenberg, PhotoEdit

Photography

Photography is the process of making pictures by means of the action of light. Light reflected from a subject forms an image of that subject on a light-sensitive device or material. Usually, but not always, the device or material is inside a camera. The image formed by the light is then digitally or chemically processed into a photograph. The word *photography* comes from Greek words meaning *to write or draw with light*.

Photography enriches our lives in many ways. From photographs, we can learn about people in other parts of the world. Photographs show us scenes from such historic events as the American Civil War (1861-1865) and the first human moon landing in 1969. Photographs also remind us of special people and important events in our own lives. Millions of people throughout the world take pictures of their family, friends, vacations, and celebrations.

Special cameras can capture images in places where human beings cannot go—into deep space, to the bottom of the ocean, and inside the human body. Photographs made by visible light, X rays, infrared rays, or other forms of radiant energy help physicians detect many types of cancer and other diseases.

Cameras can also “see” events in a way that the eye cannot. For example, some cameras can record action that occurs so rapidly we see it only as a blur. Through this type of photography, scientists examine moving parts of machinery and study hummingbirds in flight.

Scientific research is only one of the many fields in which photography plays an important role. The adver-

tising industry uses photographs to publicize products and services. Photography is such an essential part of news reporting that photojournalism has become a specialized field. Mug shots and pictures taken with hidden cameras help the police find criminals. Military leaders use aerial photographs to learn about enemy troop movements and plan battle strategy.

Some photographs, like great paintings, have lasting value as works of art. Such pictures, through the photographer’s imagination and technical skill, are exceptionally beautiful or express significant ideas.

A camera works in much the same way as the human eye. Like the eye, a camera takes in rays of light reflected from an object and focuses the rays into an image. But the camera records the image on film or converts the image into electronic information and stores it. As a result, the image can be made permanent, reproduced endlessly, and seen by an unlimited number of people.

A crude type of camera was developed by about 1500. However, the first true photographs were not made until the 1820’s and 1830’s. Early photographers needed much heavy equipment and knowledge of chemistry. Gradually, as a result of scientific and technical advances of the 1800’s and 1900’s, cameras became smaller, lighter, more efficient, and easier to operate. Today, a person can take a photograph simply by aiming a camera and pressing a button.

From the late 1800’s to the late 1900’s, almost all photographs were made using chemical processes that required film and a darkroom. In the late 1990’s and early 2000’s, digital technology began to replace these chemical processes. Digital cameras record incoming light rays as electronic signals. The images captured by digital cameras can be easily transferred to a computer and processed using digital imaging software. Today, most professional and amateur photographers work with digital cameras. But film cameras and chemical processing methods are also still in use.



News photography

© A. Ramey, PhotoEdit

Photography can be divided into two general areas—*still photography* and *motion pictures*. This article will discuss still photography. Both film and digital photography will be covered. For information about motion pictures, see the *World Book* articles on **Motion picture** and **Camcorder**. This article will discuss kinds of cameras; how to take photographs, including the principles of lenses, focusing, exposure, and lighting; the processes used to make film and digital photographs; the history of photography; and careers in photography.

Cameras

The camera is the photographer’s basic tool. There are hundreds of kinds of cameras, with a wide range of designs, features, and complexity. But all cameras have some basic things in common.

Many photographers are professionals who take pictures as a career. For example, portrait photographers often take pictures of their subjects in special studios. Nature photographers record images that may be used for scientific research, or for publication in books or magazines. Photojournalists capture images of events, people, and places for news publications. But millions of photographers are not professionals. They simply enjoy taking pictures of their family, friends, vacations, and celebrations.

How a camera works. A camera is basically a light-proof box with a small *aperture* (opening) at one end and a light-sensitive electronic chip or piece of film at the opposite end. The electronic chip is called an *image sensor*. Light reflected from a scene enters the camera through the aperture and exposes the sensor or film. The inside of the camera must be completely dark so that light rays reach the sensor or film only through the aperture. A device called a *shutter* opens when the camera is taking a picture. It remains closed at all other times to keep light away from the sensor or film.

In nearly all cameras, the aperture is part of a *lens* mounted on the front of the camera. A lens consists of multiple pieces of curved glass or plastic inside a tube. The lens concentrates incoming light rays on the sensor or film. In this way, the lens gathers enough light to

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ment offices in the city or in the factories on the outskirts of the community. Factories in Pyongyang produce industrial goods, such as farm tractors and electric locomotives.

Pyongyang was founded about 3,000 years ago. It was the capital of ancient Korea. The Chinese invaded the city in 108 B.C. and ruled it until A.D. 313. After that, a series of small kingdoms controlled the Pyongyang area. In 427, Pyongyang became the capital of Koguryo, a Korean kingdom that also ruled part of southern Manchuria. Chinese armies destroyed Pyongyang in 668. However, the Korean kingdom of Koryo rebuilt the city during the 900's.

After World War II ended in 1945, Pyongyang served as the headquarters of the Soviet occupation army, which supported the Korean Communists. In 1945, Korea was divided into two parts. Two states, North Korea and South Korea, were established in 1948. Pyongyang became the capital of Communist North Korea. Much of the city was destroyed during the Korean War (1950-1953). However, Pyongyang was later rebuilt.

Chong-Sik Lee

See **Korea, North** (pictures).

Pyorrhoea. See **Periodontitis**.

Pyramid, in geometry, is a solid figure with triangular faces that meet at a common point. The base of a pyramid is a *polygon*, a plane figure bounded by three or more sides. The number of faces in any pyramid equals the number of sides in its base. The point farthest from the base—at which the faces meet—is called the pyramid's *vertex*.

In a *regular pyramid*, the faces are all *congruent* (equal in size and shape). Such a pyramid has a base that is a *regular polygon*—that is, a polygon with all sides equal and all angles equal. A perpendicular line extended from the vertex of a regular pyramid meets the base at its center. A regular pentagonal pyramid is pictured below. Its base is a regular five-sided figure called a *pentagon*.

The *altitude*, or height, of a pyramid is the distance along a perpendicular from the vertex to the base. The *volume* (V) of any pyramid may be found by using the following formula:

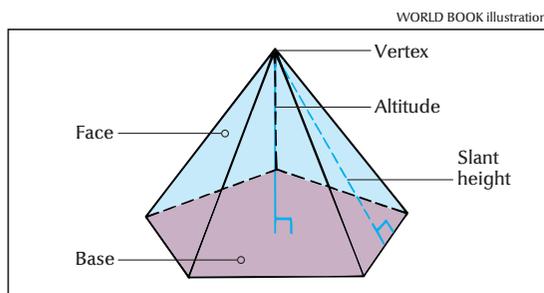
$$V = \frac{1}{3} Bh$$

In this formula, B stands for the area of the base and h for the height of the pyramid.

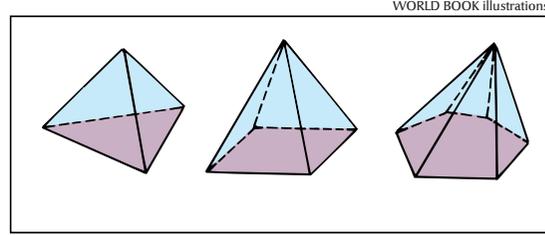
For a regular pyramid, the altitude of any face is called the *slant height*. The formula used to determine the area of the faces (L) of a regular pyramid is

$$L = \frac{1}{2} Ps$$

Parts of a pyramid



Some kinds of pyramids



Here, P stands for the total length of the base's *perimeter* (outer boundary) and s for the slant height.

Arthur F. Coxford, Jr.

Pyramids are large structures with square bases and four smooth, triangular-shaped sides that come to a point at the top. Several ancient peoples used pyramids as tombs or temples. The most famous pyramids are those built about 4,500 years ago as tombs for Egyptian kings. These Egyptian pyramids are among the Seven Wonders of the Ancient World.

Egyptian pyramids

The ruins of 35 major pyramids still stand near the Nile River in Egypt. Each was built to protect the body of an Egyptian king. The Egyptians thought that a person's body had to be preserved and protected so the soul could live forever. The Egyptians *mummified* (embalmed and dried) their dead and hid the mummies in large tombs. From about 2700 to 1700 B.C., the bodies of Egyptian kings were buried inside or beneath a pyramid in a secret chamber that was filled with treasures of gold and precious objects.

Many scholars believe that the pyramid shape has a religious meaning to the Egyptians. The sloping sides may have reminded the Egyptians of the slanting rays of the sun, by which the soul of the king could climb to the sky and join the gods.

Funeral ceremonies were performed in temples that were attached to the pyramids. Most pyramids had two temples that were connected by a long stone passageway. Sometimes a smaller pyramid for the body of the queen stood next to the king's pyramid. Egypt has at least 40 smaller pyramids that were used for queens or as memorial monuments for kings. The king's relatives and officials were buried in smaller rectangular tombs called *mastabas*. These buildings had sloping sides and flat roofs.

The first pyramids. Imhotep, a great architect and statesman, built the first known pyramid for King Zoser about 2650 B.C. Zoser's tomb rose in a series of giant steps, or terraces, and is called the *Step Pyramid*. This pyramid still stands at Saqqarah, near Cairo.

The first smooth-sided pyramid was built about 2600 B.C. It still stands at Medum. It began as a stepped pyramid, and then the steps were filled in with casing stones to give the building smooth, sloping sides. Other pyramids built during a period of Egyptian history called the Old Kingdom (about 2650-2150 B.C.) can be seen at Abusir and Dahshur. During the Middle Kingdom (about 1975-1640 B.C.), pyramids were built at Hawara, Illahun, Lisht, and Dahshur—near what is now Cairo. The remains of these pyramids are still impressive.



The Great Pyramid, built about 4,500 years ago, rises at Giza, near Cairo.

The Pyramids of Giza (Al Jizah) stand on the west bank of the Nile River outside Cairo. There are 10 pyramids at Giza, including three of the largest and best preserved of all Egyptian pyramids. They were built for kings about 2600 to 2500 B.C. The largest was built for King Khufu (called Cheops by the Greeks). The second was built for King Khafre (Chephren), and the third for King Menkaure (Mycerinus). A huge statue of a sphinx, called the Great Sphinx, was probably built for Khafre. It stands near his pyramid.

The pyramid of Khufu, called the *Great Pyramid*, contains more than 2 million stone blocks that average $2\frac{1}{2}$ tons (2.3 metric tons) each. It was originally 481 feet (147 meters) tall, but some of its upper stones are gone now and it stands about 450 feet (140 meters) high. Its base covers about 13 acres (5 hectares).

A study of the Great Pyramid shows how these gigantic structures were built. The ancient Egyptians had no machinery or iron tools. They cut big limestone blocks with copper chisels and saws. Most of the stones came from quarries nearby. But some came from across the Nile River, and others came by boat from distant quarries. Gangs of men dragged the blocks to the pyramid site and pushed the first layer of stones into place. Then they built long ramps of earth and brick, and dragged the stones up the ramps to form the next layer. As they finished each layer, they raised and lengthened the ramps. Finally, they covered the pyramid with an outer coating of white casing stones. They laid these outer stones so exactly that from a distance the pyramid appeared to have been cut out of a single white stone. Most of the casing stones are gone now, but a few are still in place at the bottom of the Great Pyramid.

The burial chamber is inside the Great Pyramid. A cor-

ridor leads from an entrance on the north side to several rooms within the pyramid. One of the rooms is called the *Queen's Chamber*, although the queen is not buried there. The room was planned as the king's burial chamber. But Khufu changed the plan and built another burial chamber, called the *King's Chamber*. The *Grand Gallery*, a corridor 153 feet (47 meters) long and 28 feet (8.5 meters) high, leads to Khufu's chamber. It is considered a marvel of ancient architecture.

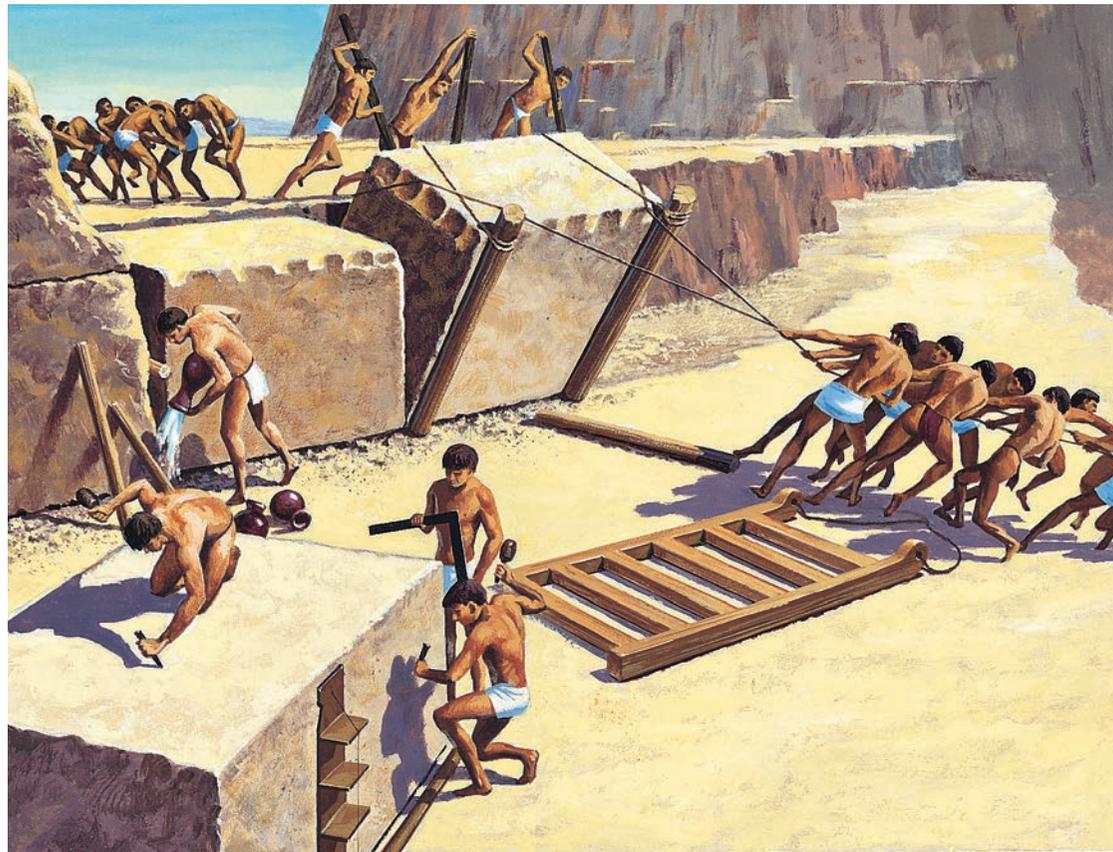
No one knows how long it took to build the Great Pyramid. The ancient Greek historian Herodotus said that the work went on in four-month shifts, with 100,000 workers in each shift. Scholars now doubt that account and believe that about 100,000 men worked on the pyramids for three or four months each year. Farm laborers built the pyramids. They worked on the tombs during periods when floodwaters of the Nile covered the fields and made farming impossible.

Thieves broke into most of the pyramids, stole the gold, and sometimes destroyed the bodies. Later Egyptian kings stopped using pyramids, and built secret tombs in cliffs. But some kings of the Kushite kingdom in Nubia, south of Egypt, built pyramids long after they were no longer used in Egypt.

American pyramids

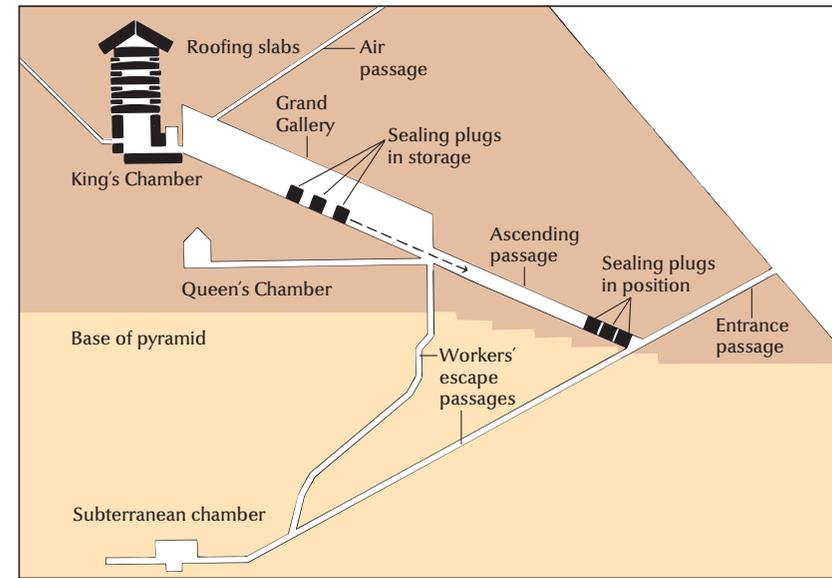
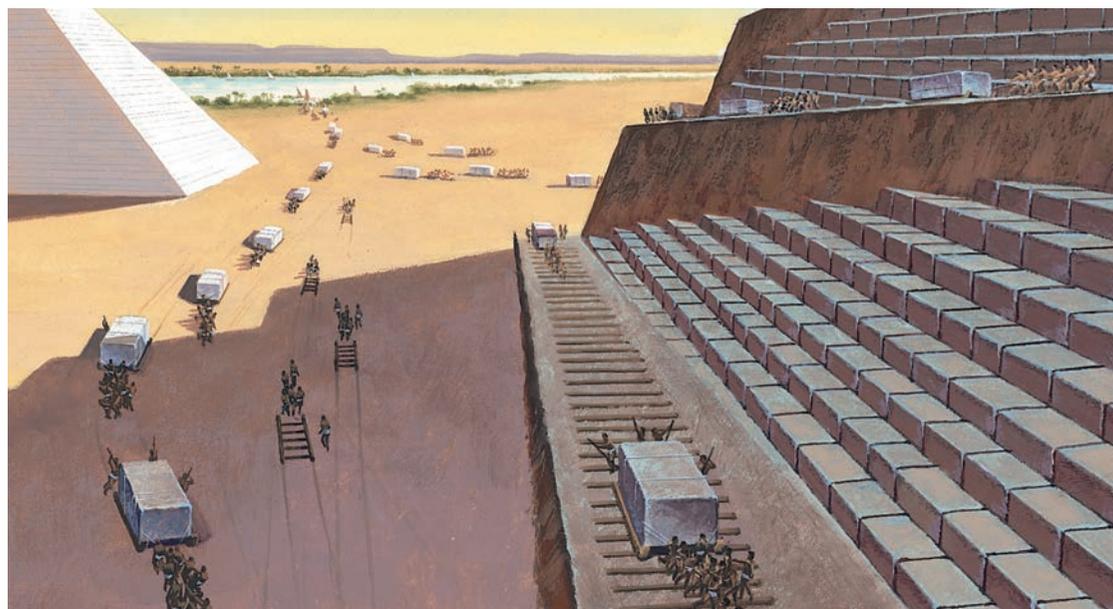
Indians of Central and South America also built pyramids. They built stepped pyramids that had flat tops. They used the flat tops as platforms for their temples.

The Moche Indians of Peru built large brick pyramids. *The Temple of the Sun*, near what is now Trujillo, on Peru's northern coast, has a terraced brick pyramid on top of a stepped platform. The ancient Mayas of Central America built pyramid-shaped mounds of earth



WORLD BOOK illustrations by Robert Addison

Building the pyramids was a great engineering feat requiring thousands of workers. First, workers cut and shaped huge limestone blocks using chisels and saws, *above*. Groups of workers dragged the blocks to the pyramid site on sledges and pulled them up ramps on the pyramid, *below*. Planks on the ramps lessened the friction of the sledges. As the pyramid grew taller, workers extended the ramps. Over 2 million blocks were used in building the Great Pyramid at Giza.



WORLD BOOK diagram

A cross section of the Great Pyramid shows the Grand Gallery, the King's Chamber, the Queen's Chamber, and various passages. After the burial, large blocks called sealing plugs were allowed to slide down the passageway from the Grand Gallery to seal off the tomb. Workers left the tomb through an escape passageway.



© Shutterstock

The Pyramid of the Sun at Teotihuacán, Mexico, had a larger base than the largest pyramid in Egypt.

with temples on top (see *Maya* [picture]).

Indians of central Mexico also built big stepped pyramids. For example, Indians constructed the great pyramids of the Sun and Moon that still stand at Teotihuacán, near Mexico City. The Toltec Indians built a stepped pyramid at Cholula that is one of the largest structures in the world. The Spanish conquerors destroyed most pyramids of the later Aztec Empire in Mexico. These pyramids were built in steps or terraces like the other American pyramids and had temples on top. Two of the greatest were at Tenochtitlan (now Mexico City). Mound-building Indians of North America built some pyramid-shaped mounds, but they were not true pyramids (see **Mound builders**). Leonard H. Lesko

See also **Egypt** (picture: Giant pyramids); **Egypt, Ancient** (pictures).

Pyramus and Thisbe, *PIHR uh muhs, THIHZ bee*, are young lovers in an ancient legend. Pyramus and Thisbe lived next door to each other in Babylon. They fell in love, but their parents would not let them marry or even

spend time with each other. They had to talk through a crack in the wall between their houses.

Finally, they planned to meet at night under a mulberry tree outside the city. Thisbe arrived first. She was frightened by a lioness that had bloody jaws from killing an animal. The frightened Thisbe ran away, dropping her veil as she fled. The lioness tore the veil apart with its bloody mouth. Pyramus then arrived and saw the tracks of the lioness and the blood on the veil. He thought Thisbe had been killed and stabbed himself in grief. Thisbe returned to the scene and found Pyramus dead. She then stabbed herself with his dagger.

The Roman poet Ovid told the story of Pyramus and Thisbe in his *Metamorphoses*. William Shakespeare's play *A Midsummer Night's Dream* (1595 or 1596) includes an amateur theater group that performs a comic adaptation of the legend. Elaine Fantham

Pyrenean shepherd, *pihr uh NEE uhn*, is a dog breed that has herded sheep in southern France for hundreds of years. Before the 1920's, this dog was little known outside the Pyrenees mountain region, where it originated. The Pyrenean shepherd has since become a valued pet and working dog. It is highly intelligent and energetic.

The Pyrenean shepherd stands 15 to 20 inches (40 to 50 centimeters) high at the shoulder. It weighs about 20 to 30 pounds (9 to 14 kilograms).

The Pyrenean shepherd has a lively, expressive face. The dog's eyes are dark brown, and it has short, upright ears. The coat is long and dense and comes in two types, rough-faced or smooth-faced. The Pyrenean shepherd is usually yellowish-brown or gray-black in color. It may have white markings on the chest, feet, or head.

Critically reviewed by the American Kennel Club

Pyrenees, *PIHR uh NEEZ*, is a mountain chain that forms a natural barrier between France and Spain. The mountains extend over a length of about 270 miles (435 kilometers), from the Bay of Biscay to the Mediterranean Sea (see **Spain** [terrain map]). They cover an area of more