

Vertebrates are animals with a spinal cord protected by a bony or cartilaginous vertebral column. The first known vertebrate fossils are from the Ordovician (488-443 million years ago), although they probably date back to the Early Cambrian (530 million years ago). This information sheet describes some of the most outstanding vertebrate fossils exhibited on the first floor of the museum.



CASE 86
LATE MIOCENE

This is an extinct species of frog described in line with fossils found in an old lignite and sulphur mine in the locality of Libros (Teruel). The fossils are associated with rocks formed in what was a fairly deep lake some 6 million years ago. The anoxic (no oxygen) conditions of the deep water prevented complete decomposition of the organisms that fell to the bottom, thus facilitating their exceptional state of preservation. Some of the frog fossils and those of other amphibians are outlined by a thin film of carbon. Their state of preservation is such that structures as delicate as larval eyes, stomach contents and even muscle tissue and bone marrow can be distinguished in some of the amphibian fossils from this locality.

Pelophylax pueyoi.

Late Miocene (6 million years ago).

Libros (Teruel, Spain).

Maximum dimension: 24 cm.



CASE 88
LATE TRIASSIC

This bipedal carnivore measuring approximately one metre long presents heterodont dentition (more than one type of tooth morphology). Thus, some of the teeth have curved, serrated crowns typical of the theropods (carnivorous dinosaurs), whereas others are leaf-shaped with a basal constriction similar to that of primitive sauropodomorphs. Although *Eoraptor* is structurally close to the common ancestor of all dinosaurs, some of its derived characters, such as having a three-fingered hand with the capacity to grip, situate it as the most primitive theropod known. However, the recent discovery of a new theropod (*Eodromaeus*) situates *Eoraptor* as a basal sauropodomorph.

Eoraptor lunensis (replica).

Late Triassic (230 million years ago).

Ischigualasto (Argentina).

Maximum dimension: 13 cm.



CASE 89
EARLY CRETACEOUS

Iberomesornis romerali is a primitive bird that was found in the locality of Las Hoyas (Cuenca). The size of the only known specimen to date is approximately 10 cm long, and it would have weighed between 15 and 20 grams. *Iberomesornis* presents a combination of ancestral and derived characters. For example, its caudal vertebrae are fused, forming a structure called the pygostyle, which is present in modern birds. In contrast, other characters are ancestral, such as the absence of the tibiotarsus and tarsometatarsus, bones that are typically found in modern birds and which are formed by the fusion of several bones in the hind limbs. Although the skull has not been preserved, *Iberomesornis* probably had teeth, as was the case with the vast majority of primitive birds known.

Iberomesornis romerali (replica).

Early Cretaceous (120 million years ago).

La Cierva (Cuenca, Spain).

Maximum dimension: 16 cm.



CASE 89
EARLY CRETACEOUS

Concornis lacustris is a fossil bird that was found in the locality of Las Hoyas (Cuenca), of which only one specimen is known. It was almost twice the size of *Iberomesornis*, and as with this latter, the skull has not been preserved. This bird belongs to the Enantiornithes, an extinct group of Cretaceous birds with the capacity to fly and primitive skulls with or without teeth. The specimen of *Concornis* from Las Hoyas presents long primary flight feathers with asymmetric vanes as in modern birds, suggesting that it had developed the capacity to fly. In Europe, only two species from the group of Enantiornithes are known, both from Las Hoyas. A third specimen was found in the province of Llerda, but it has not been possible to assign it to any particular species because it was a juvenile individual.

Concornis lacustris (replica).

Early Cretaceous (120 million years ago).

La Cierva (Cuenca, Spain).

Maximum dimension: 16 cm.



CASE 90
EARLY OLIGOCENE

This is a small crocodile (larger individuals reached approximately 1.5 m in length) found solely in the northeast of the Iberian Peninsula. It was covered by thick armoured skin and inhabited freshwater or slightly salt water lakes and lagoons in what is now the Ebro River Basin. A recent review of this species proposed it be assigned to the genus *Diplocynodon*. Modern crocodiles are large (up to 5 m long) aquatic predators covered by scales and bony plates (osteoderms), which live in tropical and subtropical climates. However, the fossil record tells a very different story: these animals once presented a wide diversity of forms, some of which were very different to modern crocodiles. For example, the atroposaurus were very small crocodylomorphs (30-70 cm in length) which probably lived on land.

Diplocynodon muelleri.

Early Oligocene (31 million years ago).

Tárrega (Llérida, Spain).

Maximum dimension: 24cm.





CASE 93
LATE MIOCENE

Hipparion, a genus of equidae, was widely distributed throughout Eurasia during the Late Miocene, although its ancestors were from North America. The first European examples of *Hipparion* were robust, but the species inhabiting Spain at the end of the Miocene were smaller and more slightly built. *Hipparion mediterraneum* reached a weight of approximately 200 kg compared to the almost 400 kg that small modern horses weigh. This species was not widespread in the Iberian Peninsula, having only been found in Catalonia and Valencia.

Hipparion mediterraneum.
Late Miocene (6 million years ago).
Piera (Barcelona Spain).
Maximum dimension: 24 cm.



CASE 96
LATE PLIOCENE

This extinct bovid species was endemic to the Balearic Islands, which it inhabited for more than 5 million years. It presents a series of exclusive derived characters such as having frontally directed eyes rather than laterally as in other bovids, being small (12-15 kg) and having a single, continuously growing incisor. A recent histological study has shown that *M. balearicus* presented a type of bone tissue that was previously only known in reptiles. This tissue indicates that it had a slower and more uneven growth rate than expected, with periodic pauses that would also have delayed sexual maturity. It is probable that selection pressure due to insularity was responsible for reversing some of the physiological and developmental characters of these mammals. Consequently, their growth would be more similar to that of the reptiles.

Myotragus balearicus.
Late Pliocene-Quaternary (2.5 million years ago - 4,000 years ago).
Mallorca (Spain).
Maximum dimension: 15 cm.



CASE 107
LATE PLIOCENE

Australopithecus is an extinct genus of hominid primates that lived in Africa between 4 and 2 million years ago. It is thought that *A. africanus* or *A. afarensis* might be the ancestors of the genus *Homo*. The "Taung Child" was the first primitive human fossil found in Africa. The skull belongs to a child aged about three years old that it is thought was attacked and killed by an eagle due to the marks that appear on some of the skull bones. This specimen provided the first evidence that primitive humans were bipedal, due to the position of the *foramen magnum*, a hole located at the base of the skull through which the spinal cord passes to connect to the brain. The position of the foramen indicates that the head was positioned at the top of the spinal column, a trait associated with bipedal locomotion.

Australopithecus africanus (replica of the "Taung Child").
Late Pliocene (2.5 million years ago)
Africa.
Maximum dimension: 14 cm.



CASE 108
EARLY PLEISTOCENE

Homo habilis is the first representative of the genus *Homo*, and lived in East Africa, in what is now Tanzania. *H. habilis* is thought to have manufactured and used stone tools (hence the name *habilis*: "handy man"); however, we cannot be absolutely certain of this because the area where tools have been found was also inhabited at the time by several other species of the genus *Homo*. On average, *H. habilis* stood 1-1.35 m tall and weighed 32 kg. It had smaller teeth than those of *Australopithecus*, but the enamel remained thick and the jaws strong, indicating that these were adapted for chewing hard food. While it used to be thought that *H. habilis* was the predecessor of *H. erectus*, recent discoveries of fossils of both species in the same area cast doubt on the idea that one evolved after the other. It is more likely that both species coexisted over a long period of time.
Homo habilis. Early Pleistocene (2.4-1.4 million years ago). Africa.

Homo habilis (replica).
Early Pleistocene (2.4-1.4 million years ago).
Olduvai (Tanzania).
Maximum dimension: 17 cm.



PRIMERA PLANTA
LATE CRETACEOUS

Tyrannosaurus rex was one of the largest terrestrial carnivores of all time. *Tyrannosaurs* belong to the coelurosaurs, a group of dinosaurs that also includes birds. Most of the feathered dinosaurs that have been found are coelurosaurs. Consequently, it has been suggested that *T. rex* might also have had feathers. However, the discovery of adult tyrannosaur skin impressions shows that it was covered with scales. It remains possible that *T. rex* had feathers or protofeathers on some parts of the body, but there is no evidence for this at the moment. *T. rex* is a well-known dinosaur because several almost complete specimens have been found. In one of them, it has been possible to isolate and study the remains of tissues preserved inside the femur; however, some palaeontologists have questioned whether these really are tissue remains.

Tyrannosaurus rex.
Late Cretaceous (65 million years ago).
South Dakota (USA).
Maximum dimension: 140 cm.