

## Defining a Mammal

The class Mammalia is composed of about 4,060 living species arranged in 138 families which in turn are grouped into 20 orders. Mammals range in size from the tiny Kitti's hog-nosed bat, weighing about 1.5 grams (0.05 oz.), to the massive blue whale, weighing up to 160,000 kilograms (180 tons).

Compared with the five million or more kinds of animals living on Earth today, the variety of mammals is rather small. They make up less than 0.5 percent of all the animal species now known, whereas insects account for about 80 percent of the total. Although mammal species are greatly outnumbered by all other animal groups, their essence derives from their sophistication in form, function, and, especially, behavior. Further, the class Mammalia contains the largest animals, some of the most abundant animals, many domesticated animals, pets, and game species. Probably most noteworthy is the fact that humans are mammals, too.

## Evolutionary History

Mammals are newcomers in the evolutionary picture. They evolved from a primitive group of reptiles (the therapsids) in the Triassic Period of the Mesozoic Era only some 230 million years ago during the "Age of Reptiles." This was a time when reptiles, including the popular dinosaurs, dominated a landscape marked by shallow inland seas and a hot, humid climate. The dog-sized early mammals were probably quite obscure.

At the end of the Cretaceous Period, some 65 million years ago, ruling reptiles nearly became extinct. Following their demise, mammals underwent a remarkable adaptive radiation. This led to the dominant position of mammals in the Cenozoic Era. During the past 65 million years, a time aptly called the "Age of Mammals," these animals have diversified into a great variety of ecological niches. They occur in marine and fresh water, underground, and in the air, as well as in trees and on the ground. They range from polar regions to the tropics on all continents and in all seas of the world.

Living members of the class Mammalia are divided into three major groups, differentiated on the basis of their reproductive anatomy. First, the monotremes are the only living mammals

that lay eggs. They consist of only one species of platypuses in the family Ornithorhynchidae and two species of echidnas in the family Tachyglossidae. They are found only in Australia, Tasmania, and New Guinea. Second are the marsupials. Most of these mammals have pouches in which to carry the young; their young are born in an undeveloped “embryonic” stage and attach to the mother’s nipples, commonly located within the pouch. There are some 258 species of marsupials residing principally in South America and the Australian region. Third, and by far the largest group of mammals, are the placentals, mammals whose females have a true placenta. This group consists of some 3,700 species residing throughout the world and includes humankind. The placenta is a complex of embryonic and maternal membranes that permits a two-way exchange of nutrients and oxygen between the blood of the mother and that of the developing embryo. In many mammals, the placenta is passed with the newborn at birth and commonly called the “afterbirth.”

## **Characteristics of Mammals**

Probably the most well-known characteristic of a mammal is its mammae or breasts. (The word *mammal* is derived from the Latin word *mammalis*, meaning “breasts.”) In females, these specialized skin glands produce milk to nourish the young; in males, they are rudimentary and nonfunctional. All mammals, except the monotremes (platypuses and echidnas), have teats or nipples to facilitate the transfer of milk to the young. In monotremes, the milk flows from pores in the skin rather than from nipples.

Having hair during some stage of development also defines a mammal. In some mammals, such as whales and dolphins, hair is limited to a few bristles on the nose or is entirely lacking except during embryonic development. A multicellular derivative from reptilian scales, hair was an important evolutionary advance for mammals. As a body covering, hair provides insulation and thus permits maintenance of a high and relatively constant body temperature, despite fluctuating air temperature. Reptiles lack this “endothermy” or warm-bloodedness and must maintain body temperature by finding shelter from excessive heat or by absorbing heat from the environment.

The lower jaw of mammals is unique among vertebrates since it is composed of only a single pair of bones, the dentaries,

which articulate directly with the skull. Evolutionary changes in the jaw bones of amphibians and reptiles resulted in yet another unique mammalian structure, the presence of three tiny, sound-conducting bones in each middle ear: the incus, malleus, and stapes. Further, a bony shelf or secondary hard palate separating the nasal passage from the mouth typifies mammals. Crocodiles and alligators are the only other animals that have a hard palate resembling that found in mammals.

With the exception of the monotremes, anteaters, pangolins, and baleen whales, all adult mammals have teeth. Mammalian teeth are set in sockets, occur in two developmental sets—namely deciduous and permanent teeth—and are differentiated into four different types adapted for assorted functions. The four types of teeth are incisors, canines, premolars, and molars. Teeth of mammals are often described numerically in a “dental formula.” This formula describes the upper and lower dentition of the jaw and is useful in identifying mammals when only the skull is available for study.

A combination of other anatomical characteristics helps to distinguish mammals from other vertebrates. Mammals have:

- A muscular diaphragm separating the lungs from the abdominal cavity.
- A four-chambered heart in which the aorta, the large vessel that carries blood away from the heart, turns to the left. (In birds, the aorta turns right; reptiles have two aortas, a left and a right.)
- Nonnucleated mature red blood cells. Because they are generally bioconcave discs, the red blood cells have a greater surface area available to transport oxygen to the tissues. As a result, these cells greatly aid in permitting the high levels of activity necessary for the survival of mammals.
- Seven cervical vertebrae. Exceptions are the manatee (*Trichechus*) and the two-toed sloth (*Choloepus*), which have six; the anteater (*Tamandua*), which has eight; and the three-toed sloth (*Bradypus*), which has nine.
- A double occipital condyle forming the articulation for the skull upon the first vertebra of the neck.
- A phalangeal formula (the number of bones in the fingers and toes) of 2-3-3-3-3 (two bones in the thumb, or the big toe, and three bones in each of the other digits).

- Limbs positioned directly below the body instead of sprawling to the side as in reptiles.

Finally, the brain of mammals is greatly enlarged, and its complex anatomy permits efficient processing and integration of information. Because of the well-developed learning centers in the brain, mammals show the greatest degree of individual variability of behavior and the most sophisticated learning ability of any animal.