

LESSON 1 INTRODUCTION – OVERVIEW OF UNGULATES

Ungulates are mammals which have hoofs, or structures like hoofs, on their toes. A hoof is simply an enlarged toenail. All such animals belong to the taxonomic group “Ungulata”.



Hippopotamus (*Hippopotamus amphibius*)

INTRODUCTION

There are two parts to a hoof:

- The ‘unguis’ - a scale-like plate that forms the top layer and which is exposed to the air. In humans, the hard part of the finger nail is the unguis.
- The ‘sub-unguis’ - a soft layer between the unguis and the tissue of the digit (a finger, thumb or toe).

Non-ungulate mammals may have claws or fingernails instead of hoofs. The primary difference between ungulates and non-ungulates is whether or not the unguis is used in walking. In ungulates,

the unguis is the primary point of contact with the ground. In non-ungulates, other tissues, such as the pads of the feet, provide the primary contact point when walking.

The hoof is basically modified epidermis and this consists of keratin, which thickens and hardens the hoof. There are a variety of ungulate ‘hoofed’ animals, and each has different hoofs. Hoofs continue to grow; in wild, hoofed ungulates length is managed by daily foraging and walking. Domesticated animals tend to stand around longer, and do not have access to enough room to be able to keep their hoofs down naturally, so may require hoof maintenance which their wild counterparts do not.

In some ungulates, the pads of the feet, behind the hoofs will touch the ground. In others, these pads do not touch the ground. Either way, it is the hoofs that carry most of the weight of the animal and as an adaptation this brings a range of benefits to hoofed animals.

Hoofs play a variety of roles including; shock absorption from the ground, weapons for protection, and tools for digging. Many ungulate mammals run (deer, horses), or carry significant weight loads (elephants, hippopotami), and hoofs help reduce damage to the foot through shock absorption. They can also serve protective functions for the foot. Some ungulates also use hoofs for digging and foraging to locate food and water. Defensively, hoofs are used both within a given species, and to defend against predators.

Digestion

Most ungulates are herbivores, with the exception of pigs and peccaries which are omnivores that eat small rodents, insects, and bugs. The majority of ungulates have evolved their digestion in a way that allows them to decompose chemicals in plants which other types of animals may find difficult to digest. Although not all ungulates are ruminants, many – including hyraxes – have multi-chambered stomachs which help digest this plant matter. All perissodactyl (odd-toed) ungulates are known as hindgut fermenters, and they have a simple stomach with a lot of the digestion taking place in the caecum. The digestive tracts of most ungulates (except pigs), are specifically designed to digest nutrients from plant materials, and contain microbes which

assist in the breakdown of cellulose for fermentation to occur.

Ruminants are a good example of animals with such multi-chambered stomachs, and they usually have four chambers to assist in digestion of plant material. The food passes through these four chambers gradually to fully allow digestion to take place. Once ingested and chewed, the food passes down the oesophagus of the ruminant species, then into the first chamber of the stomach, known as the rumen. It then follows into the reticulum, the omasum and then the fourth chamber, the abomasum. The first three chambers digest the carbohydrates, and quite often the food is regurgitated to be chewed and then swallowed again for added digestion. Once the food passes through the four stomachs, it then enters the duodenum, the first section of the small intestine. Camelids all have a three-chambered stomach which works in the exact same way as a four, and are also able to ruminate.



Cow Grazing

Suggested Tasks: ▼

Throughout this course you will be provided with suggested tasks and reading to aid with your understanding. These will appear in the right hand column. Remember: these tasks are optional. The more you complete, the more you will learn, but in order to complete the course in 20 hours you will need to manage your time well. We suggest you spend about 10 minutes on each task you attempt, and no more than 20 minutes.

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Suggested Tasks

Ungulates consist of two groups of animals - odd toed ungulates and even toed ungulates. And there are more even toed ungulates than odd toed ones.

Take a guess at how many species of odd toed ungulates and even toed ungulates there are, and write down your answers.

Now go online and search to see if you were close. Search using phrases such as “list of ungulate animals”, “how many species of ungulates are there?” or “number of ungulate animal species”.

Are you surprised by what you found?

In perissodactyl species the digestive system consists of a simple stomach which consists of walls made up of involuntary muscle. Food enters the stomach to be processed, then passes into the small intestine. Sphincters, on both the entrance and exit to the stomach, contract and relax to control the flow and passage of food. The lining of the stomach contains gastric glands which are lined by three types of cells: chief cells which produce digestive enzymes; mucous cells which produce

a thick, sticky fluid; and parietal cells, which produce hydrochloric acid to assist in protein digestion.

All ungulates have teeth which are specialized for chewing plant material. They have large, square molars and incisors designed to pluck and tear plant matter. Their jaws are modified to allow lateral (side-to-side) movement, as well as up and down movement for maximum grinding action.



Gerenuk (*Litocranius walleri*)

Behaviour

Most species exhibit typical foraging behaviours, even when not in need of food. Domestic animals, for example, are fed regularly yet will still spend a lot of time moving about in their enclosure as if they are foraging. Some ungulates

exhibit grazing behaviours, feeding on grasses, and they will graze for long periods of time. Other ungulates are browsers and these feed on shrubs, trees, vines and fruit. Giraffes are a good example of a browser, and deer are a good example of grazing behaviours. Ungulates spend much

GRANDORDER: UNGULATA

Ungulates are all classified within the grandorder, *Ungulata*. Ungulates have evolved features that are adaptive for life on open grasslands. A good example is long legs which help them run away quickly from predators. To lengthen the legs, ungulates evolved unguligrade locomotion. In this type of movement, only the hoof is in contact with the ground. This type of motion is a specialised feature of running animals, including horses and deer.

It is important to remember that the hoof is essentially a toe tip, part of an anatomically enlarged toe. Deer, sheep, and goats walk on two toes; rhinos, tapirs and some extinct horses walk either on three toes or on one toe (living horses). The remaining toes not used for walking are either reduced, as in pigs and tapirs, or completely lost, as in rhinos and most ruminants.



Goat (*Capra hircus*)

of their time feeding to obtain all the nutrients they can from the plant materials, and even the omnivorous pigs and peccaries spend most of their time foraging for roots and insects. Weaned infants commonly exhibit oral activity such as chewing.

Social behaviours of ungulate animals vary between species, and are not solely related to the evolution or biology of the animals. Ecological factors also play a part in ungulate social groupings.

Reproductive behaviour of ungulates varies between species but they do exhibit some similarities. Both male and female must have full sexual intercourse for reproduction to occur, and all ungulates are eutherian (previously known as placental) mammals. Therefore, the female will give birth to live young, and the offspring are raised and nursed with milk which is secreted from the mammary glands.

The Ungulate Brain and Behaviour

The ways in which ungulates use resources (e.g. for food and shelter) are relatively simple across all ungulates; but social behaviours are extremely varied. Some ungulates have far more complex social behaviours than others and brain size tends to be greater in these animals.

Ungulates in the wild typically feed by foraging. Domestic and captive animals, which lack the opportunity for wider foraging, often display abnormal oral behaviours such as biting, chewing, and tongue rolling.

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Suggested Tasks

Which ungulates do you think are amongst the fastest land animals?

Write down three possibilities and then check online to see if you were right.

Try searching for “world’s fastest hooved animals”, “top 10 fastest land animals”, or use a similar phrase.

The other major types of movement are plantigrade and digitigrade. Humans are plantigrade, with the heel striking first in each stride. Bears, opossums, racoons and most other vertebrates that walk but seldom run are plantigrade. Conversely, running dinosaurs, birds, carnivores and extinct ancestors of hoofed mammals use digitigrade movement, increasing leg length by standing on and walking on their digits – that is, toes or fingers.

All animals in the grandorder *Ungulata* have hoofed feet, except for those which are aquatic (the Cetaceans, which include dolphins, and the Sirenes, which include manatees).

There are seven separate orders as follows:

- **Artiodactyla** - includes: Hippopotami, Deer, Giraffe, Sheep, Cattle, Antelope, Camelids
- **Cetacea** - includes: Dolphins, Porpoises, Whales

- **Perissodactyla** - includes: Horses, Rhinoceroses, Tapirs
- **Tubulidentata** - includes: Aardvarks
- **Hyracoidea** - includes: Hyraxes (or Conies)
- **Proboscidea** - includes: Elephants
- **Sirenia** - includes: Manatees and Dugongs

As with many biological specimens, the taxonomy – or classification – of ungulates changes according to recent discoveries across fields such as evolutionary biology and genetics. Recent research suggests that cetaceans (dolphins, porpoises, and whales) may have evolved from artiodactyls (even-toed ungulates). Fossil evidence supports the possibility of a shared ancestor and, as such, some scientists now use the super order, *Cetartiodactyla* to demonstrate this relationship.



Antelope are one of many Artiodactyl ungulates