MAMMALOGY

THE STUDY OF MAMMALS

The Class Mammalia, first named by Carl Linnaeus, is not the newest of the classes in which we are interested; Class Aves, the birds, is. The fossil record shows only a few scattered forms clearly identified as mammals as far back as the upper Triassic Period, perhaps 200 million years ago. The earliest of these are only fragmentary remains and still subject to dispute among paleontologists. Since the ruling reptiles (dinosaurs, etc.) still had the Jurassic and Cretaceous periods to be the dominant animal forms on earth, the early mammals were small, obscure, and very primitive by comparison with modern mammals. The rapid extinction of the great reptiles at the end of the Cretaceous period seems to have stimulated rapid and revolutionary development of the mammals, and the ensuing Cenozoic Era has, in fact, been referred to as the "Age of Mammals". New species of mammals began to occupy the environmental niches vacated by the dinosaurs. From the beginning of the Paleocene Epoch, which began the Cenozoic Era, about 65 million years ago, an explosive distribution of mammals into nearly every available habitat has been accompanied by the burgeoning of a fantastic variety of orders and families. Some were unable to survive competition or environmental changes and are now extinct. However, the best estimates of living mammalian species, puts the total number at about 4,500, now distributed around much of the earth.

The current theory is that the earliest identifiable mammals were tiny, shrew-like mammals and emerged during the late Triassic period. Mammal ancestors were mammal-like reptiles (synapsids) that were around about the same time as the emergence of dinosaurs. Synapsids were distinguished by having extra openings in the skull behind the eyes; this opening gave the synapsids stronger jaw muscles and jaws than previous animals. Synapsids eventually gave rise to the early therians who diverged into the three divergent lines of the monotremes, marsupials and placental mammals, which still exist today.

IDENTIFYING CHARACTERISTICS OF MAMMALS

Although some confusion did exist in human understanding of the animals, all modern forms of mammals are known to show the following features:

A. Presence of **hair** at least in some phase of the life cycle, even in small amounts. The whales (Cetacea) are the only unusual group in this respect; they may have only a few bristles around the mouth, and perhaps only in the embryonic stage.
    1. Hair is a specific type of structure growing out of a follicle in the skin; it is unique to mammals and never encountered in any other animal. There is the occasionally confusion in cases such as the 'hairy frog" which does not have hair!
    2. Specific names have been applied to various special types of hair: fur, quill, wool, bristle, whisker, etc., but they are still hair or "pelage".

B. A variety of well developed **dermal glands**, including the following:
    1. Sweat glands for production of perspiration for temperature control. They are possessed in varying degrees and sometimes in limited areas of the body.

2. Sebaceous glands for production of waxy or oily secretion for the purpose of lubricating and softening the skin, waterproofing the skin, hair, etc.
3. Scent glands for production of odorous substances for purposes of defense, courtship, territorial marking, etc. As one would suppose, a very good sense of smell, normally, allows the mammals to get the appropriate information from these odors.
4. Mammary glands for the production of milk to feed the newborn offspring, for varying periods of time until weaning, depending on the species.
    a. Only functional in the female during the time of lactation. Males have non-functioning mammary glands.
    b. Milk varies greatly from order to order. Varied proportions of lipids (fats), casein (protein), lactose (sugar), and minor other components in different animals. For example, cow's milk, rich in lactose (4%) is unsuited for young marine mammals, who normally nurse on milk which is about 50% lipid, but has little sugar. Cow's milk is about 4% lipid.
    c. Most mammals have localized structures called nipples, teats, etc., which may be united in an udder. The only major exception is the order Monotremata (duck-billed platypus and echidnas) which has the mammary glands diffused all over the entire abdomen, from which the nursing young licks the milk off the skin and hair.
    d. Other forms of so-called milk are not scientifically named: "pigeon milk", "coconut milk", etc., which had some fancied similarities to the real thing.

C. **Homeothermic** (endothermic, constant body temperature), a trait shared with birds (Class Aves).
1. The advanced four-chambered heart, with the lung circulation separated from the body circulation, makes possible the high metabolic rate to maintain a stable body temperature, not subject to variation due to external changes. The opposite is the case in the poikilothermic or ectothermic animals: fish, amphibians, reptiles and all other lower classes.
2. The body temperature of various orders are close to 100*F (38*C) and will seldom vary more than a degree or so in a healthy animal. Internal controls vary the metabolic rate and cooling devices (sweating, vasoconstriciton, and vasodilation, etc.). Some behavior contributes as well. There is little variation regardless of the environmental temperature. Some animals such as dogs, cats, goats, and others have normal temperatures a few degrees above those cited. Others, including all marsupials, and particularly the monotremes, may be somewhat lower and may even fluctuate.
3. With few minor exceptions, temperature control in the mammals is internal and automatic although some behaviors (panting, sunbathing, swimming, wallowing) assist the animal in maintaining its body temperature. The animal can only function well within a limited range of internal temperature. To exceed these limits in either direction may be very harmful (hyperthermia = too high; hypothermia = too low). A constant body temperature is maintained by a delicate balance between heat production and heat loss. Since maintaining this constant body temperature requires high energy expenditure, the endothermic animal must eat more than the ectothermic animal. It is the endothermic animal's ability to internally regulate its temperature, however that allows it to remain active in winter and to exploit habitats unavailable to the poikilotherms. No poikilotherms can live in extremely cold areas because they are dependant on the environment to maintain their body

temperature. Unlike the moniotherms, they do not have an internal ‘”furnace”. Thus, a lizard is very sluggish on a chilly morning. Not until it can “sun” itself and bring its internal temperature up can it search for and digest a meal.

4. The requirement for a stable temperature supported by metabolism of food is a significant factor in size limitations of mammals because of the operation of the proportional rule relating size to weight (sometimes called the 3/2 Power Rule). A very small animal has a disproportionately large surface area when compared to an otherwise similarly shaped animals which is considerably larger. This increased surface area may cause such rapid heat loss that the animal’s metabolism cannot keep up with it, so the animal dies. Thus, a tiny shrew, possibly the world’s smallest mammal, can starve to death in just a few hours, and cannot tolerate too cold an external temperature. If the whale did not have the ocean to cool it, it would overheat.
5. Means of internal temperature control (physiological or behavioral)
    a. Insulation by hair or blubber
    b. Vasoconstriction: pores close and capillaries constrict. This tends to reduce the surface loss and reserves the circulating blood for the most essential parts of the body, which cannot be deprived for long without serious harm (ie. the brain). This is controlled by the autonomic nervous system.
    c. Shivering: automatic behavior with some effect in increasing heat by making muscles work more than usual. This is controlled by the autonomic system.
    d. Behavior: conscious acts to favor whichever temperature is needed; seeking shelter or altering body surface by curling up to conserve heat or stretching out, swimming, or wallowing to cool off.
    e. Sweating, panting, or bathing to utilize cooling effect of evaporation. Some mammals lick themselves to gain this effect (hedgehogs, kangaroos). Panting is “oral sweating”.

(Mnemonic for mammal characteristics - **WHALE**: **W**arm blooded, **H**air or fur, **A**ir to breath, **L**ive birth, **E**ats mom’s milk)

Rules of Environmental Adaptations

The ability of mammals to live in harsh environments is due largely to their ability to use ***homeothermy***; the regulation of a constant body temperature by physiological means. Mammals must maintain a delicate balance between heat production and heat loss to survive. Most heat is lost near a body's surface. Thus, the less surface area a body has *relative to its total size* the less heat it will lose from its surface. Larger mammals have less heat loss than small mammals because of their large body mass relative to surface area.

In cold climates, the greater the exposed surface area, the greater the loss of heat and therefore energy. Animals in cold climates need to conserve as much energy as possible. A low surface area to volume ratio helps to conserve heat, as there is a smaller surface area for the heat to pass through.

In warm climates, an animal will overheat quickly if it has a low surface area to volume ratio. Therefore, animals in warm climates will have high surface area to volume ratios so as to help them lose heat.

Bergmann’s rule states that species of larger size are found in colder environments, and species of smaller size are found in warmer regions.

Allen's rule states that the appendages (arms, legs, ears, and nose) of endothermic animals are relatively shorter in colder climates than those of equivalent animals found in warmer climates.

ADAPTATION TO PHYSICAL ENVIRONMENT AND METHODS OF LOCOMOTION

A. **Aquatic** – may be divided into riverine, estuarine and marine, but not necessarily. More or less equipped for life in fresh, brackish or ocean waters. The body is streamlined for speed; appendages are either modified for swimming or lost altogether. Insulation is provided by fur an/or a thick layer of blubber.
    1. **Order Cetacea** (whales, dolphins, porpoises) – most completely modified. Hind limbs lost except for vestigial bones buried deep in the body. Body had become torpedo-shaped and hairless for efficiency in swimming; with horizontal tail flukes (without bones) for power. Many species have evolved to enormous size resulting in the largest animals that have ever lived (i.e. blue whale). Some have lost all teeth and eat small crustaceans in enormous quantities by "filter-feeding" through baleen ("whalebone").
    2. **Order Sirenia** (manatees, dugongs) – totally aquatic, but only superficially like whales. By the process of convergent evolution, have also lost hind limbs and gained tail of horizontal flukes. Exclusively herbivorous, sluggish and unintelligent. Inhabit fresh estuarine and coastal ocean waters. Fossils show ancestry related to the elephant. Living species limited to tropical or subtropical waters.
    3. **Order Pinnipedia** (seals, sea lions, walrus) – only partially adapted to water, still capable of coming up on land, although very clumsily. Show close connection with land carnivores and are exclusively carnivorous as are the whales. All four limbs are still functional in water; less so on land. Living species mostly limited to cold temperature or polar waters.
    4. Scattered examples from other Orders, less completely modified in anatomy and behavior, perhaps in evolutionary process of becoming more completely aquatic. Sizes range from large (polar bear) to medium (sea otter) to small (muskrat) to very small (water shrew and water vole).

B. **Burrowing or Fossorial.** Modified to spend much or all of its life underground. Development of powerful shoulders, short limbs and strong digging claws. Sense of vision is poor (in one obscure group of mole rats, *Spalax* spp., sight is lost altogether). Some dig extensively and almost continuously in search of food. Others dig extensive burrows in which they live, rising to the surface to seek food. Examples of the first type are moles, gophers, mole rats; the second type are ground squirrels, badgers, wombats, and aardvarks.

C. **Arboreal**. Body modified to facilitate spending much or all of life in trees: strongly prehensile hands and feet (most primates0, sharp claws for climbing bark (tree squirrels, martens, etc.) or massive, thick claws for hanging inverted (sloths). Most have good binocular vision for judging distance efficiently. Some have prehensile tails strong enough to support the animal (many neotropical monkeys, porcupines, opossums and one carnivore, the kinkajou). Many Asian and Australian examples: cuscuses, phalangers, and binturongs. Some so thoroughly adapted as to be almost helpless on land (sloths, pygmy anteater).

D. **Aerial**. Bats, the only mammals with true powered flight, and various other types which have gliding or "volant" flight: flying squirrels (Rodentia), flying lemurs (Dermoptera), gliders and flying possums (Marsupialia). Bats spend most waking periods in flight;

sleeping or hibernating while hanging inverted. Others use gliding flight mainly as a defensive escape, occasionally to reach a different tree for food.

E. **Arid**. Kangaroos (Marsupialia), camels and gazelles (Artiodactyla, kangaroo rats (Rodentia) and others. Effective water conservation by some or all of these means: utilization of metabolic water derived from dry carbohydrate foods; concentration of urine by very efficient kidneys to minimize loss, tolerance of elevated internal temperature to reduce need to sweat; light coloration of hair to minimize absorption of solar energy; behavior to minimize exposure to sun (use of shade, nocturnal activity, burrowing, etc.) Human groups, which have adapted to arid hot deserts have done so by developing behavior patterns rather than by physiological modifications. Thus, Sahara Arabs wear long flowing robes as insulation from solar heat; African Bushmen and the Aborigines of Australia are skilled at finding and conserving very scarce water.

F. **Arctic**. Modified body and/or behavior to permit survival and growth in depths of Arctic sub-zero temperatures for the length of the winter. (No land mammals in regard to the Antarctic). All Arctic mammals are white or change to white for winter camouflage. Many small forms hibernate or remain in snow tunnels and burrows all winter. Larger forms can maintain body temperature because of effective fur (polar bear, arctic fox, and arctic hare). Lemmings and ground squirrels remain in shelter. Short appendages reduce heat loss (Allen's rule).

G. **Cursorial Gait**. Land animals with body modified for maximum running speed in open, flat ground. Most involve evolutionary loss of some articulations of limb bones and fusion or loss of bones such as the ulna or fibula. In most cases, there is a reduction in the number of digits from primitive five to as few as one. Limbs have become longer with main muscle masses close to the body so that only light, thin limbs have to be moved while running. Limbs, generally restricted in flexibility of movement, swing only front to rear rather than in all directions. This minimizes injuries such s sprains and dislocations from running. Small animals are rarely considered to be in the group. Rabbits and some rodents are fast runners but have little special modification. Best examples are among the ungulates: horse (Equidae) gone to the minimum of one functioning toe on each limb (hoof, "toenail", digit III), most deer (Cervidae), many antelope (Bovidae) and the pronghorn (Antilopridae). The last named three families (Artiodactyla) have only two digits effective as major supports (III and IV). However, digits II and V may still be present although reduced. The only good example in the Carnivora is the cheetah (*Acinonyx jubatus*), the only animal fast enough to chase the pronghorn and catch it. Fortunately for the pronghorn, the two species live on different continents so they never meet! The Canidae are behaviorally adapted to the cursorial chase of prey but show less anatomical changes and are more persistent than speedy. A few examples include species called "cursorial" but only in a broad sense: greyhound and whippet (domestic dogs) and the patas monkey (*Cercopithecus patas*).

H. **Saltatorial Gait**. Land animals modified for rapid movement by a leaping gait; some capable of tireless long distance speed. Modifications require greatly developed hind legs and strong, heavy tail for a counterweight. The forelegs are simultaneously reduced in size and play little or no part in fastest motion. Obvious examples are the large kangaroos of Australia (mostly *Marcopus* spp.) and also rodents. The jerboas (Dipodidae) of the Old World and kangaroo rats (Heteronyidae) of the New World show an excellent model of convergent evolution. Note that many of the Lagomorpha (rabbits and hares) are often thought of as hopping, but their full-speed gait, rapid though it is, uses all four feet. In fact, the Arctic hare (*Lepus arcticus*) when in full speed-running will occasionally rear up and run bipedally for a short distance before resuming its normal gait.

I. **Variations in Foot Form**; Adaptations to gait and function. Since its derivation from the reptiles, the basic pattern of paired fore and hind limbs (arms and legs), each with five digits, has undergone evolutionary change to accommodate different modes of locomotion. Extreme cases have been mentioned above; the bats (Chiroptera) for flying the whales (Cetacea) for swimming, among others. The feet of land animals can ordinarily be classified in one of the following forms, usually indicative of the animal's way of life and manner of movement:

1. **Plantigrade** (Latin: planta – sole and gradi – to step): walking with weight supported from heel to toes; with the hind foot (pes) flat on the ground. The digits may be reduced in number. Examples are many, including: bears, primates and elephants. The term may also be applied to the forefoot (manus) or it may be called "palmigrade" (Latin: palma – palm of hand).
2. **Digitigrade** (Latin: digitus – finger or toe): walking with the weight supported by the toes and fingers (as far back as the metapodial-phalangeal joints), all usually called "toes" in quadrupeds other than the primates. Examples are among the most familiar such as dogs, cats, etc.
3. **Unguligrade** (Latin: ungula – hoof or nail): walking with weight supported by the hooves (equivalent to the toenails and fingernails) with the digits more or less vertically arranged and not normally in contact with the ground. Best examples are the horses (the one hoof is equivalent to the nail of Digit III) and most of the Artiodactyla (pigs, deer, giraffes, cattle, etc.) but not necessarily all of them. The hippopotamuses carry their weight on a fleshy foot, which really rests on the bones, so hippos are plantigrade. The very heavy quadrupeds (elephants, hippopotamus and rhinoceros) may be referred to as "hoofed" but actually have merely massive nails which do not support their weight. They are better thought of a "graviportal" (Latin: gravis – heavy and portare – to carry) and have very strong, short limbs. The hippos and rhinos are still classified as hoofed animals because other details of their anatomies and the fossil record of their ancestry clearly puts them with the more typical Artidactyla and Perissodactyla, respectively.

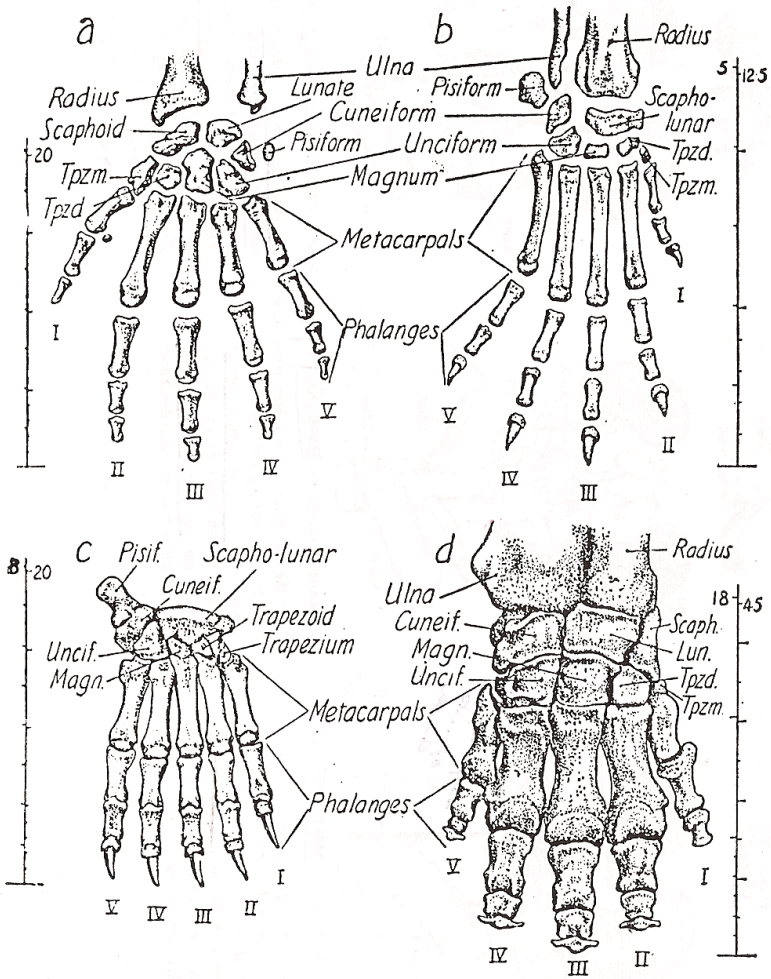


FIG 43. Dorsal view of the manus of: (a) man, (b) dog, (c) bear, (d) elephant. The right extremity in all cases save (a). The bones are separated in (a) and (b) for clearer illustration.

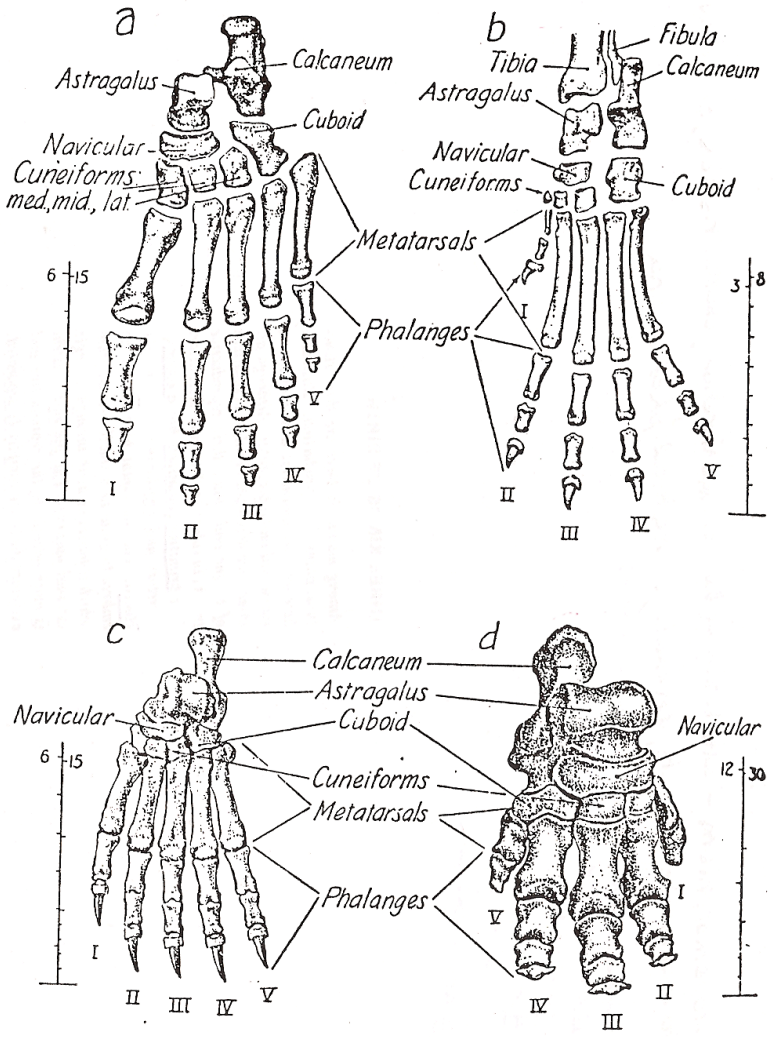
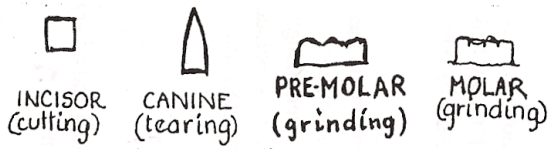


FIG 49. Dorsal views of the bones of the left pes of: (a) man, (b) dog, (c) bear; and of the right pes of (d) elephant.

SKULLDUGGERY AMONG THE MAMMALS

or Food-Getting Adaptations

Tooth and jaw structure tell us so much about the eating habits of mammals that a good student can tell by the skull alone what animal it belongs to. Each species has its characteristic dentition ("arrangement of teeth," cf. "dentist"): combinations of the following:



The teeth of mammals are adapted in different ways to get food.

HERBIVOROUS

grinding molars
clipper-like incisors
no canines

Gnawers of seeds, roots, and stems. **Rodents**

Field mice and **woodchucks,** like all rodents, have long incisors, and a space between the incisors and molars. The chewing area can be closed off by a fold of skin for food storage.

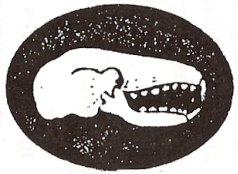
Stem croppers. Ungulates ("having hoofs")

Cows and **deer** have no upper incisors. They tear grass with lower teeth and lips against the upper roof plate. **Sheep** and **goats** have similar dentition, but crop the grass closer as their jaws are narrower, and lips thinner. Sheep are not popular on cattle ranches!

Horses bite grass stems. They have both upper and lower front teeth.

INSECTIVOROUS

All teeth sharp-pointed, suitable for catching, holding and cutting prey.



Insect Eaters. Insectivores

Insects are attracted to plants of the fields and grasslands, and they, in turn, attract **moles** and **shrews.** These animals have a battery of small teeth useful in seizing and crunching hardshell beetles and other small fry.

Toothless. Some Mammals don't have any teeth. They feed primarily on insects such as Ants and Termites. Examples: Pangolins and True Anteaters.

CARNIVOROUS

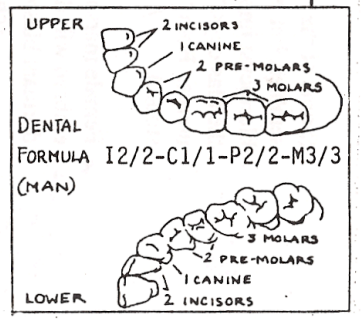
sharp molars for tearing and cutting,
canines for slashing.

Meat Eaters. Carnivores

Field mice, moles, and shrews attract **foxes,** who feed on them and on rabbits, abundant in grassy meadows. Foxes have teeth equipped to handle meat. The canine teeth help seize and tear prey.

OMNIVOROUS

Such animals as **opossums, skunks, coons,** and **man** are omnivorous; literally eating anything. This broad diet is reflected in the teeth which are less specialized than in most mammals.



Dentition is expressed in a dental formula. The example given means that in one-half of man's jaw, from front to back, there are 2 upper and 2 lower incisors, 1 upper and 1 lower canine, 2 upper and 2 lower pre-molars, and 3 upper and 3 lower molars.

Summary of Mammalian Reproduction

A. Necessary conditions for successful reproduction

1) Two sexes, compatible individuals in good health.
2) Appropriate number mix of sexes: Some species are monogamous for life, some are monogamous for one season while others produce best in a harem situation, having a single male to impregnate up to several dozen females, but only as long as the male can continue to maintain his dominance and reproductive monopoly before being ousted from his position by younger and stronger males.
3) In most species, females are only receptive to the male during restricted periods. Sometimes the male may also have a yearly cycle, but the female is, in most cases, the governing factor. The frequency and regularity of the female estrus cycle differs among the Order, Family and even Genus:
    a) **Monoestrous** - regularly one estrus per year (bears, deer).
    b) **Polyestrous** - regularly more than one estrus per year (llamas, primates and many domesticated animals in contrast with their wild ancestor etc.).

B. Major variations on the pattern - exceptions

1) Subclass Prototheria, Order Monotremata (platypus and echidna) are the only egg laying (oviparous) mammals (very similar to reptiles). They are unusual in many anatomical details as to be separate from all other mammals. They have a cloaca like birds and reptiles. The male fertilizes the female with a penis normally retained within his cloaca. Her two separate uteri open into her cloaca. The egg(s) incubated by the female in either a temporary abdominal pouch (echidnas) in an underground nest (platypus). When the eggs hatch, the young nurse by licking milk from the fur and belly of the mother until they are old enough for the adult fare of insect and worms etc. There are no teats/nipples – only mammary glands.
2) Subclass Theria, Infraclass Metatheria, Order Marsupials (pouched mammals). This order is **viviparous** (bearing live young) but the infant (joey) is in a very embryonic state. Born in a more or less conventional manner, the joey must travel unaided from the opening of the cloaca, up to the abdomen, to the pouch (marsupium). Where it finds a mammary nipple to fasten on. There the development continues until the young is sufficiently developed to leave the pouch and live outside. Some species such as the kangaroos and their near relatives (all from the Australian region) have single births since the growing infant is, sooner or later, is all the mother's pouch can hold. Others. Such as the American opossum, are more productive, with litters numbering more than a dozen. Those infants unable to reach a nipple are doomed. Some species, generally the very small ones such as the Mouse opossum of the Neotropic Region as well as some Australian types, are so small that they lack a pouch, so that the young merely hang on to the nipple and 'dangle'.
3) The phenomenon of ***delayed implantation*** is observed in several different taxa. The development of the fertilized egg is suspended at approximately the <u>blastocyst</u> stage (consisting of about 100 cells formed by about 5 or 6 splittings) and remains dormant in the fallopian tube for about 3 months until stimulated by hormones to resume the trip to the uterus, where the normal implantation and continued development occurs. The phenomenon of delayed implantation is of the greatest importance to species in which the sexes meet only for a limited time each year or if births must be carefully timed to meet the season when food is most abundant. The best examples are seen

in the bears of the North Temperate Zone (polar, brown and Asiatic black, etc.). Pinnipeds (sea lions, elephant seals, and true seal, etc.) that lead solitary lives all year except for the breeding season. The phenomenon is also noted in smaller Carnivora, primarily the Order Mustelidae (weasels, skunks, etc.) for essentially the same reason: the female must delay the birth of her offspring until the most advantageous time.

4) Some marsupials display a phenomenon called **embryonic diapause,** which resembles, but is not the same as delayed implantation. With embryonic diapause, the blastocyst imbeds in the uterus then becomes dormant while in delayed implantaion, the blastocyst's implantation is delayed for about 3 months and then it imbeds in the uterus. Both "phenomenon" appear to be regulated by hormones but neither is well understood.

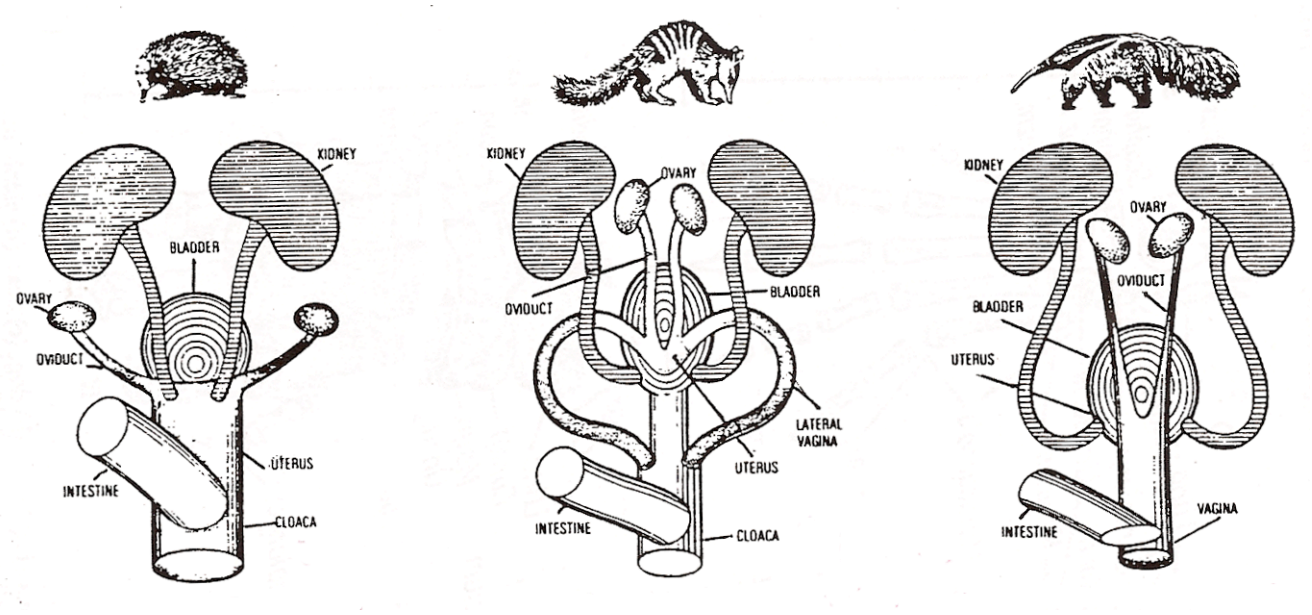
   Female marsupials have a double uterus and may be impregnated in both uteri, but only one embryo will develop. If that young should be lost either before or after birth the remaining dormant blastocyst will resume growth. This phenomenon is not specifically adapted to the yearly schedule.

C. The placenta is the key evolutionary adaptation that permits a long period of intra-uterine development (up to 22 months or so in elephants) and thus the birth of well developed infants. Although the difference is not absolute, species are commonly divided as to either their young are:
   1) **Altricial**: born in a relatively undeveloped state: eyes closed and/or ears not yet functional; hair or fur not sufficient for unprotected life; coordination and strength poor and requiring considerable growth; basically a great dependence on support and care by one or both parents. Examples include cats, dogs, mice and primates.
   2) **Precocial**: born in a relatively well-developed state, capable of running shortly after birth; hair or fur sufficient for independent survival in the environment; rapidly independent of mother, possibly taking solid food within a few days even though still nursing part of the time. Examples include horses, antelope, some of the larger rodents (porcupine, guinea pig, capybara, etc) and many others.

D. Zoo's interest in captive reproduction.
   1) Importation of wild caught specimens is expensive, time consuming and a very closely regulated process. Captive bred animals are much easier to obtain.
   2) Concern for endangered and threatened species makes it desirable to try and avoid wild caught individuals except to add vigor to the captive gene pool. Careful system of "stud book" or lineage records can minimize inbreeding dangers.
   3) Observation of captive animals has produced useful research information not otherwise easily obtained. This can aid in improving even the wild population since these are often difficult to observe. One example is that many wild animals are either nocturnal or crepuscular; these conditions are difficult even for modern photographic techniques.

THREE KINDS OF MAMMALIAN BIRTH

Among mammals there are three structural plans for reproduction, illustrated here by three anteaters: a monotreme, a marsupial and a placental. Although all three have developed similar adaptations of tongue and claw, their reproductive tracts are basically dissimilar. The primitive monotreme has a common excretory and egg-laying opening, the cloaca. The marsupial plan allows an embryo to grow in small uterus, from which it passes at birth through a single external opening. The placental system is more advanced; the reproductive and excretory ducts are completely separated.



SPINY ANTEATER: **MONOTREME**

The monotreme egg is formed in the ovary, then passes rather slowly through the oviduct, its leathery shell being formed along the way. By the time the shell is complete, the egg reaches the uterus and is quickly born via the animal's cloaca.

BANDED ANTEATER: **MARSUPIAL**

After the marsupial egg has been fertilized by sperm passing through a lateral vagina, it grows in the central uterus. The embryo then breaks through the uterine wall and passes through the cloaca. Afterward the temporary break heals over.

GREAT ANTEATER: **PLACENTAL**

Placental development takes place in a central uterus, which expands markedly to accommodate the embryo as it grows. This allows it to attain greater development before birth, which takes place through a separate opening, the vagina.

ORDERS OF MAMMALS

The class Mammalia is divided into scientific Orders. While the classification of mammals at the family level has been relatively stable, higher levels such as orders has been changing due to more recent molecular genetics evidence. The number of mammallian orders differs depending on the source. For example Cetartiodactyla is used by some to include the even-toed hoofed mammals and the whales.

Order Monotremata (MON-oh-tree-MAH-tuh)
A monotreme lays eggs. Each egg hatches into a young animal that laps milk from pores on its mother's belly. (echidna, also called spiny anteater and platypus).

Order Marsupialia (mar-SOO-pee-AY-lee-uh)
Marsupials usually have pouches. These animals give birth to tiny, underdeveloped young. This is an extremely diverse order, which some scientists consider several orders. (**See NOTE in Marsupialia Study Guide**.) (rat opossum, true opossum, quokka, sugar glider, Tasmanian devil, marsupial mole, numbat, cuscus, bandicoot, koala, wombat, kangaroo and wallaby).

Order Insectivora (in-sek-TIH-vor-uh)
Insectivore means "insect eater". Most insectivores have long, narrow snouts and sharp claws that are well-suited for digging for food, usually insects. (mole, shrew, hedgehog, tenrec).

Order Macroscelidea (ma-kroe-she-LIH-dee-yuh)
Elephant shrews tend to be active in thornbush country, grass plains, thickets, and rocky outcroppings during the day in mild to cold weather. However, they are nocturnal during hot weather, moonlit nights, and when being harassed by diurnal (day-active) predators. They have large hind legs and naked tails.

Order Dermoptera (der-MOP-ter-uh)
A dermopteran glides from tree to tree. It does this by stretching well-developed folds of skin that extend from the sides of its neck to all four feet and that enclose its tail. (colugo or flying lemur).

Order Chiroptera (ki-ROP-ter-ruh)
A chiropteran is a winged mammal, the only kind of mammal that actually flies. (bat).

Order Scandentia (scan-DEN-tee-uh)
Tree shrews resemble long-snouted squirrels, but there is an absence of long whiskers (with the exception fo *Ptilocercus*, the pen-tailed tree shrew), and they have bar-bottom feet with tubercle-like pads to aid them in climbing. They are believed to be closely related to the primates. They are identified by their naked tails with long white hair on the end.

Order Primata (pree-MAH-tuh)
Primates have the ability to grasp with their fingers. They have hard nails on some of their fingers. They have forward facing eyes and can see objects in three dimensions. Some have highly developed brains. (lemur, aye-aye, loris, potto, tarsier, marmoset, monkey, baboon, gibbon, gorilla, chimpanzee, orangutan and human).

Order Pilosa formerly members of **Xenarthra** (zee-NAR-thruh) or sometimes called **Edentata** (ee-den-TAH-tuh) with the armadillos. Edentata means "without teeth", but all edentates except

anteaters do have small teeth, usually in the back of the jaw. Edentata is now considered a Superorder. Sloths and anteaters are the living members of the order **Pilosa**, whose name refers to the animals' hairiness. They are very different from each other and highly specialized. They are chiefly solitary, but may form loose association. (anteater, sloth) Armadillos are now with the Order **Cingulata**.

Order Pholidata (FOE-lih-DOE-tuh)
Large, horny scales cover the long, tapering body of a pholidote (pangolin).

Order Lagomorpha (LAG-uh-MOR-fuh)
(pikas, hares, and rabbits)
Most lagomorphs have hind legs that are suited for leaping. Like a rodent, a lagomorph has chisel-like front teeth that grow throughout its life. It has two pairs of front teeth in its upper jaw. (pika, hare and rabbit).

Order Rodentia (roe-DEN-tee-uh)
A rodent has chisel-like front teeth, one pair in the upper jaw and one in the lower jaw, that grow throughout the animal's life. (agouti, capybara, beaver, chinchilla, chipmunk, squirrel, marmot, field mouse, lemming, muskrat, hamster, gerbil, Old World mouse, rat, New World mice, gopher, and jerboa).

Order Cetacea (see-TAY-shuh)
A cetacean spends its entire life in the water. It breathes air through a blowhole in the top of its head and feeds on fish squid, or plankton. (dolphin, whale and porpoise)

Order Carnivora (car-NIH-vor-uh)
Most carnivores are exclusively meat eaters, but many also eat plants. They usually have sharp teeth that are well suited for cutting and tearing flesh. Some have claws that help them seize prey. (wolf, dog, jackals, fox, bear, giant panda, coati, raccoon, lesser panda, marten, weasel, skunk, cat, lion, cheetah, leopard, hyena, mongoose, civet). Also includes the pinnipeds.

Suborder Pinnipedia (PIN-ih-PEH-dee-uh)
Pinniped means "fin-footed", they have a streamlined, torpedo-shaped body with four limbs modified into flippers. These meat-eaters spend much of their lives in water, but they come ashore to give birth. They are part of the **Oder Carnivora** (sealion, seal and walrus)

Order Tubulidentata (too-byu-luh-den-TAH-tuh)
This order includes only one animal, the aardvark. It is named for its peg-like teeth.

Order Proboscidea (PROE-buh-SIH-dee-uh)
A proboscidean has a long, flexible trunk (i.e. elephant).

Order Hyracoidae
A hyracoid has hoof-like nails on its toes. Its upper front teeth are somewhat like tusks. (hyrax)

Order Sirenia (sigh-REE-nee-uh)
A sirenian lives in shallow coastal waters and rivers where it feeds on water plants. It has paddle-like forelimbs and a flattened tail. (dugong and manatee)

Order Perissodactyla (puh-RISS-oh-DAK-tul-uh)
A perissodactyl is a hoofed animal with an odd number of toes on each foot. (horse, donkey, zebra, tapir and rhinoceros). One of two orders considered an ungulate (hoofed mammal).

Order Artiodactyla (AR-tee-oh-DAK-tul-uh)
An artiodactyl is a hoofed animal with an even number of toes on each foot. (giraffe, deer, moose, reindeer, elk, antelope, cattle, bison, yak, waterbuck, wildebeest, gazelle, springbok, sheep, musk ox, goat, pig, peccary, hippopotamus, camel, and llama). One of two orders considered an ungulate (hoofed mammal).