

Zoology – MAMMALS

THINGS YOU NEED TO KNOW FROM THIS CHAPTER...

1. Classification of Mammals
 - a. What phylum do mammals belong to?
 - b. What class do they belong to?
 - c. Memorize the 11 orders of mammals from your notes and the example mammals of those orders.
 - i. I suggest that you make flashcards. Put the example mammals on one side and the order names on the other. Then start practicing by flipping through them.
2. What is the critical sign of being a mammal?
 - a. What are the many functions of hair?
3. Are all mammals placental?
 - a. What is a placenta?
 - b. What always nourishes mammalian newborns?
4. How many extant mammal species are there?
5. What did mammals of the late Triassic Period look like?
 - a. What does diphyodont mean?
 - b. What does endothermic mean?
 - c. What glands did these mammals have to have since they had hair?
 - d. Why did these mammals diversify (or radiate)?
 - e. What were the keys to their success?
6. Do mammals molt?
 - a. Why do mammal coats have various colors, spots, and stripes?
 - b. What are vibrissae?
 - c. Can a porcupine shoot quills in defense?
7. What is the difference between horns and antlers?
 - a. What animals have true horns?
 - i. Are horns branched?
 - ii. Are they shed?
 - iii. Are they found in both sexes?
 - b. Which mammalian family produces antlers?
 - i. Are they found in both sexes?
 - ii. What happens as the animals get older?
 - c. Why isn't the rhinoceros horn a true horn?
8. From what are all mammalian integumentary glands derived?
 - a. What are the difference between the following glands...
 - i. Eccrine sweat
 - ii. Apocrine sweat
 - iii. Scent glands
 - iv. Sebaceous glands
 - v. Mammary glands
9. Teeth
 - a. What is the difference between homodont & heterodont dentition?
 - i. Which condition exists in mammals?

- b. What are the following teeth used for in mammals?
 - i. Incisors
 - ii. Canines
 - iii. Premolars
 - iv. Molars
- 10. What do we call insect eaters?
 - a. How long are their digestive tracts?
- 11. What do we call plant eaters?
 - a. How are their teeth different than other mammals?
 - b. What is a diastema?
 - c. What is cellulose?
 - i. How do mammals get energy from it?
 - d. What is a cecum?
 - e. What does coprophagus mean?
 - f. What is unique about ruminants?
- 12. What do we call meat eaters?
 - a. How long are their digestive tracts?
 - b. As a general rule, are they intelligent animals?
- 13. What do we call generalists that eat plant and animal matter?
- 14. Finish the following sentence with increases &/or decreases.
 - a. As an animal _____ in body weight its food intake per body size _____.
- 15. Do mammals migrate?
- 16. What unique hunting strategy is utilized by bats?
 - a. How is nocturnal different from crepuscular?
- 17. What is estrous and how does it help baby mammals survive?
 - a. Differentiate between the following terms...
 - i. Proestrus
 - ii. Estrus
 - iii. Metestrus
 - iv. Diestrus
- 18. What is menstruation
- 19. What are monotremes?
 - a. Give an example monotreme mammal.
- 20. What are marsupials.
 - a. Finish the following statement with shorter &/or longer.
 - i. They have a _____ gestation period and a _____ lactation period.
 - b. What is unique about the timing of kangaroo births?
- 21. What are placental mammals?
 - a. Finish the following statement with shorter &/or longer.
 - i. They have a _____ gestation period and a _____ lactation period.
 - b. What's strange about human development?
- 22. List some examples of domesticated mammals.
- 23. Why are rodents particularly troublesome to humans?

24. What transmits and carries bubonic plague & typhus?
25. What transmits and carries tularemia?
26. What transmits and carries Rocky Mountain spotted fever?
27. What transmits and carries lyme disease?
28. How do humans become infected with trichina worms and tapeworms?

CLASSIFICATION OF MAMMALS

Phylum Chordata

Class Mammalia (** Only select orders, listed below, need to be memorized.**)

Order Marsupialia – viviparous pouched mammals – opossums, kangaroos, et al.

Order Chiroptera – bats

Order Primates – monkeys, apes, humans, et al.

Order Xenarthra – armadillos, anteaters, et al.

Order Lagomorpha – rabbits, hares, et al.

Order Rodentia – squirrels, rats, et al.

Order Cetacea – whales, dolphins, et al.

Order Carnivora – dogs, wolves, cats, bears, et al.

Order Proboscidea – elephants

Order Perissodactyla – odd-toed hoofed mammals – horses, zebras, rhinoceroses, et al.

Order Artiodactyla – even-toed hoofed mammals – swine, deer, cattle, sheep, goats, et al.

I. Features and Diversity

A. Overview

1. Hair is a critical sign of being a mammal.
2. Hair serves many functions: protection, concealment, waterproofing and buoyancy, signaling, sensitive vibrissae and especially thermal insulation.
3. Mammals have other characteristic features.
 - a. Most have a specialized placenta to feed the embryo.
 - b. The mammal nervous system is more advanced than in other animal groups.
 - c. Mammary glands nourish the newborn.

B. Diversity

1. About 4,600 living species are known.
2. Nevertheless they are the most highly differentiated group in the animal kingdom.

II. Origin and Evolution of Mammals

A. History

1. The evolution of mammals from their earliest amniote ancestors is very fully documented.

2. Over the last 150 million years, small, ectothermic, hairless ancestors evolved into today's endothermic, furry mammals.
3. Early Mammals of the Triassic Period
 - a. The earliest mammals of the late Triassic were small and mouse- or shrew-sized.
 - b. They were diphyodonts; teeth were replaced only once as deciduous and permanent teeth.
 - c. They were almost certainly endothermic although cooler than modern placental mammals.
 - d. Hair was essential and also indicates that sebaceous and sweat glands were present.
 - e. There is no fossil evidence but mammary glands must have evolved before the end of the Triassic.
 - f. Young early mammals must have hatched from eggs and relied on maternal milk.
 - g. Mammals, having developed in the mid-Triassic, had to wait 150 million years to diversify.
4. Cenozoic Radiation of Mammals
 - a. Mammals survived first as shrew-like nocturnal animals, then in a radiation in the Eocene Epoch.
 - b. The radiation is attributed to the many habitats vacated by extinction of many amniote groups (including dinosaurs) at the end of the Cretaceous.
 - c. Mammals were agile, endothermic, intelligent, adaptable, and gave birth to young they protected.

III. Structural and Functional Adaptations of Mammals

A. Integument and Its Derivatives

1. Skin

- a. Mammals skin is generally thicker than in other classes of vertebrates.
- b. As with all vertebrates, skin is made of epidermis and dermis.
- c. In mammals, the dermis becomes much thicker than the epidermis.
- d. The epidermis is thinner and well protected by hair.
- e. In places that are subject to abrasion, the outer layers become thicker and cornified with keratin.

2. Hair

- a. Hair is characteristic of mammals; it is reduced on humans and exists as a few bristles on whales.
- b. Dense and soft underhair serves for insulation by trapping a layer of air.
- c. Coarse and longer guard hairs protect against wear and provide coloration.
- d. Hair stops growing at a certain length; it remains in the

follicle until new growth pushes it out.

e. In most mammals, there are periodic molts of the entire coat.

1) Foxes and seals shed once every summer.

2) Most mammals molt twice, in the spring and in the fall, with the winter coat much heavier.

3) Some have white winter coats for camouflage and brown summer coats.

f. Patterns including spots, stripes, salt-and-pepper, etc. are disruptive and conceal the animal.

g. Vibrissae or “whiskers” are sensory hairs; they provide a tactile sense to nocturnal mammals.

h. Porcupine, hedgehog, and echidna quills are barbed and break off easily.

3. Horns and Antlers

a. True Horns

1) Horns are found in ruminants such as sheep and cattle.

2) Horns are hollow sheaths of keratinized epidermis.

3) They embrace a core of bone rising from the skull.

4) They are not normally shed and are not usually branched, but may be greatly curved.

5) Horns grow continuously and are found in both sexes, although they may be longer in males.

b. Antlers

1) Antlers are formed in the deer family.

2) Antlers are composed of solid bone when mature.

3) Antlers develop beneath an annual spring covering of highly vascular soft skin or “velvet.”

4) Except for caribou, only males produce antlers.

5) When growth is complete just before breeding season, the blood vessels constrict and the stag removes the velvet by rubbing it against trees.

6) Antlers are shed after the breeding season and a new bud appears for the next growth.

7) Each year, the new pair of antlers is larger than the previous set.

c. Rhinoceros Horn

1) Hairlike keratinized filaments arise from dermal papillae and are cemented together.

2) These structures, however, are not attached to the skull.

4. Glands

a. Mammals have the greatest variety of integumentary glands; all are derived from the epidermis.

b. Sweat glands are tubular, highly coiled glands found in

mammals but never in other vertebrates.

c. Eccrine Sweat Glands

- 1) Eccrine glands secrete a watery fluid that draws heat away from the skin surface.
- 2) They are found in hairless regions such as footpads.

d. Apocrine Sweat Glands

- 1) Apocrine glands open into a hair follicle.
- 2) In humans, they develop near puberty and are restricted to armpits, external ear canals, etc.
- 3) In contrast to watery secretions of eccrine glands, apocrine secretions form a film on the skin.
- 4) Apocrine glands are unrelated to heat regulation and are correlated with reproductive cycles.

e. Scent Glands

- 1) Present in nearly all mammals, they vary greatly in location and function.
- 2) They communicate with members of the same species: mark territory, warning and defense.

f. Sebaceous (oil) Glands

- 1) Usually intimately associated with hairs, onto which they secrete their oil.
- 2) Cells accumulate fats, then die and are expelled to form oily sebum.
- 3) It does not turn rancid but serves as a dressing to keep the skin and hair pliable and glossy.
- 4) Most mammals have sebaceous glands over the entire body.

g. Mammary Glands

- 1) Mammary glands are probably modified apocrine glands.
- 2) They are rudimentary in males and occur on all female mammals.

B. Food and Feeding

1. Mammals exploit a wide variety of food sources; some are specialists and others are generalists.
2. Mammal structures are closely associated with adaptations for food finding or capturing.
3. Teeth
 - a. Structure of teeth reveal the life habits of a mammal.
 - b. Reptiles had homodont dentition or uniform tooth patterns.
 - c. Differentiation of teeth for cutting, seizing, gnawing, etc. resulted in heterodont dentition.
 - d. Types
 - 1) Incisors have sharp edges for snapping or biting.
 - 2) Canines are specialized for piercing.

- 3) Premolars have compressed crowns with one or two cusps for shearing and slicing.
- 4) Molars have larger bodies and variable cusp arrangements for crushing and grinding.

4. Feeding Specializations

a. Insectivores - Shrews, moles, anteaters and most bats are insectivores.

- 1) They eat little fibrous vegetable matter so their digestive tract is short.

b. Herbivores - Browsers and grazers include horses, deer, antelope, cattle, sheep and goats. Gnawers include rodents, rabbits and hares.

- 1) Herbivores have reduced or absent canines but molars are broad and high-crowned.
 - 2) **Diastema** – gap between premolars and incisors.
 - 3) Cellulose is a molecule produced by plants that makes their cell walls rigid. This is where most of the nutrition is stored, but the chemical bonds are difficult to break.
 - 4) Herbivores use anaerobic fermentation chambers so microorganisms can metabolize cellulose.
 - 5) A side pocket or cecum may also serve as a fermentation chamber and absorptive area.
 - 6) Hares, rabbits, and some rodents eat fecal pellets in order to provide additional fermentation.
- (coprophagus)
- 7) Ruminants have a huge four-chambered stomach.
 - 8) Food is regurgitated, re-chewed, and passed to the rumen, reticulum, omasum and abomasum.
 - 9) Herbivores generally have long digestive tracts for the prolonged time needed to digest fiber.

c. Carnivores

- 1) Most carnivores feed on herbivores.
- 2) A high protein diet is easily digestible and therefore the digestive tract is shorter.
- 3) Carnivores do not have to continuously graze and they have more leisure time.
- 4) Capturing prey also requires more intelligence, stealth, and cunning.
- 5) In turn, this has driven herbivores to have keen senses and escape behaviors.

d. Omnivores - pigs, raccoons, rats, bears and most primates including humans

- 1) Omnivores feed on both plant and animal tissues.
- 2) Food supplies in temperate regions vary by season; migration and hibernation are solutions.

3) Some mammals cache food stores during times of plenty, a common behavior of rodents.

5. Body Weight and Food Consumption

a. The smaller the animal, the greater is its metabolic rate and the more it must eat per unit size.

b. The amount of food varies in proportion to the body surface area rather than the body weight.

1) A 3 gram mouse will consume per gram of body weight five times more food than does a 10 kilogram dog and about 30 times more food than does a 50,000 kilogram elephant.

c. Small mammals must spend much more time hunting and eating food than do large mammals.

d. A small shrew weighing 2 grams must eat more than its body weight each day and will starve if deprived of food for a few hours.

e. In contrast, a mountain lion may kill an average of one deer a week.

C. Migration

1. Fewer mammals than birds make migrations; most remain in a home range.

D. Flight and Echolocation

1. Mammals have not exploited the skies extensively; bats can fly and some mammals glide from trees.

2. Bats are nocturnal (active at night) or crepuscular (active at twilight).

3. Echolocation, along with flight, allows bats to navigate and eat insects in total darkness at night.

4. Bats use frequencies from 30,000 to 100,000 Hz (cycles per second), well beyond our hearing range.

5. Ten to 200 pulses of signals are sent to locate prey; an echo is received before the next pulse is sent.

6. Some moths have evolved ultrasonic detectors to detect and avoid approaching bats.

7. All bats are nocturnal although fruit-eating bats use sight and olfaction to locate food.

8. Flowers that are evolved to utilize bats as pollinators have smelly white flowers that open at night.

9. The tropical vampire bat has razor-sharp incisors and anticoagulant saliva.

E. Reproduction

1. Reproductive Cycles

a. Most mammals have mating seasons timed to coincide with most favorable time to rear young.

b. Female mammals usually restrict mating to a fertile period during the periodic estrous cycle.

c. This time of female receptivity is known as heat or estrous.

d. Stages of the Estrous Cycle

1) **Proestrus** is the period of preparation when new follicles grow.

2) **Estrus** is when mating occurs; this is timed to be simultaneous with ovulation.

3) If pregnancy does not occur, estrus is followed by **metestrus**, a period of repair.

4) During **diestrus**, the uterus becomes small and anemic until the cycle repeats.

e. Menstrual Cycle

1) Old World monkeys and humans have a cycle terminated by menstruation.

2) Menstruation involves shedding of the endometrium or lining of the uterus.

2. Reproductive Patterns

a. Egg-Laying Monotremes

1) Monotremes such as the duck-billed platypus lay eggs with one breeding season per year.

2) She lays eggs in a burrow nest where they are incubated for 12 days.

3) Similar to reptiles and birds, there is no gestation and the egg provides all nutrients.

4) However, after hatching, young suck milk from the mother's fur near her mammary glands.

b. Pouched Marsupials

1) Marsupials are pouched, viviparous mammals.

2) Gestation is brief and marsupials give birth to tiny young that are still embryos.

3) Early birth is followed by a prolonged interval of lactation and parental care.

c. Placental Mammals

1) Eutherians are viviparous placental mammals.

2) They have an investment in a prolonged gestation in contrast to marsupials with an investment in prolonged lactation.

3) Humans are slower developing than any other mammal; this contributes to our uniqueness.

d. Patterns

1) The ultimate number of young produced per year also depends on mortality rate.

2) Small rodents that are prey for carnivores usually produce more than one litter each season.

3) Meadow mice can produce up to 17 litters of four to nine young each year!

4) At the other extreme, an elephant produces on average four calves during her 50-year life.

F. Mammalian Populations

1. A population of animals includes all members of a species that can potentially interbreed in a region.
2. All mammals live in ecological communities with other animal and plant species.

IV. Humans and Mammals

A. Domesticated Animals

1. Dogs were probably the first domesticated animals, being an adaptable offspring of social wolves.
2. The domestic cat is probably derived from an African race of wildcat.
3. Nomadic people probably subdued horses, camels, oxen and llamas.
4. Some totally domesticated animals no longer exist as wild species (e.g. dromedary camel, llama).
5. Many have been selectively bred to yield characteristics desirable for human purposes.

B. Mammals, Crop Damage and Human Disease

1. Rodents and rabbits are major pests of growing crops and stored foods.
2. Human monocultures and the elimination of predators have made this a more severe problem.
3. Many rodents carry diseases.
 - a. House rats and prairie dogs carry bubonic plague and typhus.
 - b. Tularemia is transmitted to humans by wood ticks and carried by rabbits and other rodents.
 - c. Rocky Mountain spotted fever is carried to humans by ticks from ground squirrels and dogs.
 - d. Ticks from white-tailed deer transmit Lyme disease.
 - e. Trichina worms and tapeworms are acquired by humans who eat meat of infected mammals.