MAMMALS NOTES

EVOLUTION AND CHARACTERISTICS

- Mammals belong to the class Mammalia, which includes 4,000 species
- Most dominant land animals on earth

ORIGIN

- Fossil skeletons show that early mammals had large eye sockets, which may have meant that they were active at night
- Mammals did not compete with dinosaurs for food, they would feed on insects
- Mammals were not abundant during the Mesozoic era
- Fossils of the first mammals are scarce thus indicating they were not as abundant
- The Cenozoic era is named the age of mammals, for this is the time which mammals rapidly started to increase

EVOLUTION

- Animals evolved from the group of reptiles called Therapids
- Therapids have both reptilian and mammalian characteristics
- Therapids have a jaw bone composed of 5 bones rather than a simple jaw bone
- Like mammals, Therapids have specialized teeth adapted for specialized function
- The earliest mammalian fossil found is from the early Mesozoic era, 200 million years ago
- As mammals evolved, the form and function of their jaws and teeth became adapted to eat foods other than insects
- The joint between the skull and lower jaw allowed mammals to evolve larger, more powerful jaw muscles, and different ways of chewing
- The limbs and digits (fingers and toes) of many mammals are adapted to their particular way of life. There is a variety of lengths and shapes of the limb bones. Homologous bones of different organisms have similar origins and/or uses and structures

CHARACTERISTICS

- Mammals are endothermic
- Mammals have hair
- Well-developed brains
- Mammalian heart has 4 chambers
- Mammals have a muscle, the diaphragm that aids in breathing
- Mammals have a single lower jaw
- Most species have 4 different types of teeth
- Most species are viviparous, in which females carry their young until fully developed
- Females secrete milk from mammary glands to feed newborn young

• Two features that distinguish them from other vertebrates are that they all have hair and produce milk BODY TEMPERATURE CONTROL

Mammals are endotherms. They can control and regulate their body temperature internally. Mammals, especially smaller ones, have a higher metabolic rate than other chordates. This high rate of metabolism helps them to regulate their body heat. Mammals also have hair as an external body feature. Hair is a part of the integumentary system which is the outer covering of the body. They also have a layer of subcutaneous fat just under the skin that can also help conserve body heat. Many mammals have sweat glands which help to cool the body when the internal temperature gets too high. The evaporation of the sweat from the skin surface helps to cool the organism. Then the organism will stop sweating. Mammals that lack sweat glands may pant to help

remove excess heat, i.e. dogs and wolves. Humans shiver when they are cold to help produce body heat. Shivering is a muscular twitch that produces friction and thus more heat. The ability to regulate body heat is useful in homeostasis (ability to maintain a stable internal environment). RESPIRATORY



The Respiratory System

All mammals use lungs to breathe, even those that live completely in water. Lungs are controlled by two sets of muscles. One set helps pull the chest cavity out and up to expand the cavity, thus pulling in air and increasing the volume of the chest. At the same time, the diaphragm pulls down and increases the cavity even more. When the chest muscles and diaphragm relax, the air is pushed from the cavity and so decreasing the volume of air in the chest cavity. Air enters through the tracheal tube down to the lungs where Bronchi branch into the two lungs. A bronchus then branches into smaller branches called bronchioles and end in small air sacs called alveolus (plural is alveoli). Some air will always remain in these air sacs. CIRCULATORY



The mammals have four chambers in their heart and have a double loop circulation system. The two loops occur as blood circulates from the heart to the lungs and back, then form the heart to the rest of the body. The right side of the heart (right atrium) collects oxygen poor blood from the body and pumps it to the lungs from the right ventricle. After going to the lungs to collect more oxygen, the blood returns to the left atrium of the heart, and then is pumped by the left ventricle to the rest of the body. These two separate loops help the body to efficiently move and transport materials throughout the body.

DIGESTIVE

Due to its higher metabolic rate, mammals may need to eat ten times more food than other animals, such as a reptile, that is the same size to maintain homeostasis. Some animals, such as the cow, rabbit, and giraffe eat only plants. Others eat only meat, such as cats (all sizes) and weasels. Others can eat all types of food, such as humans and bears. Some whales are filter feeders. Others eat only meat, like the killer whale. As mammals changed over time, their jaws and teeth adapted to eating a larger variety of organisms. Their more powerful jaw muscles allowed them to develop more ways of chewing. Mammals today have specialized teeth, including incisors, canines, molars, and premolars. Carnivore teeth are sharper and more pointy so they can tear meat from other animals. Herbivore teeth have flatter surfaces so they can grind up tough plant tissues. Omnivores have some teeth for tearing and grinding. Mammal teeth enable food to be processed more efficiently. The more efficiently an animal can obtain and process their food, then the more energy they can obtain from their food for their body to process. Digestive enzymes can break down meats quicker than plant tissues, so carnivores have shorter digestive tracts. Herbivores have longer digestive tracts because it takes longer to digest tough plant tissues. Many herbivores have special digestive organs that help break down the tough plant materials, such as in a cow. Cows have rumen, which are stomach chambers where food can be stored and processed. In these chambers are microorganisms (symbiotic bacteria) that help break down the cellulose tissue of plants.



EXCRETORY

Mammals have well developed kidneys that help control the makeup of fluids in the body. The kidneys remove nitrogen wastes in the form of urea from the blood. Urea and other wastes makeup the urine which can be stored in the urinary bladder until the organism is triggered to remove it from the body. The kidneys help the mammal to maintain homeostasis by filtering the urea from the blood and by removing excess water or concentrating urine to conserve water when needed. Kidneys enable the organisms to live in areas that they wouldn't be able to live in otherwise because they are as efficient as maintaining homeostasis.



CHEMICAL CONTROLS

The nervous system is not the only system that helps to control the body functions/processes. Mammals have endocrine glands that excrete hormones that can affect different parts of the body to elicit responses from the body tissue s that are programmed to respond to the hormones. Adrenaline for example affects muscle tissue in the fight or flight response. Other hormones can help the organism in the change and development of the body, i.e. testosterone and estrogen. Hormones are carried by the blood to all parts of the body but only affect those that are programmed to respond to them.

NERVOUS/RESPONSE

Mammals have the most highly developed brain of all animals. The brain has three main parts: the cerebrum, the cerebellum, and the medulla oblongata. The cerebrum coordinates complicated behaviors such as thinking and learning. The cerebellum controls muscle coordination. The medulla oblongata regulates the involuntary body functions. These are the ones your body does without you having to think about it, such as breathing and heartbeat. Humans have a cerebral cortex which is an outer layer that allows complex behaviors such as thinking to happen.

Mammals depend on well-developed senses to pick up and respond to stimuli in their environment. Some mammals have better senses than others such as a dog's sense of hearing and smelling. Mammals all have the same basic structure in the ear but some differ in their ability to detect sounds. Dogs, bats, and dolphins can hear higher frequencies than humans. The elephant can hear lower frequencies better. Many mammals have color vision. Those that are active in the day (diurnal) have better color vision than those that are active at night (nocturnal)



REPRODUCTION

All mammals reproduce by internal fertilization. The male deposits the sperm into the female's reproductive tract where fertilization occurs. Mammals are grouped by how they develop and raise their young. All mammals have young that depend on the mother's milk. Mammals usually need a lot of care after birth and for extended periods of time as they grow. The length and intensity of that care varies by species. The young are cared for by one or both parents. Some species even live in social groups where more than just the parents care for them, i.e. lions and elephants. This parental care helps to ensure the young survive and reproduce. The time where the parent cares for them is when the you learn behaviors needed to survive and any complex social behaviors seen in their species.



FIGHTING DISEASE

All organisms live in the environment where there are microorganisms that can cause disease (pathogens). Mammals have an immune system that helps protect the animal from disease. If an animal does get sick, then the immune system can help to fight the disease so the animal can recover. The skin is a barrier to prevent organisms from entering. The immune system also has specialized cells that detect and kill pathogens.



MOVEMENT

Mammals have adapted in various ways to help them in movement. They have a backbone that is flexible so that they can move up and down but also twist side to side. Flexibility allows the animal to move/walk with a bouncing stride. Shoulder and pelvic girdles are streamlined and flexible which allows for various movements of the limb. Some of these movements include walk, run, hop, climb, burrow, swing, fly, pounce, leap, and swim. Depending on the species, they may use more than one of these movements.

INTERRELATIONSHIPS OF ORGAN SYSTEMS

Mammals have organ systems that are dependent on one another. All body systems depend on the circulatory system for the transport of materials and nutrients. The respiratory system brings in oxygen that is then carried by the circulatory system to the rest of the body. Nerves carry impulses to and from all parts of the body which can cause the body to move by the skeletal system. The skeletal system depends on the digestive system to collect the calcium needed for bones to grow. The animal's organ systems work together to meet the needs of the organism as a whole.

MAMMAL ORDERS



There are 19 orders of mammals in the class Mammalia in which 17 nourish unborn young in the placenta, then the egg laying mammals and marsupials. (Others pictured are no longer living) MONOTREMES AND MARSUPIALS

Only 5 percent of all mammalian species are in the orders Monotremata and Marsupialia MONOTREMATA

- Oviparous or egg laying mammals
- Only 3 in existence
- Duck-billed platypus and two species of spiny anteaters called enchidna
- Not completely endothermic (their body temperature is lower and fluctuates more than other mammals)

- Monotremes share two notable characteristics with reptiles
- The digestive, reproductive, and urinary systems all open into a cloaca
- Females lay soft shelled eggs that incubate outside the body

MARSUPIALS

- Marsupials give birth to tiny immature young that crawl to a pouch on the mothers belly immediately after they are born
- Marsupials bear live young, but at a very early stage of development
- Young marsupials complete their development in an external pouch
- They attach themselves to milk secreting nipples nursing until they are mature enough to survive outside the pouch
- 250 species of marsupial species exist in Australia, New Guinea, Tasmania, and the Americas. These include the kangaroo and Tasmanian devil. The opossum is an American marsupial.
- 60 million years ago, no placental mammals inhabited the continent. Lacking competition, Australian marsupials underwent adapted radiation and eventually became adapted to all environments.

PLACENTAL MAMMALS

Placental mammals are named for an internal structure called the placenta, which forms when the embryo's tissues join with tissues from within the mother's body.

CHARACTERISTICS OF MAMMALS

- Placental mammals carry unborn young in the uterus until the young can survive in the wild
- Oxygen and nutrients are transferred from mother's blood to baby's blood
- The placenta is a membrane providing nutrients, removing waste & gas exchange between the mother and developing young
- Gestation period is the time which mammals develop in the mother's uterus

INSECTIVORA

- Consists of 400 species
- Includes shrews and moles
- Small animals with high metabolic rate and found in North America, Europe, and Asia
- Most have long pointed noses that enable them to grub for insects, worms, and invertebrates
- Live on ground, trees, in water, and underground

RODENTIA

- Largest mammalian order having over 2,400 species
- On every continent except Antartica
- Includes squirrels, marmots, chipmunks, gophers, muskrats, mice, rats, and porcupines
- Only two incisors in each jaw, grow as long as the rodent lives, and used for gnawing

LAGOMORPHA

- Includes rabbits, hares, and small mountain mammals called pikas
- Found worldwide

• Double row of incisors, large front teeth backed with two smaller ones, adaption for herbivorous diet. EDENTATA (also known as Xenarthra)

- Made up of 30 living species including anteaters, armadillos, and sloths
- The name edentate means "without teeth"
- Edentates have adaptations for insectivorous diets, including a long, sticky tongue, and clawed front paws

• Sloths, on the other hand have continuously growing teeth as an adaptation for grinding plants

CHIROPTERA

- Made up of over 900 species of bats
- Live throughout the world except in polar environments
- A bat's wing is modified front limb which skin membrane between extremely long finger bones
- Bats use thumbs for climbing, walking, or grasping
- Most bats are active at night and have a special way to navigate using echolocation (bouncing high frequency sound waves off objects)
- Frequency of returning sound waves with the size, distance, and rate of movement of different objects
- Bats that use echolocation have small eyes and large ears
- Feed on insects and have teeth specialized for such diets
- Some feed on fruit and flower nectar and do not use echolocation

CETACEA AND SIRENIA

- 90 species of whales, dolphins, and porpoises are distributed worldwide
- Cetaceans have fish like bodies with forelimbs modified as flippers
- Cetaceans divided into two groups which are toothed and baleen whales
- Toothed whales include beaked whales, sperm whales, beluga whales, narwhals, killer whales, dolphins and porpoises
- Have over 100 teeth
- Prey on fish, squid, seals and whales
- Baleen whales lack teeth
- Shrimp and other small invertebrates are the prey of the baleen whales
- The order Sirenia is made up of four species of manatees and dugongs
- Front limbs are flippers for swimming
- Sirenians lack hind legs but have flattened tails

CARNIVORA

- 250 living species in carnivoria are distributed worldwide
- Most of the species mainly eat meat, which explains the name
- Some members of this order such as bears feed extensively on plat material as well as meat, so they are called omnivores
- Carnivores generally have long canine teeth, strong jaws, and clawed toes

PINNIPEDIA

- Pinnipedia are water dwelling carnivores and have streamlined bodies
- This order includes Seals and Sea Lions

ARTIODACTYLA AND PERISSODACTYLA

- Ungulates-hoofed mammals, classified into two orders: ARTIODACTYLA and PERISSODACTYLA
- These two classes are herbivores
- They have a storage chamber in their stomach called the rumen and food undergoes double digestion
- Ungulates with an even amount of toes make up the class Artiodactyl, such as giraffes and camels

• Ungulates with an odd number of toes make up the class Perissodactyla, such as donkeys and rhinoceros PROBOSCIDEA

- Characterized by a boneless nose or proboscis
- Elephants are the largest land dwellers alive today, weighing more than 6 tons

• It has modified incisors, called tusks, for digging up roots and stripping bark from branches PRIMATES

- 200 living species of primates classified as prosimians
- Includes lemurs, tarsiers, and lorises, or anthropods (gorillas, chimps, and humans)
- A complex brain has enabled anthropoids to develop behaviors and to live in highly organized social groups