CLASS: MAMMALIA (MAMMALS)

SUBCLASS: PROTETHERIA

SUBCLASS: THERIA

THE ORIGIN AND EVOLUTION OF MAMMALS

According to the fossil record, the endothermic and furry mammals evolved from the small, ectothermic and hairless ancestor.

Skull structures (anapsids, diapsids, synapsids) and teeth are the most important fossils to identify the origin of mammals.

MAMMALS DEVELOPED AS A SEPERATE BRANCH OF THE THERAPSIDA ORDER OF THE SYNAPSIDA SUBCLASS OF MAMMAL-LIKE REPTILES IN THE JURASSIC PERIOD

Early Evolution of Mammals developed from **Therapsids (Paleozoic Synapsids)**.

Cynodonts are the only therapsid group which lived in the Mesozoic era.

- High metabolic rate
- Powerful and specialized jaw musculature
- Heterodont teeth
- Turbinate bones
- Secondary palate
- Loss of lumbar ribs

Earliest True Mammals (Triassic Fossils)

- Mouse sized
- Diphyodont teeth (change only one time)
- Three middle ear bones
- Mammalian jaw joint between dentary and temporal bones)

The Earliest Mammals

- Endothermic (but lower body temperature than modern placental mammals)
- Hair
- Sweat gland
- Mammary gland (must have developed before the end of the Triassic period)
- Probably breed from eggs in an

Living mammals are divided into two clades: **Monotremes & Therians**

Living Mammals: 29 order; 1 order of Monotremes; 7 orders of

STRUCTURAL DIFFERENCES BETWEEN MAMMALS AND REPTILES

1. Body covers with hair in mammals; Body covers with scale in Reptiles
2. Mammal's skull has got two occipital condyle; Repile's skull has got one occipital condyle.
3. There is a muscular diaphragm that separates the chest cavity from the abdominal cavity in mammals.
4. The lower jaw of mammals is one piece whereas it consists of several pieces in Reptiles.
5. The lower jaw bones directly with the skull in mammals, while it makes a joint with quadratum in reptiles.
6. There are three bones (incus, malleus and stapes) in the middle ear in mammals. There is only one bone (stapes), in the middle ear in reptiles.
7. Mammals have diphyodont teeth; teeth heterodont in most
8. The heart is four chambers and has got only left aortic root in Mammals. The heart is 3-4 chambers in Reptiles
9. In mammals, the larynx (sound box) is well developed.

Characters Indicating that Mammals are More Developed Animals than Birds

Their body is covered with **hair**

Young nourished by milk from **mammary gland**

Cerebral cortex well developed

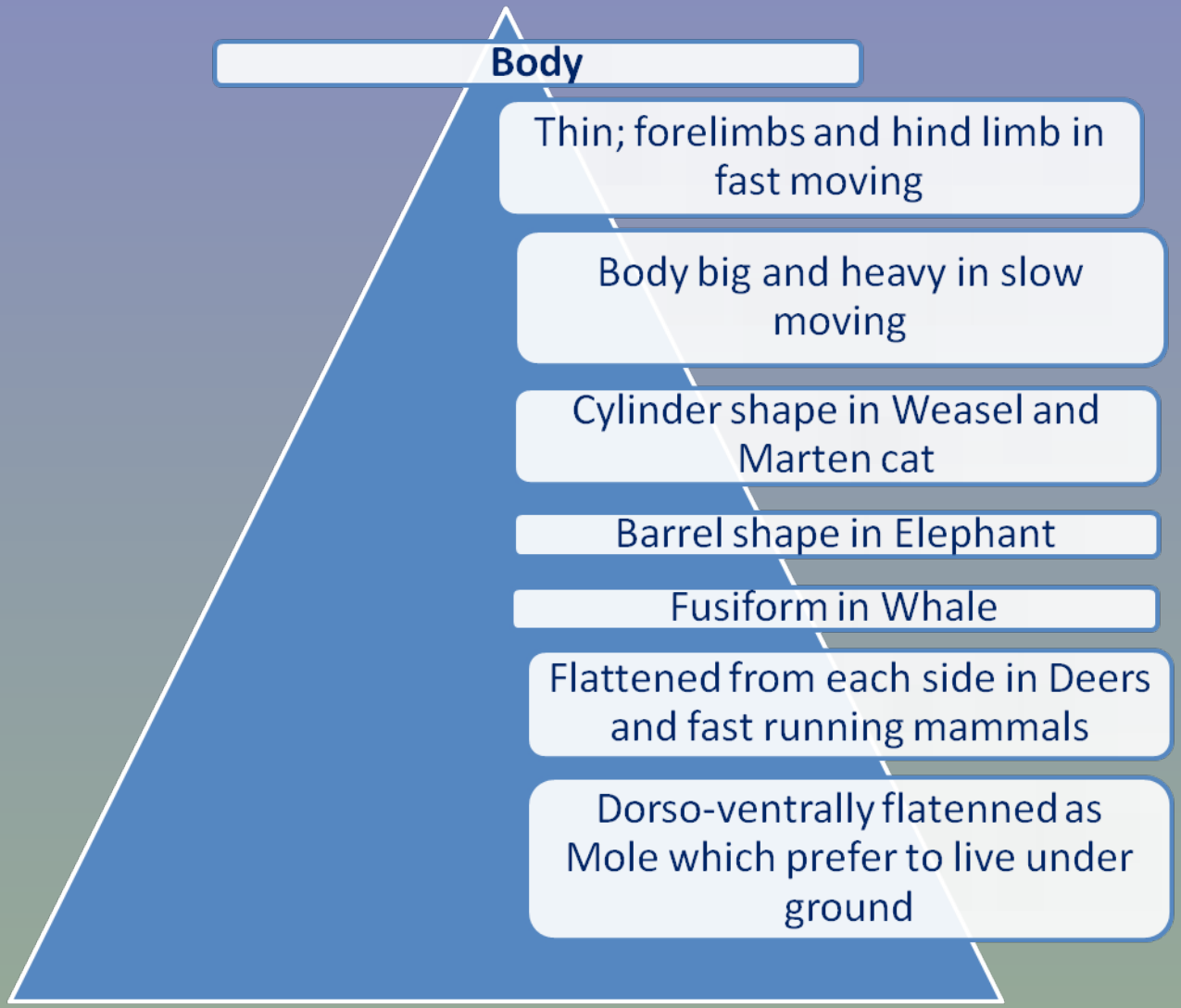
Well-developed sound, hearing and vision organs

Nonnucleated, biconcave red blood cells

Memory formation

Allows learning and keeping them in mind

MORPHOLOGY


Body
Thin; forelimbs and hind limb in fast moving
Body big and heavy in slow moving
Cylinder shape in Weasel and Marten cat
Barrel shape in Elephant
Fusiform in Whale
Flattened from each side in Deers and fast running mammals
Dorso-ventrally flatenned as Mole which prefer to live under ground

SKIN

- **Thicken than other Vertebrate**
- The epidermis layer is thin in the areas covered with hairs; and thick such as hand, feet and soles.
- The skin is called **PACHYDERM** that animals has weak hair and very thick skin.
- Scale, nail, hoof, horn, many glands and hair are formed by differentiation of epidermis layer.
- Body of the Tatum (Armadillo) covers with scales as a armor which formed by epidermis
- Epidermal scales are present in tail of beaver, lemur ve oposum.
- The horns of deer and other horn animals are different.
- Horns are present only in male in deers, and old ones fall every year in the autumn to form new ones.

Mamary, sweat, fat, scent and tear (lacrimal) glands of the mammals are originated from

- Mamary gland secrete milk to provide the feeding of infant.

Embryologically, mamary glands form the thickening of the epidermis and the milk is carried out through the channels.

- Mamma is not present in Monotremata (Egg Lying Mammals) and milk collected in a sac-like part.
- Milk ejaculate to the mouth of the infant by special muscles in Marsupialia (Pouched

- Sweat glands help to remove some substances that are formed as a result of metabolism, as well as keeping the body temperature constant (thermoregulation).
- Sweat glands present different part of the body in mammals.
- Forexample, they present only the sole part of the body and between the fingers which have got hairy body.
- Completely lost or present only on the face in some of the bats.
- Completely lost in aquatic vertebrate such as Whale.
- Present on the tongue in dogs.

- The most smelly secretions are secreted by the skunk and used as an effective defense weapon. This secretion is known as **methyl mercaptan** and causes blindness.
- There are some glands which secrete scent on the root of the tail in Canidae family. This secretion is used in communication between individuals.
- Tarsal scent glands that develop only the breeding season on the hind libs of male deers to atrract female specimens.
- Preputial scent glands found in most mammals

Hair is the most important structures formed by differentiation of epidermis layer in mammals.
There are usually two types of hair present in the mammals:

1.Long-thick Hair

2.Short-Think Hair(to protect body temperature)

- No hair in Pinnipedia order
- The growth of the hair is limited and stops after reaching a certain length.
- But the hair is continously growth on the head of human and the on the mane and tail of horse.
- The most important function of hair is to maintain body temperature.
- Hairs is frequent and thich in some mammals living in northern hemipshere.
- Hairs present on the sole in some mammals living

There is only a small amount of hair around the lip in Cetacea family (Whales), and a fat layer is formed under the skin to protect the body temperature.

Seals from marine mammals have a dense hair cover. When the air between the hairs of these mammals is deep into the depths, they emerge with water pressure.

Another task of the hair is protection the animal. The hairs that has thorny in hedgehogs are used to defend the animal against enemies.

The hairs on the tail present in the mammals living on trees (such as squirrels) serve to ensure body balance.

Some mammals living under the ground or dark places has got hairs called Vibrissae in their parts of their bodies that are sensitive to touch

There are nerves in the base parts of the long hairs around the nose and eyes of carnivores and rodents, and there are movement disturbances in the animals when they are

Mammals have many different colors

There are usualy two types of chromatophore are present.

Melanophore (black and brown) and **xanthophore (red and yellow pigment).**

Different colors of hair located in various part of the body of some mammals are used to inform the danger.

SKELETON SYSTEM

Reduced bone number compared to other vertebrates

Changes are observed in fore and hind legs depending on the way of life in mammals.

Fast moving mammals, legs are long and thin

Slow moving mammals (Elephant), legs are very thick.

MUSCULAR SYSTEM AN MOVEMENT-LOCOMATION

Metameric array in the abdominal muscles is not very clear

The muscles in the head, neck and extremities are thinner and more developed.

Face muscles in mammals are well developed and give some facial expression to any event

DIGESTIVE SYSTEM

- Lips present around the mouth.
- Lips are mobile in mammals except Monotremata and Cetacea

Tooth consist of two parts:

1.Enamel develop from epidermis

2.Dentin ve pulp develop from dermis

- Four types of theeth present in mammals: **Incisors, canine, premolars and molars**
- The canine teeth are well developed in carnivorous mammals. These are big and pointed.
- These teeth are used to catch, kill, break up and defend against enemies
- The incisor teeth are useful in capturing and cutting food and are well developed in herbivorous mammals.
- The upper canine teeth are quite elongated in *Odobenus rosmarus* (Pinnipedia family)
- The upper canine teeth of the Vampire bats are long and

Some mammals teeth have **heterodont type** (all the types of tooth present)

Some of the mammals teeth have **Homodont Type (similar) (**Dolphins)

Diphyodont: The type of dentition characterised by two sets of teeth. First set is of temporary and second is of permanent.

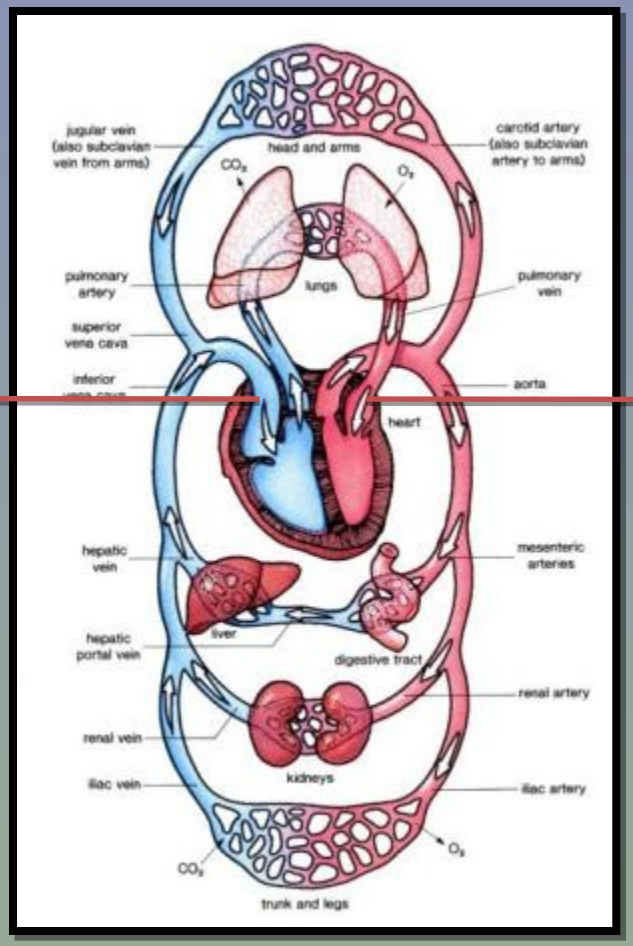
The digestive system and stomach shape of the mammals varies depending on the type of food.
The stomach is in the form of a bag in the omnivorous or carnivorous mammals

CIRCULATORY SYSTEM

Heart with 4 chambers.
Homoethermic-Endothermic
Nonnucleated and biconcave red blood cells

Clean blood (Right(

Dirty blood (Left)



Tricuspit

Bicuspid

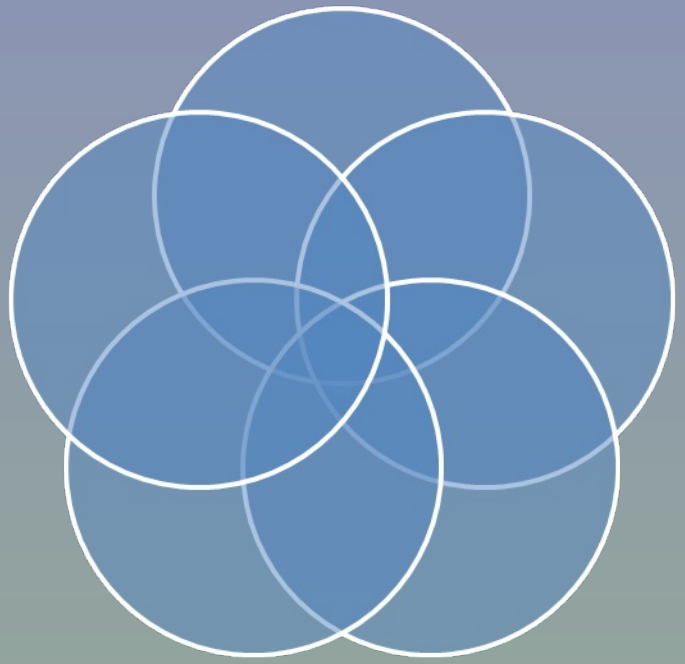
RESPIRATORY SYSTEM

- Respiration rate is quite high in the insectivorous mammals
- Significant changes have occurred in the respiratory systems of some aquatic mammals. In many of these animals, valves created to close the outer nostrils. Lungs are long in Sirenia (Sea Cows)

Why Mammals Make Sound?

To Fright the enemies

Communication



Gathering (Forming a Flock)

Attracting opposite sex

Migratory mammals

EXCRETORY SYSTEM

- Metanephric kidneys
- Ureters that usually open into a bladder
- Main nitrogenous waste is **urea**

NERVOUS SYSTEM

- Brain is well developed especially cerebral cortex
- Cerebrum and Cerebellum are quite big.
- 12 pairs of cranial nerves.
- **Olfactory sense highly developed; middle ear with three bones**

REPRODUCTIVE SYSTEM

Separate sexes

Internal fertilization

- Copulary organ a penisare present in males.

Testis are present usually in **Scrotum** sac.

- **Monotremes** are egg-laying (oviparous) mammals.
- **Monotremes have got cloaca**
- The duck-billed platypus has one breeding season each year
- Usually two ovulated eggs are fertilized in the oviduct.
- Embryos developed in the uterus for 10-12 days
- A thin leathery shell is secreted around the embryos before the eggs are laid.
- Echidnas incubate their eggs in an abdominal pouch.
- After hatching, young feed on milk produced by the mother’s mammary glands.
- Monotremes have no nipples, young lap milk secreted onto the belly of the mother

- **Marsupials** are pouched, viviparous mammals.
- They have a transient type of placenta called **Choriovitelline (yolk sac) placenta.**
- At first, an embryo encapsulated by shell membranes and floats free for several days in the uterine fluid.
- After hatching embryos, of most marsupials do not implant
- Gestation (the intrauterine period of development) is short
- Birth to tiny young (in this period they are still embryos).
- Followed by a prolonged interval of lactation and parental care

- Most of them breed in spring and winter.
- Although many male mammals are fertile at any time, female mammals fertility is restricted to a specific time during a periodical cycle (estrous cycle).
- Females copulate with males only a relatively brief period in this cycle, called **heat** or **estrus**
- Animals that have only one estrus during their breeding season are called **monestrous (dogs, foxes, bats, etc.)**
- Animals that have a recurrence of estrus during breeding season are called **polystreous (Mice, Squirrel)**
- **Pregnancy period in mammals is generally proportional to size**
- **The number of young produced in a birth is**