

**Phylum Mammalia-  
Subphylum  
Vertebrata**  
Learning Outcome G5

## Learning Outcome G5

- Relate the complexity of the form and function of vertebrates to the evolutionary continuum of animals

## Student Achievement Indicators

Students who have fully met this learning outcome will be able to:

- Examine members of the Subphylum *Vertebrata* and describe their unifying characteristics
- Compare members of two or more classes of vertebrates
- Compare the vertebrates and invertebrates in terms of increasing complexity, with reference to characteristics including
  - endoskeleton vs. exoskeleton
  - presence or absence of vertebral column
  - closed vs. open circulatory system
- Describe the diverse ecological role of vertebrates

## Classification

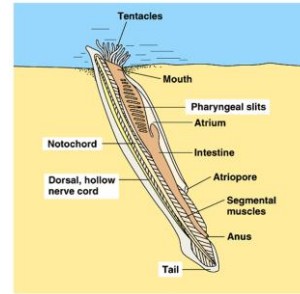
- Kingdom *Animalia*
- Phylum *Chordata*
- Class *Mammalia*

## Characteristics

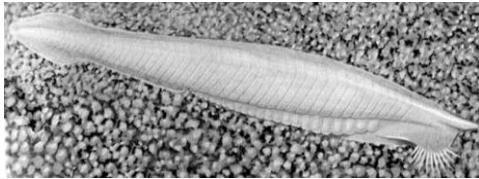
- Notochord is always present at some point during vertebrate development
- A notochord is a skeletal rod of connective tissue that runs lengthwise along the dorsal surface and beneath nerve cords
- Contains a hollow dorsal nerve tube
- Has gill slits
- Make up 5% of known animal species

## Invertebrate Chordates

- A few groups of invertebrates have both vertebrate and invertebrate characteristics.
- The invertebrate chordates are a link between vertebrates and invertebrates.
- These organisms are generally filter feeders.
- Can have the above characteristics during embryonic development
- Examples – tunicates, lancelets and hagfish

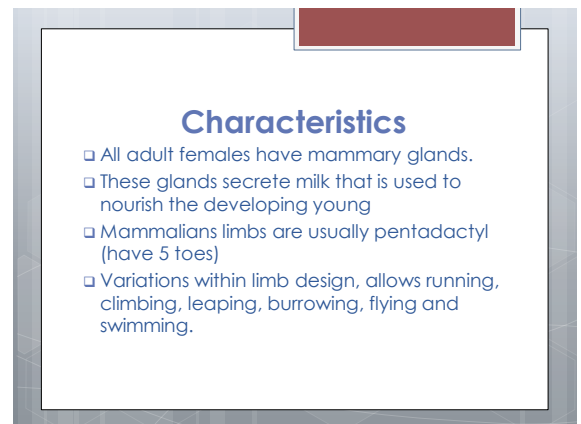
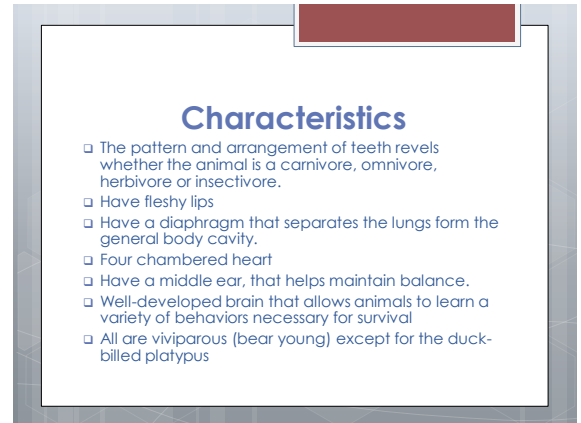
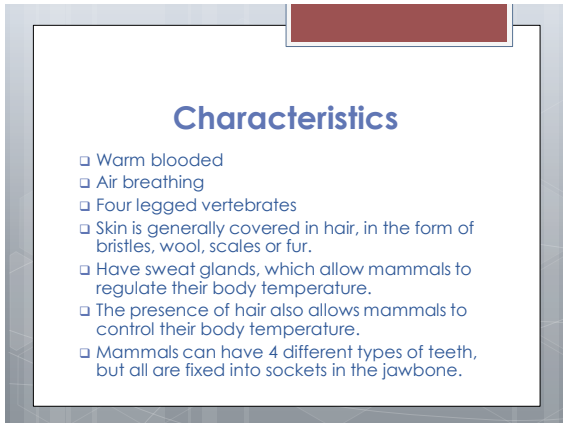
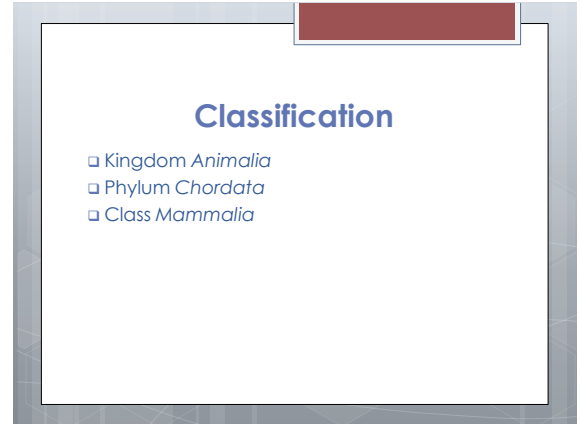


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## Vertebrates

- Includes 95% of all chordates
- Belong to the subphylum *vertebrata*
- Have a vertebrae which is a hollow cartilaginous or bone structure that surrounds and protects the dorsal nerve chord.
- Has an endoskeleton
- Large brain protected by a skull
- Advanced nervous system
- Advanced circulatory system
- Complex heart with a circulatory system
- A special outer covering
- One or two pairs of appendages
- A large coelom contains vital organs
- There are seven classes, we will examine one class; Class *Mammalia*



## Adaptations for Keeping Warm

- Hair
- Both thinner and outer guard hairs and the short under hairs provide excellent insulation
- In colder climates, they help prevent the animal from losing heat
- In areas of extreme cold, the outer guard hairs are often hollow, giving them the ability to insulate the animal.
- Coat coloration also allows animals to blend into its environment
- This is advantageous to both predator and prey

## Adaptations for Keeping Warm

- In some mammals the hair has become modified, for example the guard hairs on the porcupines have become quills, which are used as defense mechanisms.
- The whiskers found on many animals are also a modification.
- These tiny, wiry hairs provide an increased sense of touch.
- These hairs contain the protein keratin which is produced by the individual hair follicles and fills the dead cells of growing hair.
- Keratin also makes up part of other animal structures.
- These structures include antlers, horns, toes, hooves, fingernails and claws

## Adaptations for Feeding

- Teeth are divided into four basic groups; incisors, canines, premolars (aka bicuspid) and molars (aka tricuspid)
- They appear in the above order from front to the back of the mouth, on both sides and in the upper and lower jaw.
- The teeth in both jaws match up and this aids in chewing.
- Each type of tooth is specialized
- The incisors are used for biting and tearing, these teeth may have become modified for survival.

## Adaptations for Feeding

- Example – elephants have modified incisors that have become tusks.
- Pre-molars and molars are used for chomping and grinding.
- Many animals can be identified by a dental formula -2,1,2,3
- Indicates that in half the jaw there are 2 incisors, 1 canine, 2 premolars and 3 molars
- In gnawing rodents such as a beaver, the second number would be missing because canines are not present in that species.

## Adaptations for Running

- Can grow continuously without a molting period, which means they do not have a period of time where they are vulnerable to predators.
- They do not have to use metabolic energy to create a new exoskeleton, like the arthropods.
- This energy can be used to create a well-developed vertebrae and bones.
- The Vertebrates skeleton is incredibly flexible.
- The pectoral and pelvic girdles have been modified for support and to allow the limbs to be directly underneath the body
- Limbs have become modified for particular environments.
- For example members of the cat family have developed claws on their feet used for climbing and holding down prey.

## Adaptations for Flight

- Bats are the only animal to exhibit true flight
- Some animals such as the Northern Flying Squirrel are capable of gliding between trees
- Bat wings differ greatly from the bird wing.

## Adaptations for Water

- During evolutionary development a number of terrestrial animals have invaded water to take advantage of other ecological niches.
- Examples of these animals are whales, porpoises and dolphins
- The front limbs have developed into fins.
- Although they lack hind limbs their well developed tail fin allows them to move through water.
- They do not breathe through their mouth, the breath through a blow hole in their head.
- Some have a streamlined body to allow fluid, quick movement.
- Sea lions, walruses and seals must use a terrestrial environment for reproduction, which makes them more susceptible to predators.
- Their limbs are still specialized for marine environments which means they are not able to move quickly on land.

## Monotremes & Marsupials

- Monotremes are one of the most primitive animals
- Lay eggs
- The eggs of monotremes are incubated within the body and the young are nourished from mammary glands that secrete milk directly into the fur.
- The three living species are the duck billed platypus of Australia and two species of spiny anteater of Australia and New Guinea.



## Montremes & Marsupials

- Marsupials are usually born in an extremely immature condition and undergo further development in the pouch on the underside of the mother.
- The hairless, partially formed young crawl into the mothers pouch and attach to her mammary glands where they remain for the duration of the feeding period.
- Generally live in Australia and neighboring islands
- Examples of marsupials – kangaroos, wallabies, koala bears





## Placental Mammals

- Includes 95% of mammals
- The placenta develops in the uterus to facilitate the exchange of material between mother and young
- As the embryo develops, an umbilical cord forms which connects it to the placenta
- The umbilical cord contains the veins and arteries that form the lifeline between mother and developing embryo
- Placental animals provide a varying degree of maternal care
- There are 24 separate orders of placental mammals including fossil forms.

