Class Mammalia

The Mammals

Key Characteristics of Mammals

1. Hair
2. Mammary glands – produce milk
3. Specialized teeth
4. 3 inner ear bones
5. Endothermic
6. Diaphragm
7. Sweat, oil and scent glands
8. Large cerebral cortex

Monotremes

- Have a cloaca
- Lay eggs
  - Nourished by the yolk
  - Platypus lays eggs in a burrow
  - Echidna incubates eggs in a pouch
  - 6 species
    - New Guinea and Australia

Monotremes

Marsupials

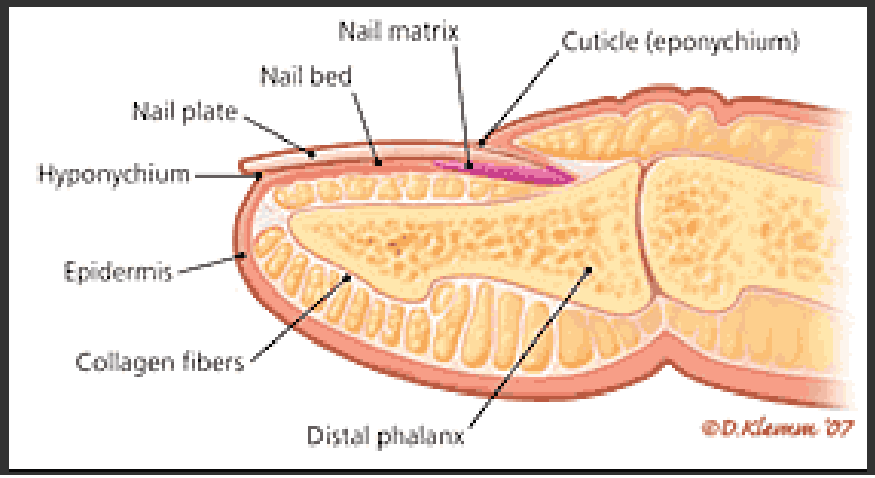
- Marsupium – pouch that covers the mammary glands
- Very short gestation period
  - 8-40 days
- Young crawl into pouch after birth
  - Feed and develop: 60-270 days
  - 250 species
    - Americas and Australia

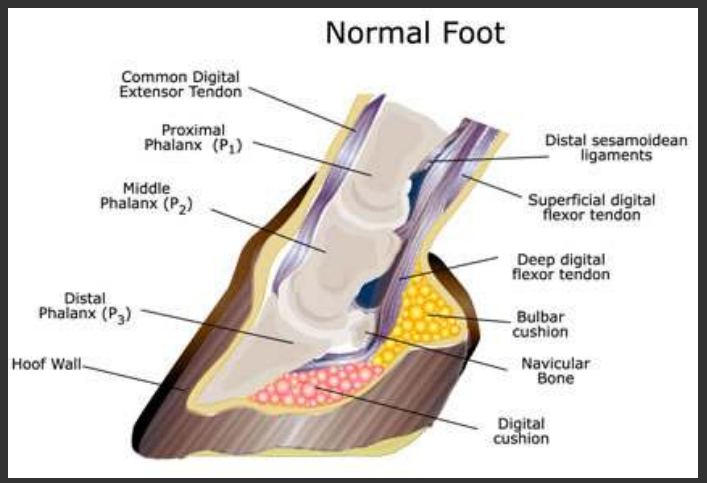
Placental Mammals

- Embryo implants into uterus
- Placenta allows gases and nutrients to diffuse from mother to baby
- Born at an advanced development stage
  - Gestation from 20 days to 19 months
  - Altricial or precocial young
  - 3800 species in all habitats

External Structure

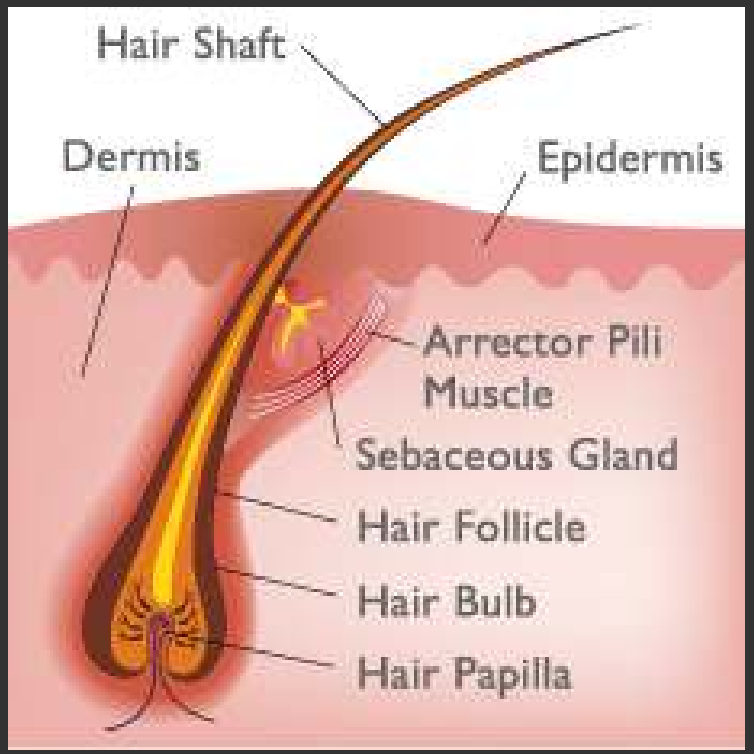
- Claws, Hoofs and Nails
- For movement and defense
- Made of dead, compacted cells filled with keratin
- Protect bone tips





External Structure

- Hair
- Made of dead cells filled with keratin protein
  - Color comes from melanin in the shaft and air spaces
  - 2 types - long guard hairs and insulating underhairs



External Structure

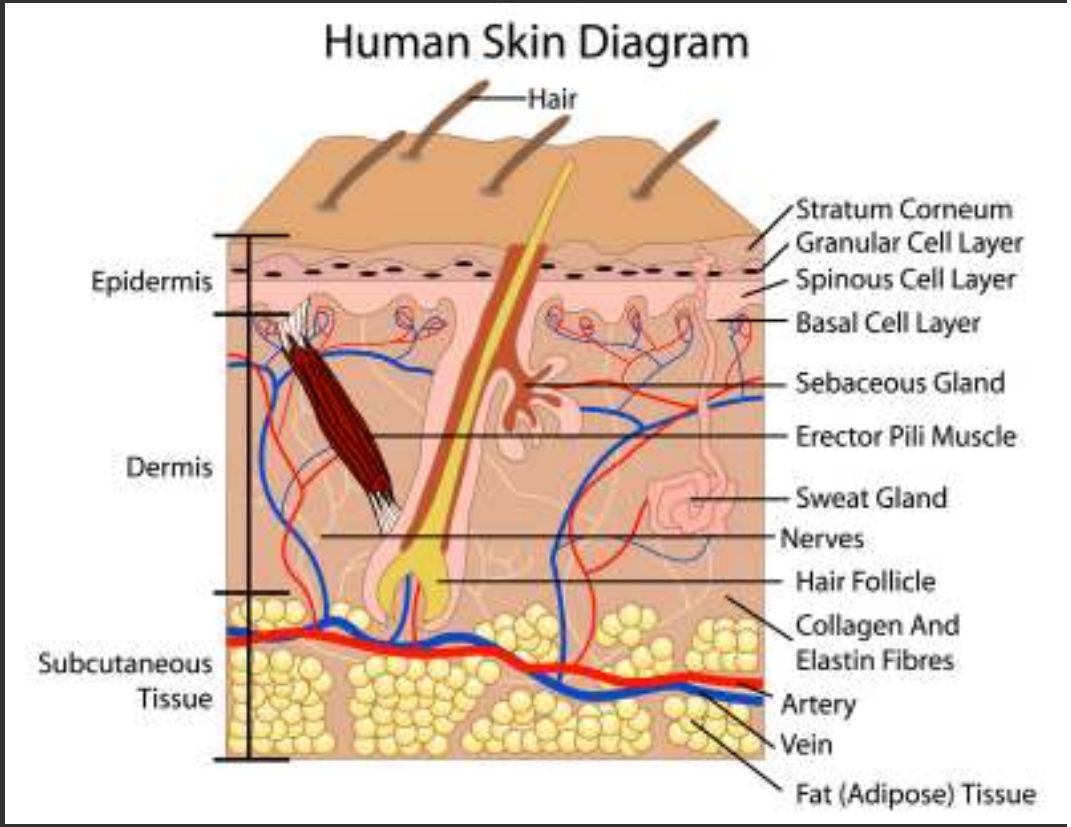
- Hair
- Some mammals molt
  - Some increase number of underhairs
    - Color change for winter

(a)

(b)

External Structure

- Hair
- Enhances sense of touch
- Hairs can stand up for insulation
  - Muscles make them stand up



External Structure

- Hair
- Reduced in some mammals
  - Elephants, hippos, whales, naked mole rats

Internal Structure

- Glands
  - Develop from cells in the epidermis
- Oil glands lubricate hair follicles
- Sweat glands for evaporative cooling
  - Microorganisms make it smell
- Scent or musk glands – release pheromones
  - For defense, mate recognition, territory marking

Internal Structure

- Glands
- Mammary glands with nipples
  - Only functional in females
  - None in monotremes
- Milk- full of nutrients for young
  - Water, sugars (lactose), fat, protein, minerals and antibodies

Skeleton and Teeth

- Protection and weight bearing
  - Rib cage covers lungs and heart
- Appendages are beneath the body
- Flexible vertebrae for better movement
  - Climbing, leaning, turning, running

Skeleton and Teeth

- Skull with jaw for chewing
  - Single articulation
- Secondary palate
  - Breathe while chewing
- Enameled teeth set in sockets
  - Two sets in life

Skeleton and Teeth

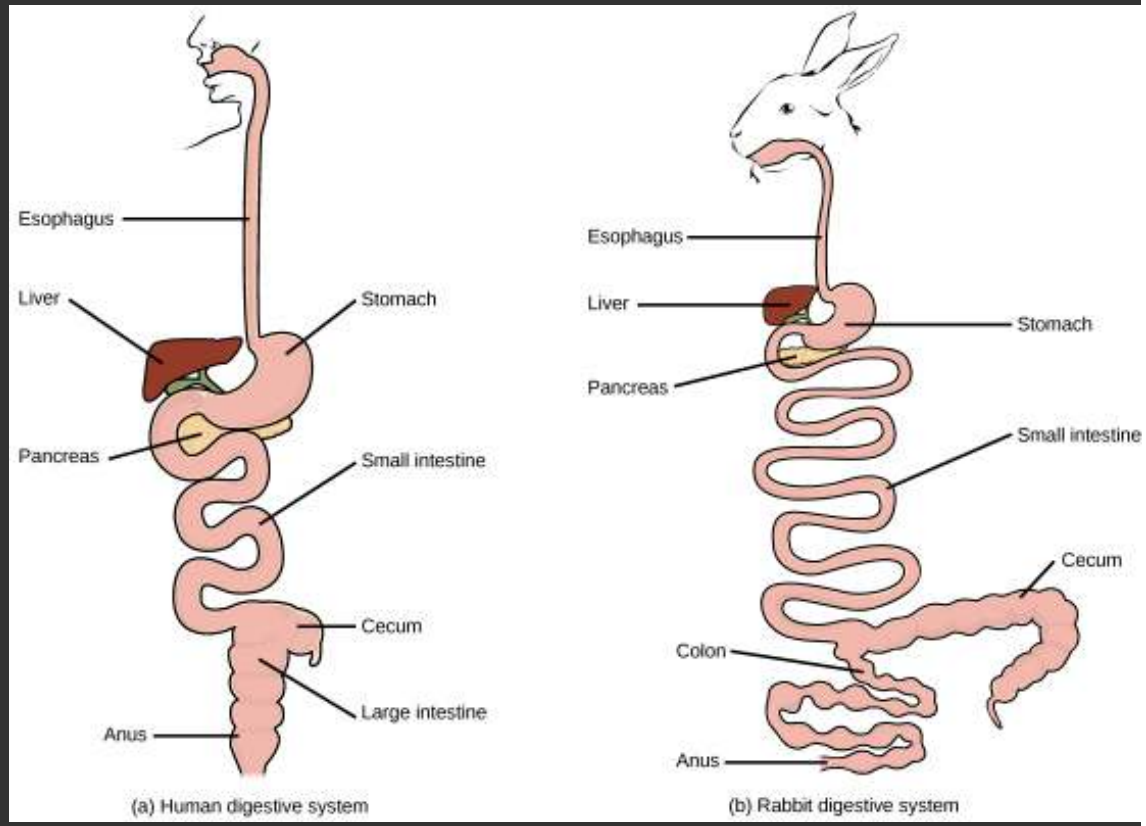
- Heterodont teeth with different functions
  - Not homodont
  - Incisors- gnaw or nip
  - Canines- tear or catch
  - Premolars- chew
  - Molars- broad chewing
  - Some mammals have reduced teeth
    - Armadillos and anteaters

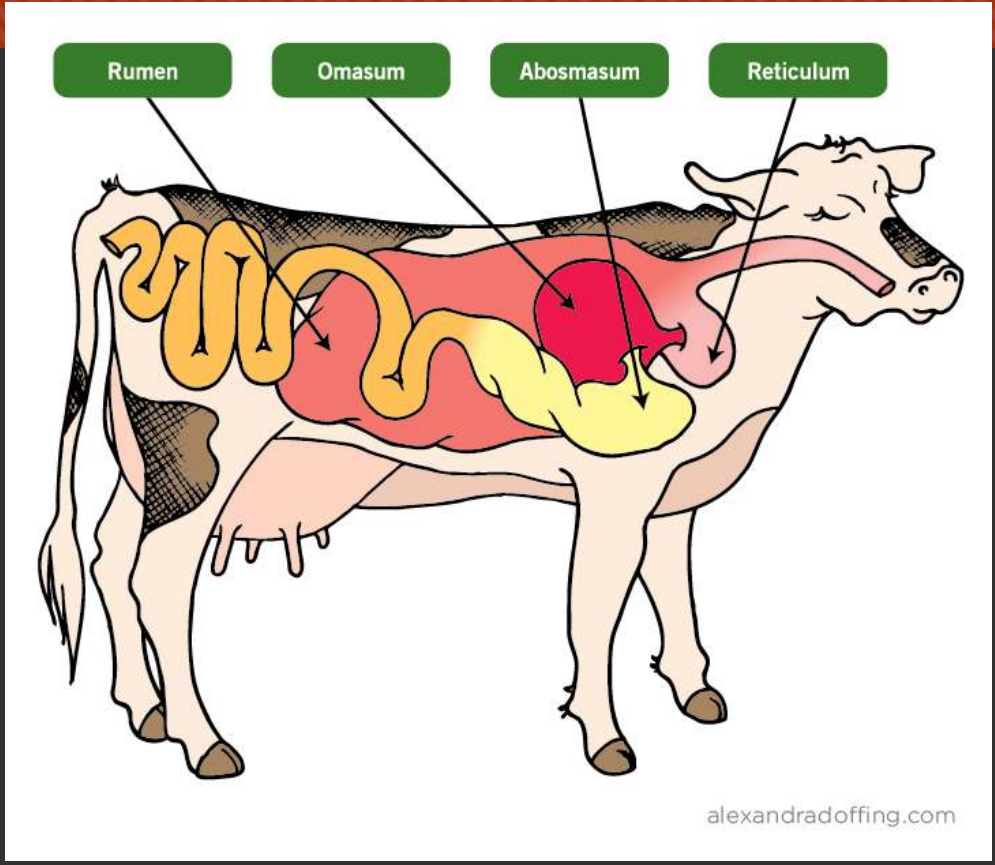
Skeleton and Teeth

- Teeth types match diet
  - Omnivores have sharp front teeth and flat back teeth
  - Herbivores- flat grinding teeth
  - Carnivores have sharp canines
  - Some mammals have teeth that grow for life
    - Why is this an advantage?

Nutrition and Digestion

- Adapted to feed on substances found in habitats
- Herbivores have a cecum - fermentation pouch
  - Filled with cellulose digesting microorganisms
  - Cows, deer and sheep with 4 stomachs (3 for fermentation)




Rumen
Omasum
Abosmasum
Reticulum
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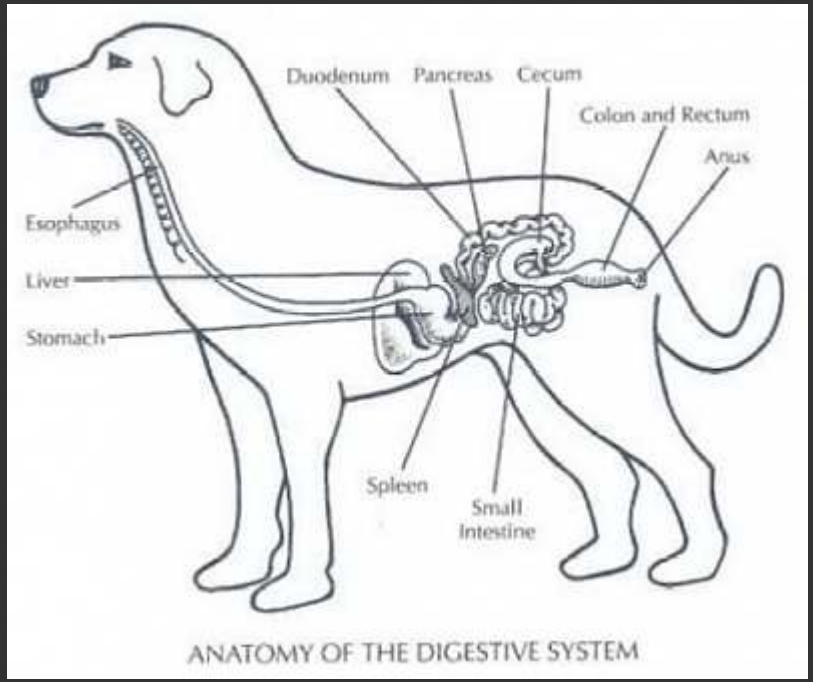
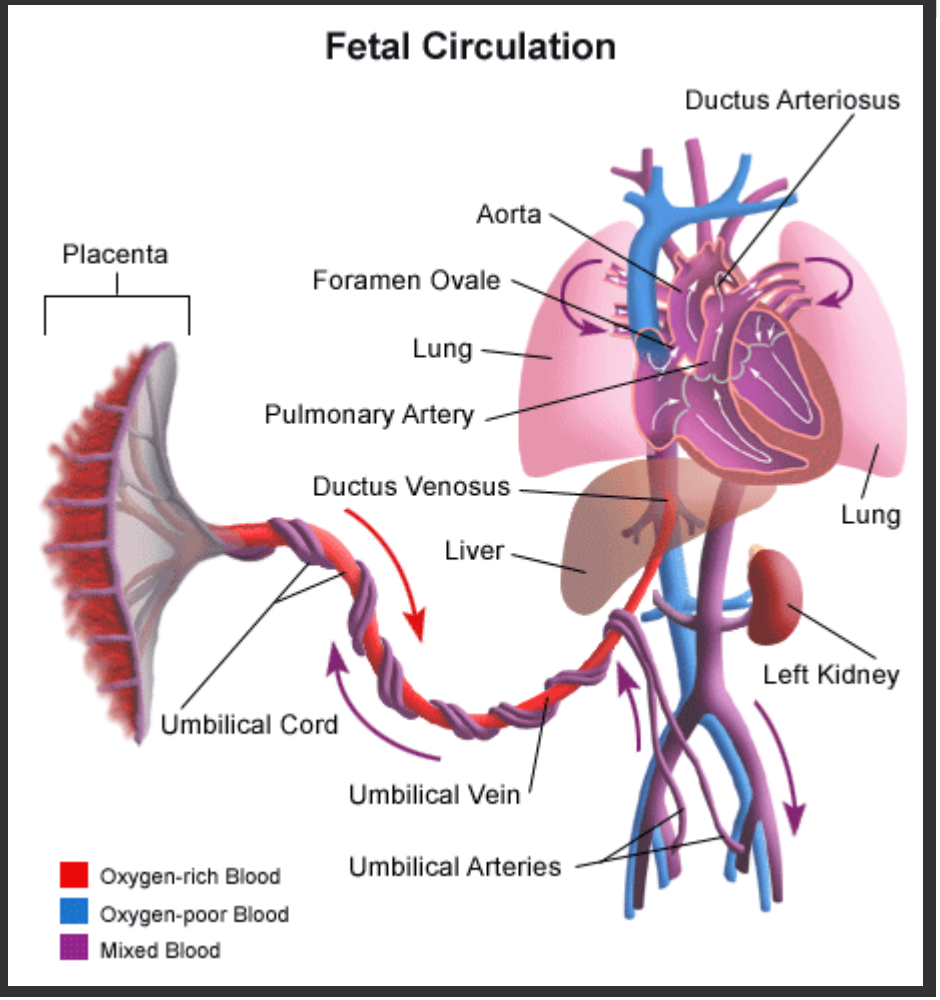

Duodenum
Pancreas
Cecum
Colon and Rectum
Anus
Esophagus
Liver
Stomach
Spleen
Small Intestine
ANATOMY OF THE DIGESTIVE SYSTEM

Circulation

- 4 chambered heart
  - Systemic and pulmonary systems are separate
- System for fetal circulation

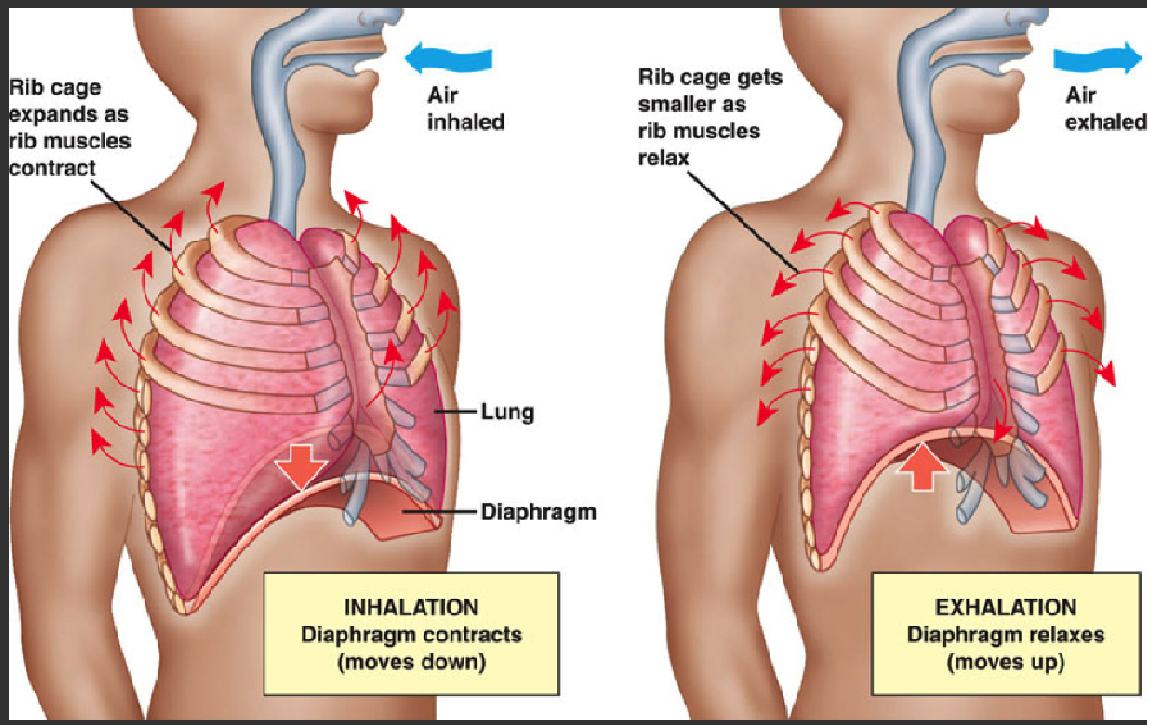


Gas Exchange

- High metabolism for endothermy = more oxygen demand
- Larger nasal cavities and snouts
  - Warm and moisten air more efficiently
- Sponge-like lungs
  - Not just a sac like reptiles and birds

Gas Exchange

- Diaphragm – muscles that assists the lungs
  - Contraction fills the lungs, relaxation empties them



Temperature Regulation

- Mammals can live in areas with extreme temperatures
  - Hot and cold

Temperature Regulation

- Warming up strategies
  - Hair helps retain the heat
- Some mammals use muscles – shivering
- Some increase metabolism
  - Cellular respiration without making ATP -heat released
- Arteries are close to veins
  - Arterial blood warms venous blood
  - Countercurrent heat exchange

Temperature Regulation

- Cooling down strategies
- Skin with low insulation
  - Thin or no hair
  - Allows heat to be lost
  - Large ears
- Behavior – finding shade or being nocturnal

*Temperature Regulation

- When conditions become too extreme to maintain body heat, many mammals switch to conservation strategies
- Winter sleep
  - Slightly decreased metabolism and body temp.
- Hibernation
  - The hypothalamus decreases metabolism, heart and respiratory rate
  - True hibernators - monotremes, insectivores, rodents and bats
  - Both groups accumulate fat

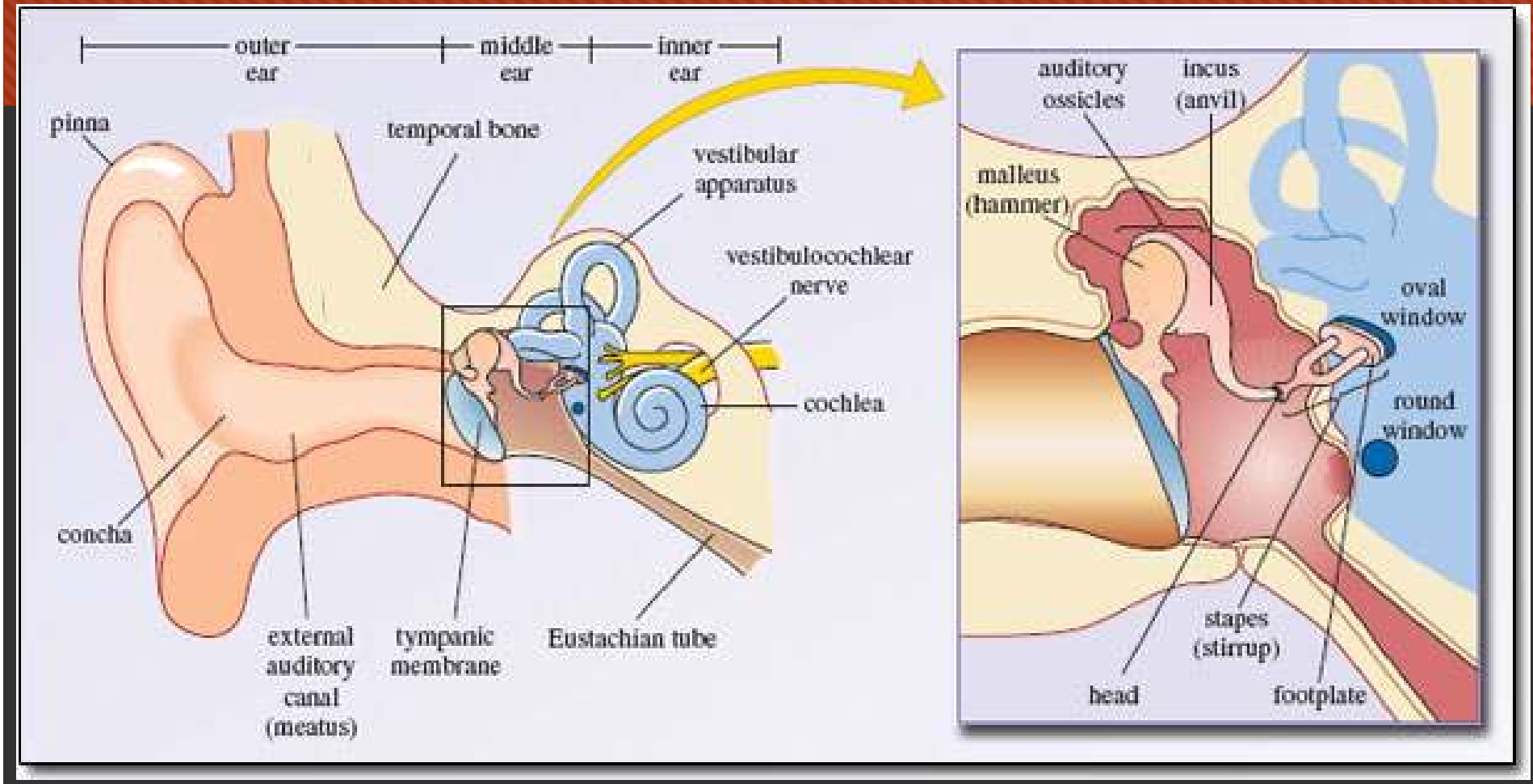
- EXAMPLE – Hibernating ground squirrel
- Body temperature drops from 37° C to 2° C
  - That's from 98.6° to 35.6°
- Breathing rate decreases from 100 -200 breaths per minute to 4 breaths per minute
- Heart rate decreases from 100-200 beats per minute to 20 beats per minute
- Upon waking up, it takes hours to return to normal levels of physiology

Nervous and Sensory Systems

- Complex mammal brains can integrate all types of sensory information
- Well developed sense of touch – hairs
- Long distance sense of smell
  - For finding food, identification and avoiding predators

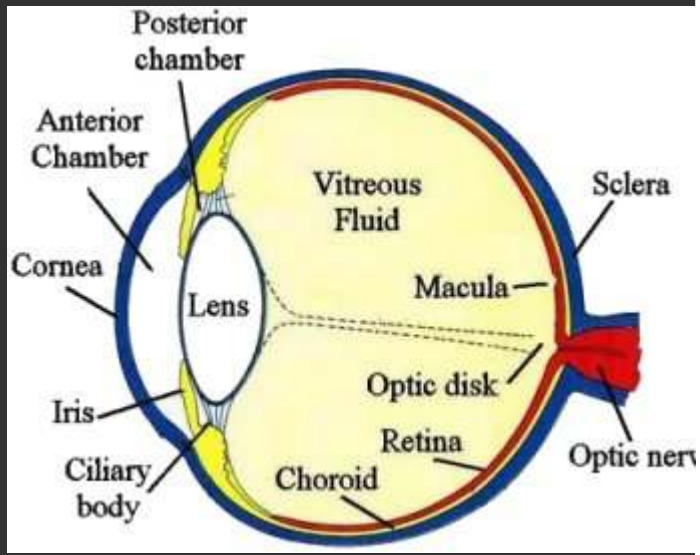
Nervous and Sensory Systems

- Advanced hearing – improved sensing of pitch and volume
  - Ear flap as a funnel
  - Ear canal leads to tympanum
  - 3 middle ear bones carry sound to inner ear
  - Inner ear has enlarged area for receptor cells - cochlea


outer ear
middle ear
inner ear
pinna
temporal bone
vestibular apparatus
vestibulocochlear nerve
cochlea
concha
external auditory canal (meatus)
tympanic membrane
Eustachian tube
auditory ossicles
incus (anvil)
malleus (hammer)
oval window
round window
stapes (stirrup)
head
footplate

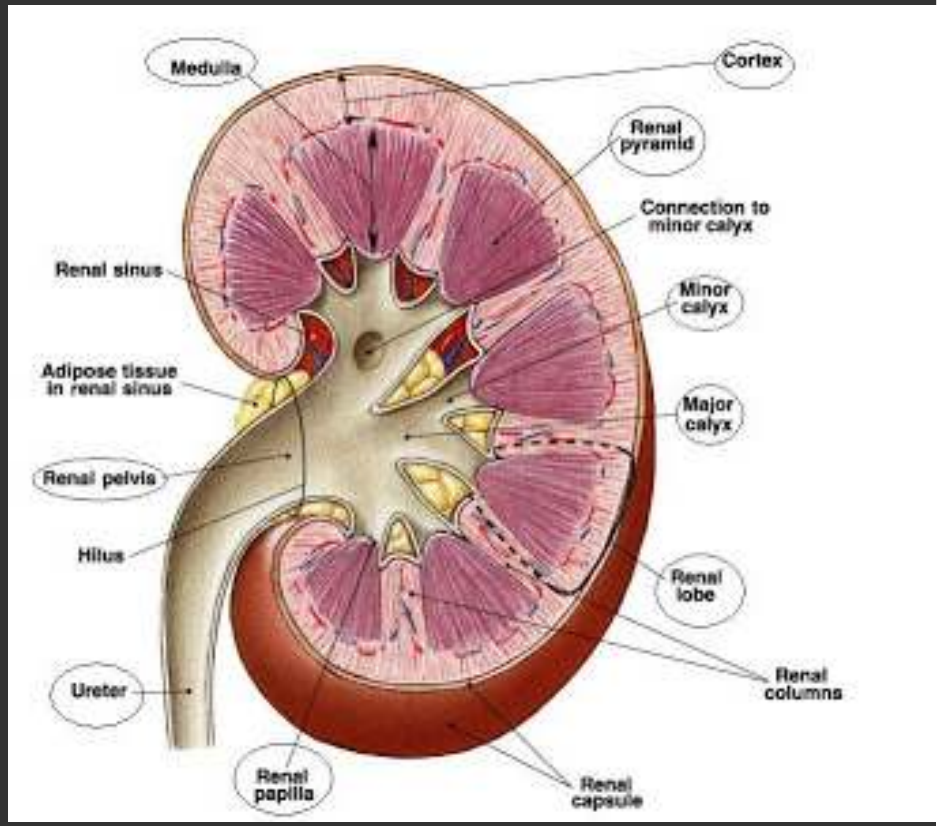
Nervous and Sensory Systems

- Most mammals do not have color vision
  - Rod cells but no cone cells- enhanced night vision
  - Color vision: primates, squirrels, some marmots and ground squirrels
  - Other animals have only 1 or 2 of the types of cells
    - Dogs cats, horses cows, pigs
  - Early mammals were most likely nocturnal



Excretion and Osmoregulation

- Adapted to limit water loss
  - Water lost in feces, sweat, respiratory surfaces, nursing
- Metanephric kidney – conserves water and makes uric acid
  - Uric acid has to be dissolved in water- some water is lost
- Highly concentrated urine
  - Dissolved solutes, salts



Behavior

- Complex behavior
- Visual cues
  - Examples?
- Smells
  - Pheromones as communicators- territory, reproductive readiness
- Vocal communications
  - Herd behavior
- Tactile communication
  - Nosing and grooming

Reproduction and Development

- Large expense of energy from the female and sometimes both parents
  - Advantages of life birth?
- Internal fertilization – occurs in the oviduct
- Uterus – modified oviduct
- Reproductive cycles are timed with favorable food and climate conditions
  - Estrus cycle- reproductive availability only at specific times