Class: Mammalia

Synapomorphies of Mammals

Evolution History of Mammals

Mammals
- First appeared ~225 mya
- Small nocturnal, insectivores

Cynodonts
- First appeared ~270 mya
- Secondary palate

Therapsids
- First appeared ~290 mya
- Limbs vertically oriented

Synapsids
- First appeared ~320 mya
- Large herbivores and carnivores

Evolution of the Mammal Skull

Synapsids
- Large temporal fenestra
- Differentiated teeth on single dentary bone
- Hinge between quadrate and articular

Therapsids
- Further differentiation of teeth
- Canines and incisors
- Larger dentary bone

Cynodonts
- Cusped teeth
- Secondary palate
- Hinge forms between dentary and squamosal
- Quadrate and articular bones migrate to inner ear
- Single lower jaw bone (dentary)
Mammal Dentition:

Four distinct tooth types

- Incisors:
- Canines:
- Premolars:
- Molars:

Digestive Tracts

Carnivores:

Herbivores:

Modes of Locomotion

Plantigrade:

Digitigrade:

Unguligrade:

Lactation vs. Gestation Times

Marsupials

Eutherians
Major Lineages of Mammals:

Monotremes:

Marsupials:

Placentals:
Differences in the Placenta:

Marsupials

- Rudimentary connection between yolk sac and maternal tissue
- Large yolk sac provides nutrients to developing embryo
- Allantois: avascular; storage of nitrogenous waste

Eutherians

- Umbilical cord connects fetus to uterus
  - Umbilical vein and artery
  - Efficient exchange of nutrients, gases and waste
- Reduced yolk sac
- Allantois connects fetal bladder to yolk sac, which drains into umbilical cord

Biogeography of Mammals

Early Jurassic:

Late Jurassic:

Early Cretaceous:

Early Paleocene:
Primate Evolution:

Ancestral primates:

Prosimians:

“Ida”

Anthropoids:

Old World Monkeys

New World Monkeys

Homonoids:

Human Evolution:

Origin of Modern Humans

Out of Africa:

Multiregional:
Evolution of the Vertebrate Heart

Two Chambers:

Two Chambers plus Septa:

Three Chambers:

Four Chambers:

Human Heart

Anterior and Posterior Vena Cava

Right Atria

Atrioventricular (AV) Valve (tricuspid)

Right Ventricle

Semilunar Valve

Pulmonary Arteries

Lungs

Pulmonary Veins

Left Atria

Atrioventricular (AV) Valve (bicuspid)

Left Ventricle

Semilunar Valve

Aorta

Body

Circulatory Schemes
### Cardiac Cycle:

<table>
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<tr>
<th>Time Function</th>
<th>Diastole</th>
<th>Atrial Systole</th>
<th>Ventricular Systole</th>
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<td>Contract</td>
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<td>Valves</td>
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<td>Function</td>
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### Cardiac Output:

**Two Factors:**

**Average Human:**

### Cardiac Control:

**Annelids and Mollusks:**

**Arthropods:**

**Vertebrates:**

### Control of Heart Rhythm:

**Sinoatrial node:**

**Atrioventricular node:**
Blood Vessels:
- Vessels:
- Arteries:
- Veins:
- Capillaries:

Mammalian Blood Composition:
- Plasma
- Cellular Elements:
  - Erythrocytes:
  - Leukocytes:
  - Platelets:

Blood Clotting:
- Blood clotting factors:
- Clotting factors from: Platelets, Damaged cells, Plasma (factors include calcium, vitamin K)

Blood Pressure:
- Systolic:
- Diastolic:

Cardiovascular Disease:
- Hypertension:
- Heart Attack:
- Stroke:
- Atherosclerosis:
- Arteriosclerosis:
- LDL’s
- HDL’s
Cardiovascular “Surgeries”

Angiogram:
Angioplasty
Stents:
Bypass Surgery:

Lungs:
Ventilation Lungs:
Pharynx:
Larynx:
Trachea:
Bronchi:
Bronchioles:
Alveoli:

Ventilating the Lung

Breathing Control
Oxygen Transportation:

Carbon Dioxide Transportation:

Deep Diving Mammals

Overview of a Nervous System

Sensory Input

Integration

Motor Output

Neurons

Cell Body:

Dendrites:

Axons:

Axons:

Myelin Sheath:

Node of Ranvier:

Synaptic Terminals:
Cluster of Neurons

Ganglion:

Nuclei:

Supporting Cells

Astrocytes:

Radial Glia

Oligodendrocytes

Schwann Cells

Reflex:

Neural Signals

Membrane Potential:
Threshold Potential:

Resting State:

Depolarization State:

Action Potential:

Rising Phase:

Falling Phase:

Undershoot:

Propagation of the Action Potential

Salatory Conduction
Communication Between Synapses

**Electrical:**

**Chemical:**

- Action potential triggers an influx of calcium
- Synaptic vesicles fuse with presynaptic membrane
- Neurotransmitter released into synaptic cleft
- Neurotransmitters bind to receptors and open ion channels on postsynaptic membrane which sets off new action potential
- Neurotransmitters are degraded by enzymes or removed by a synaptic terminal

Neurotransmitters

Postsynaptic Potentials

- **Subthreshold:**

- **Temporal Summation:**

- **Spacial Summation:**

  - **Spacial Summation with an Inhibitor**

Vertebrate Nervous System

- **Ventricles:**
- **White Matter:**
- **Gray Matter:**
Peripheral Nervous System

Autonomic:

Sympathetic:

Parasympathetic:

Enteric:

Somatic:

Brain

Medulla Oblongata and Pons:

Cerebellum:

Midbrain:

Hypothalamus:

Cerebrum and Corpus Callosum:

Limbic system

Memory:
Camera-Type Eyes

Eye Parts

- Sclera (white)
- Cornea (clear)
- Choroid (pigmented)
- Iris (color of eye)
- Retina
  - Rods:
  - Cones:
- Pupil
- Fovea (focal point)
- Blind spot

Scars of Evolution

Focusing

Near Vision:

Distance Vision:

Myopia:
Hyperopia:
Astigmatism:
Hearing and Equilibrium

Outer Ear:

Middle Ear:

Inner Ear:

Eustachian Tube:

Sound:

Volume:

Pitch:

Equilibrium:
Chemoreception:

Tastebuds:

Olfactory Receptor Cells: