Phylum Chordata

- Characterized by having a stiffened notochord at some point in their development---a precursor to a spinal column
- Besides the subphylum Vertebrata, this phylum includes the tunicates and amphioxus ("both ends pointed"

Vertebrate Derived Characteristics

- Vertebrae, except for hagfish (issue of Craniata)
- Cranium (skull)
- Prominent heads with complex sense organs
- Forebrain containing the cerebral cortex, where complex thinking occurs

Some Unique Embryonic Characteristics

- Large Hox Gene Complex
  - regulates the genes that control the process of body development from front to back
  - Common to all animals but multipled in vertebrates
- Neural Crest
  - Thought to be a 4th embryonic germ layer (with endo-, ecto-, and mesoderm)
  - Gives rise to most vertebrate sensory systems

Basic Vertebrate Design

- Verts tend to be bigger and more active than non-vert chordates
- They have to have muscles and a skeleton
- Since they move, they encounter all sorts of things
  - Requires tough but flexible protective covering
  - Elaborate sensory system so they know what they're encountering

Embryological Development

- The zygote develops 3 germ layers:
  - **Ectoderm**-forms adult superficial skin, linings of most of the anterior and posterior digestive tract, and the nervous system, included eyes and ears
  - **Endoderm**-forms central portions of digestive linings, the glands that support digestion, including the liver and pancreas, and most of the respiratory surfaces
  - **Mesoderm**-forms last and becomes muscles, skeleton, connective tissues, and circulatory and urogenital systems

More on the Mesoderm…

- It's the mesoderm that splits to form the **coelom**, or body cavity, where the internal organs are. This divided into:
  - **Pleuroperitoneal cavity** (around the viscera)
  - **Pericardial cavity** (around the heart)
    - These cavities are lined by thin layers of mesoderm called the **peritoneum** (**pericardium** around the heart), and the gut is supported by sheets of this called the **mesentaries**.

The Neural Crest

- This is the final germ layer that forms in the embryo
  - Forms manmy of the structures in the front of the head and almost all of the peripheral nervous system, the front section of the brain, the adrenal glands, skin pigment cells, secretory cells of the gut, and smooth muscle lining the aorta

Pharyngeal Stage of Development

- All vertebrate embryos go through a pharyngeal stage where they have pharyngeal clefts which are precursors to gills
- In everybody but fish these disappear, but their linings give rise to many glands in the lymphatic system: thymus, tonsils, carotid bones, parathyroid glands

Dorsal Hollow Nerve Cord

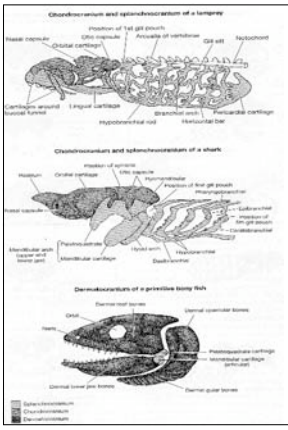
- This derived characteristic of vertebrate embryos is formed by an infolding of the ectoderm and develops dorsal to the notochord
- It seems to control development of the notochord, and that's probably the reason it's maintained in the vertebrates which don't keep the structure as adults.

Adult Tissue Types

- See assignment…..

Skeletomuscular System

- The basic vertebrate structure starts with the notochord, a stiffening rod running the length of the body
- The cranium gets added on, followed by the pharyngeal skeleton of the gills, then the axial skeleton (vertebrae, ribs, fin supports), and last the appendicular skeleton---the limbs



The cranial skeleton consists of:

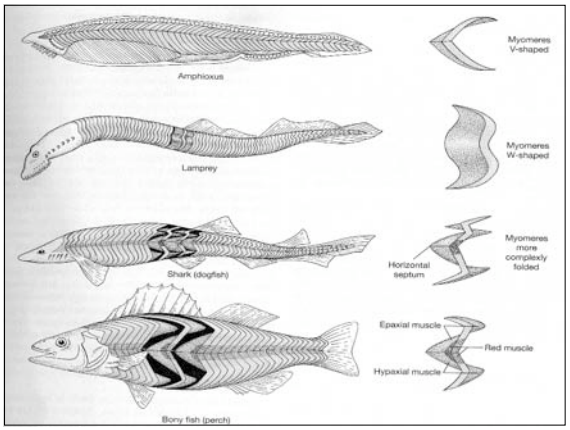
Chondrocranium-the skull

Splanchnocranium- the portion supporting the gills

Dermatocranium-an external covering.

Axial Skeleton and Musculature

- The notochord is the original “backbone” of all the chordates
- Vertebrae or cartilage or bone surround and replace the notochord as it develops, although portions remain as intervertebral disks in adult tetrapods
- The notochord is packed with incompressible fluid-filled vacuoles that make it rigid. It’s wrapped in a fibrous sheath and is the attahcment site for segmental muscles and connective tissues



Energy Acquisition in Support of Metabolism

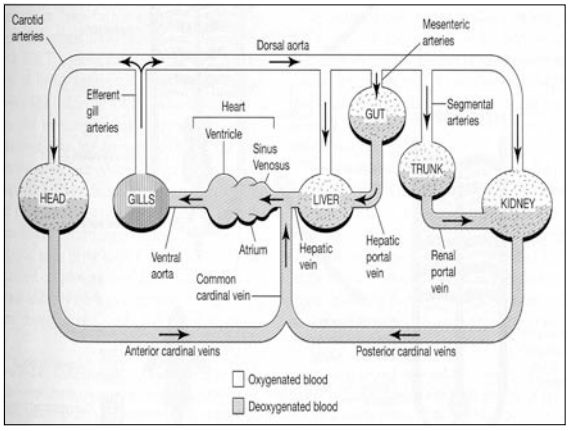
- Food is processed by the digestive system to release energy and nutrients which have to get to the tissues
- Oxygen is required for the process of energy release
- Therefore the gas exchange surfaces and the circulatory system are all closely intertwined with the digestive system

Feeding and Digestion

- Feeding: getting food into the mouth, chewing (maybe), and swallowing
- Digestion: breakdown of complex molecules for absorption through the gut
- Esophagus, stomach, intestine, cloaca or rectum

Respiration and Ventilation

- Ancestral chordates probably relied on gas exchange through the skin
- This is probably still important in modern amphibians but large body size and high levels of activity of most verts require a better system
- Gills do the work in water, lungs in air, and both these depend on large surface areas allowing for quick diffusion of oxygen into the blood



Excretory System

- Kidneys dispose of mostly nitrogenous waste products from protein metabolism and regulate water and minerals
- In the tetrapods, the kidneys do all this; in fish, the gills and skin also play a role
- Non-vertebrates lack true kidneys

Reproduction

- Vertebrates usually have two sexes producing egg and sperm which are released to combine and form the zygote
- The gonads producing these are paired, produce estrogen and testosterone, among other hormones
- In all but the jawless vertebrates, there are ducts which transport eggs and sperm to the cloaca or other exit
- Vertebrates may deposit eggs, retain eggs in the female, or are viviparous (live-bearing)

The Nervous System

- Vertebrates are unique in having a dual nervous system:
  - **Somatic** or **Voluntary**: innervates the limb muscles we consciously move and relays sensory information from the skin
  - **Visceral** or **Involuntary**: innervates organ muscles and the sensors that monitor things like blood pH.

Sensory System

- Complex multicellular sense organs are a derived characteristic of vertebrates
- Senses include: taste, tough, smell, sight, hearing (or other pressure sensors like the lateal line in fish), electroreception, and the ability to detect position (inner ear)