Embryology – Chapter 5

- Karl Von Baer (1792-1876) - Father of Modern Embryology
  - Von Baer's Law
    - During development, general characters appear before specific ones.
- Ernst Haeckel (1834-1919)
  - THE BIOGENETIC LAW
    - Ontogeny recapitulates Phylogeny
      - Ontogeny: the developmental history of an individual
      - Phylogeny: the history of an evolutionary lineage

- Combining from the ideas of Haeckel and Von Baer:
  - Early embryological stages of an organism resemble early embryological stages of more primitive forms.
  - There is a progressive divergence of similarity of forms during development.

- <u>MODES OF REPRODUCTION:</u>
  - *Ovipary*
    - eggs are laid or spawned
  - *Vivipary*
    - the egg is retained and the embryo develops within the mother
  - *Ovovivipary*
    - egg retained in the mother, development is internal, egg (yolk) provides entire nourishment of the embryo
  - *Euvivipary*
    - the embryo cannot develop without nourishment being constantly supplied by the mother

VERTEBRATE GAMETES (reproductive cells)

- Vertebrates are oogamous:
  - produce two types of reproductive cells (gametes).

1. Egg:
   - the larger and non-motile gamete, is produced by the female.
   - contains 1 haploid set of chromosomes
   - all cytoplasmic organelles
   - yolk (embryonic nutrition)

VERTEBRATE GAMETES (reproductive cells)

1. Sperm:
   - the smaller and mobile gamete, is produced by the male
   - supplies the nuclear material (1 haploid set of chromosomes) necessary for late embryonic development
   - supplies the stimulus to initiate egg division

EGG TYPES BASED ON THE AMOUNT OF YOLK

I. Microlecithal Egg
- relatively small egg with little yolk
- amphioxus and therian mammals

II. Mesolecithal Egg
- moderate size egg with a moderate amount of yolk
- lampreys, lower Actinopterygian fish, Sarcopterygian fish, amphibians
- is probably the primitive condition for vertebrates

III. Macrolecithal Egg
- relatively large egg with yolk constituting most of the volume
- chondrichthyeans, reptiles and birds, prototherian mammals

EGG TYPES BASED ON THE DISTRIBUTION OF YOLK

I. Isolecithal Egg
- yolk evenly distributed throughout egg
- only therian mammals

II. Telolecithal Egg
- yolk concentrated at one pole
- all other vertebrates + amphioxus

VERTEBRATE ONTOGENY

- Cleavage
  - early cell divisions from fertilized egg to blastula
- Blastulation
  - formation of a "hollow ball"
- Gastrulation
  - formation of zygote with multiple cell layers
  - for vertebrates, the ectoderm, mesoderm, and endoderm
- Neurulation
  - formation of a hollow nerve tube and splitting of layers to form internal cavities

THE PRIMARY GERM LAYERS AND THEIR GENERAL DERIVATIVES

- Ectoderm - the outer germ layer of the embryo
  1. Body (Skin) Ectoderm:
     - epidermis
     - linings of oral and urogenital cavities
     - epithelial structures
  2. Neurectoderm:
     - nervous system
     - eye retina
     - derivatives of the neural crest (mesectodermal tissues including the visceral skeleton)

THE PRIMARY GERM LAYERS AND THEIR GENERAL DERIVATIVES

- Mesoderm - the middle germ layer of the embryo
  1. Lateral Mesoderm:
     - skeletal and connective tissues
     - Musculature
     - vascular systems
     - urinary and genital systems (most)
     - lining of the coelomic cavity
  2. Chordamesoderm:
     - Notochord
     - necessary for the induction of the CNS

THE PRIMARY GERM LAYERS AND THEIR GENERAL DERIVATIVES

- Endoderm - inner germ layer of the embryo
  - lining of the digestive tract
  - digestive accessory organs (liver, pancreas, spleen)
  - most of the gills and lungs

❖ Gastulation results in a **triploblastic** organism – one with three distinctive germ layers.

Mesodermal Regions and Differentiation

1. Dorsal Mesoderm:
   - vertebral column and ribs with associated musculature
   - portions of the dermis attaching epidermis
2. Lateral Plate Mesoderm:
   a) somatic mesoderm (outer layer, adjacent to ectoderm)
      - connective tissues and blood vessels of body wall
      - limbs and limb girdles w/associated musculature
   b) splanchnic mesoderm (adjacent to endoderm)
      - smooth muscles and connective tissue of GI tract
      - heart and blood vessels of the viscera
3. Intermediate Mesoderm:
   - a ribbon of unsegmented mesoderm extending the length of the trunk
   - kidneys and urogenital system

- Mammalian birth patterns and the placenta
  - Infraclass Metatheria (except bandicoots)
    - Choriovitelline Placenta
  - Infraclass Eutheria
    - Chorioallantoic Placenta
    - Plus **trophoblastic** layer