

- **Kidney functions:**
    - regulation of water and salt balance within the body
    - elimination of waste
  - **Result is the production of urine**
    - Urine = water + salts + nitrogenous wastes
      - Nitrogenous wastes = ammonia, uric acid, or urea
  - **Salt balance**
    - also helped by:
      - Sweat glands – mammals
      - Nasal glands – birds
      - Rectal glands – elasmobranchs
      - Salt-excreting glands – marine fish
- 1) removal of salt from circulatory system  
 2) removal of excess water from circulatory system

---

---

---

---

---

---

---

---

---

---

- **Waste elimination:**
  - Catabolism of protein -> ammonia
    - Ammonia converted by liver into urea or uric acid
    - Non-toxic product removed by kidney
- **Three types of nitrogen removal in vertebrates:**
  1. **Ammonotelism** = direct removal of ammonia
    - Freshwater fish
  2. **Uricotelism** = excretion of uric acid
    - Reptiles & Birds
  3. **Ureotelism** = excretion of urea
    - Mammals, amphibians & marine fish

---

---

---

---

---

---

---

---

---

---

- Basic Kidney Structure**
- **Functional unit**
    - Kidney tubule
    - Renal tubule
    - Nephron
  - **Nephron divided into two portions:**
    1. **renal corpuscle**
      - composed of the glomerulus and a capsule
    2. **convoluted tubule**
      - drains fluid from the capsule and connects to a series of ducts leading to the ureter
  - **Most vertebrates have a final storage chamber**
    - the urinary bladder

---

---

---

---

---

---

---

---

---

---

- Three types of kidney tubule systems
  1. High output, low filtration kidney
    - amphibians, freshwater fish
    - large renal corpuscle, short convoluted tubule
  2. Low output, high filtration kidney
    - mammals & birds
    - large renal corpuscle, addition of the loop of Henle
  3. Low output, low filtration kidney
    - marine fish, reptiles
    - small renal corpuscle, very short distal tubule

---

---

---

---

---

---

---

---

- Kidney development
  - Tripartite concept of development
  - Initial development along the nephric ridge
  - Nephrotomes develop along the ridge within each body segment
  - Connected to one another via the archinephric duct
  - Appear early in development from anterior to posterior
    - Important in filtering early developmental nitrogenous wastes

---

---

---

---

---

---

---

---

- **Pronephros kidney**
  - First segment of the kidney to develop
  - Filters fluid from the coelomic cavity
  - Usually degenerates late in development
- **Mesonephros kidney**
  - Middle segment of the kidney
  - Taps into archinephric duct
  - May degenerate through development
- **Metanephros kidney**
  - Last portion to develop
  - Develops its own collection tube – the ureter
- If all three portions function simultaneously, termed Holonephric kidney
- Opisthonephric kidney = Holonephric kidney – Pronephros portion

---

---

---

---

---

---

---

---

- Mammalian kidney unique
  - No longer confined to the nephric ridge
  - Ureter expands to form **renal pelvis**
  - Urine is collected within numerous **calyces**
  - Each calyx is fed by a **renal pyramid**
  - **Cortex** = glomeruli + proximal and distal convoluted tubules
  - **Medulla** = loop of Henle

---

---

---

---

---

---

---

---

#### Genital Development

- Initial development referred to as the **indifferent stage** of development
  - males & females develop the same
  - gene products determine if future development is male or female
  - gonads located in same position with the same ducts
- Gonads develop along the genital ridge (adjacent to the nephric ridge)
- Both sexes develop **primary sex cords** extending into the tissue

---

---

---

---

---

---

---

---

- Ovary development
  - **secondary sex cords** innervate the gonadal tissue
    - primary sex cords degenerate
    - secondary cords differentiate into the **ova** and **follicular cells**
    - upon maturation these cells move to the surface of the ovary
    - egg is released, and follicle becomes the **corpus luteum**

---

---

---

---

---

---

---

---

- Oviduct development
  - archinephric duct of urinary system expands dorsally into the body wall
  - body wall folds to become the oviduct
  - anterior end = ostium or infundibulum
    - surrounded by mesentery to "channel" eggs into opening
- Specializations within the oviduct:
  - ovisac
  - shell gland
  - uterus
  - vagina

---

---

---

---

---

---

---

---

- 4 Types of Mammalian Uteri:
  - duplex
    - seen only in marsupials
  - bipartite - body with median septa
  - bicornuate - body without septa
    - most common in eutherian mammals
  - simplex - total fusion of uterine horns

---

---

---

---

---

---

---

---

- Testis Development
  - reproductive tissues develop from **primary sex cords**
    - **interstitial cells** - produce testosterone
    - **seminiferous tubules** - produce sperm from epithelium
    - **Sertoli cells** - assist meiotic cells (nutrients)

---

---

---

---

---

---

---

---

- Male Ducts

- archinephric duct taken over by testis
  - now called **ductus deferens**
  - sperm transported via **central canal** or **rete testis**
- modifications of the ductus deferens:
  - **epididymis** for temporary sperm storage & maturation
  - **vesicular glands** for the secretion of seminal fluid
  - **Prostate & bulbourethral** glands for additional fluids

---

---

---

---

---

---

---

---