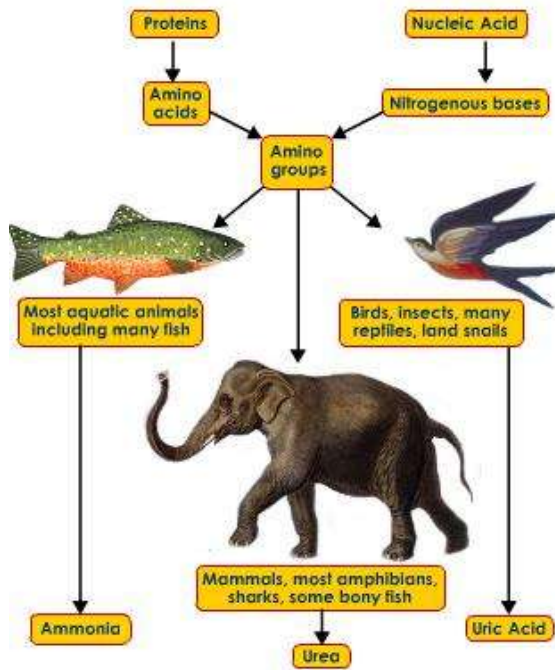


# Chapter 51

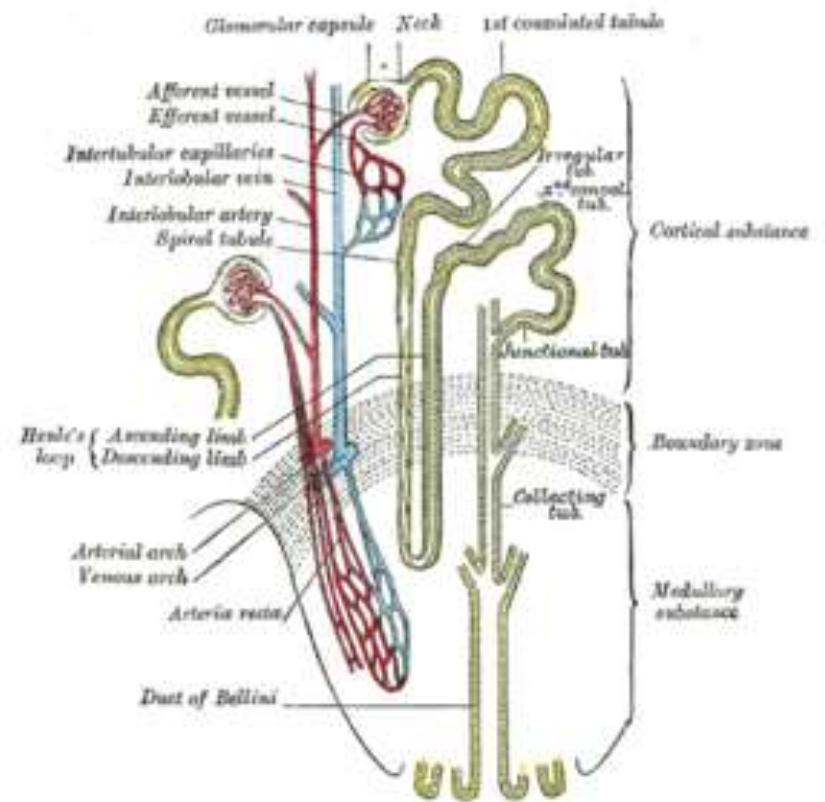
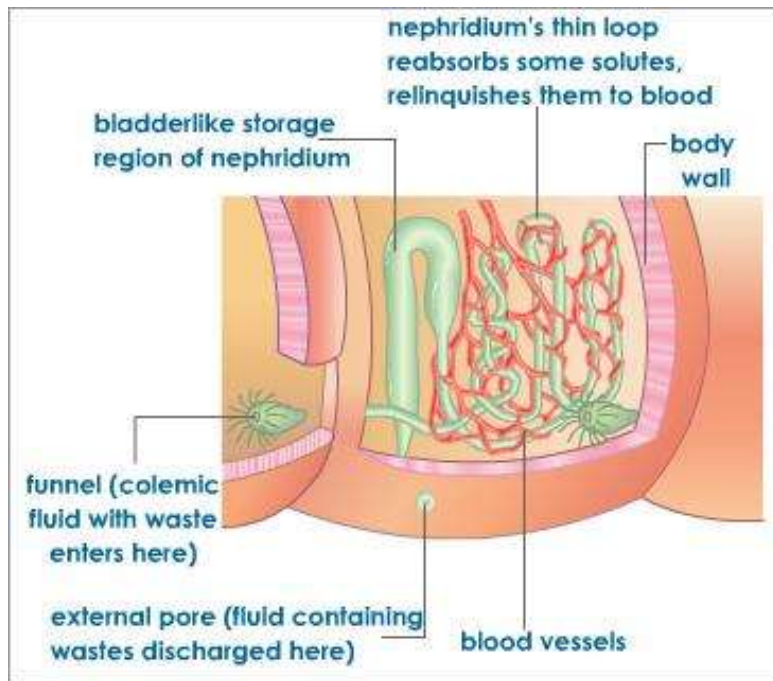


- Osmotic Regulation and the Urinary System

# QOD



- Animals have a wide variety of excretory organs. Though they all serve the same basic purpose of maintaining osmotic balance, they have significant structural differences. Compare and contrast nephridia and the kidneys.



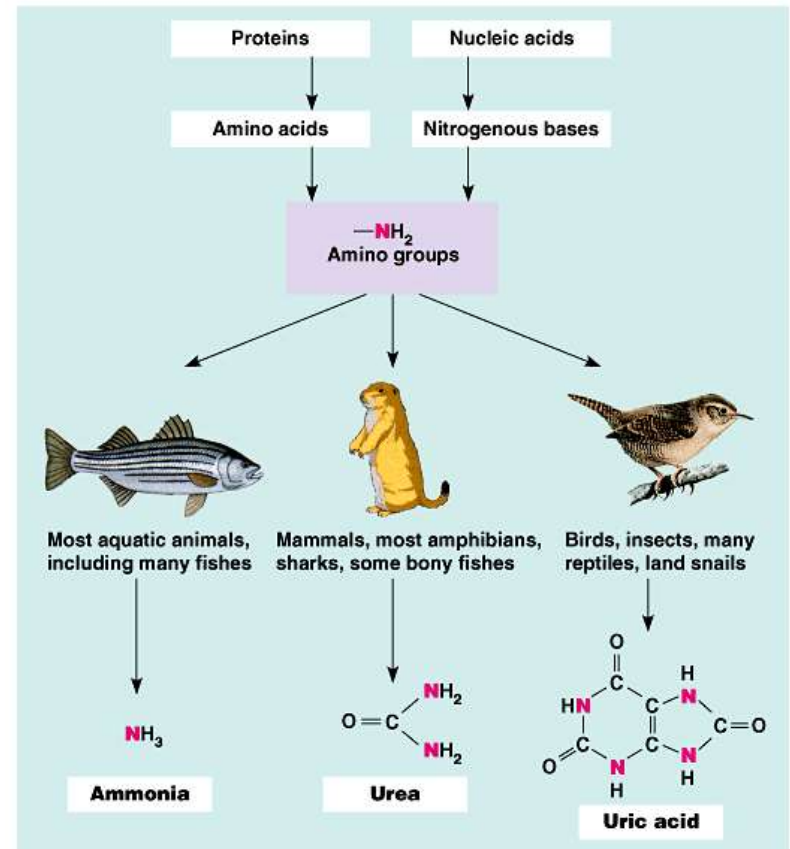
# *Homeostasis*: regulation of internal environment

- **Thermoregulation**      internal temperature
- **Osmoregulation**      solute and water balance
- **Excretion**      nitrogen containing waste



# Water balance and waste disposal

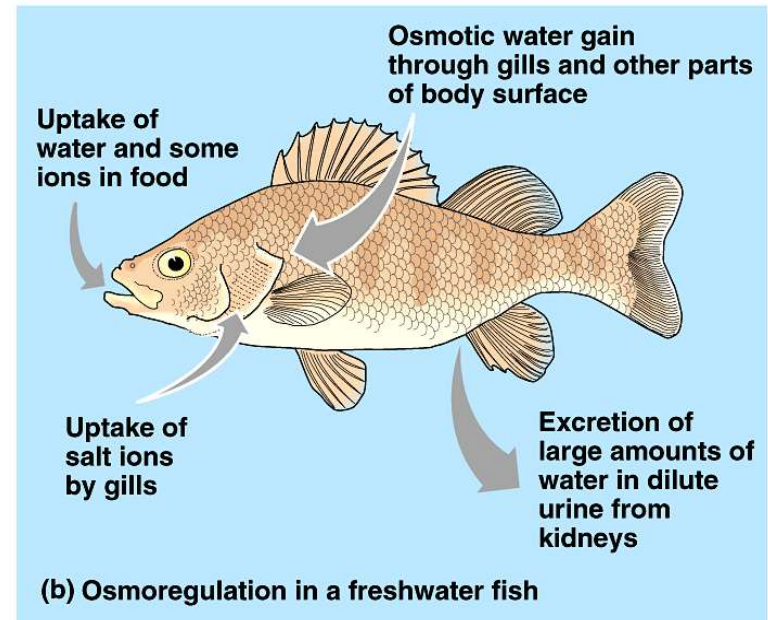
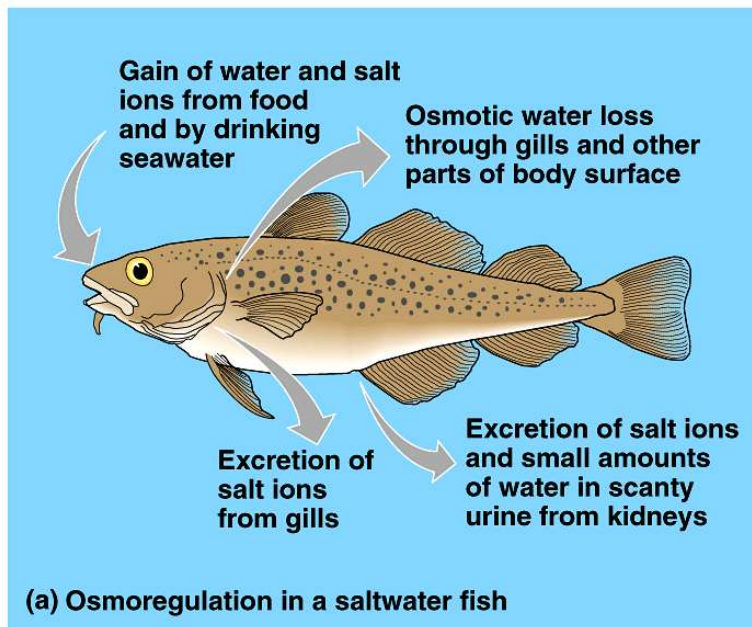
- Osmoregulation - management of the body's water content and solute composition
- Nitrogenous wastes - breakdown products of proteins and nucleic acids;
  - **Ammonia**: most aquatic animals, many fish – VERY TOXIC
  - **Urea**: mammals, most amphibians, sharks, bony fish (in liver; combo of  $\text{NH}_3$  and  $\text{CO}_2$ )
  - **Uric acid**: birds, insects, many reptiles, land snails



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# Osmoregulators

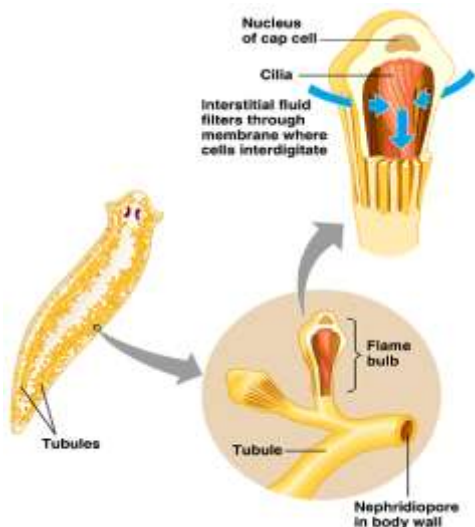
- Osmoconformer: no active adjustment of internal osmolarity (marine animals); isoosmotic to environment
- Osmoregulator: adjust internal osmolarity (freshwater, marine, terrestrial)
- Freshwater fishes gains water, loses; excretes large amounts of urine salt vs. marine fishes loses water, gains salt; drinks large amount of saltwater



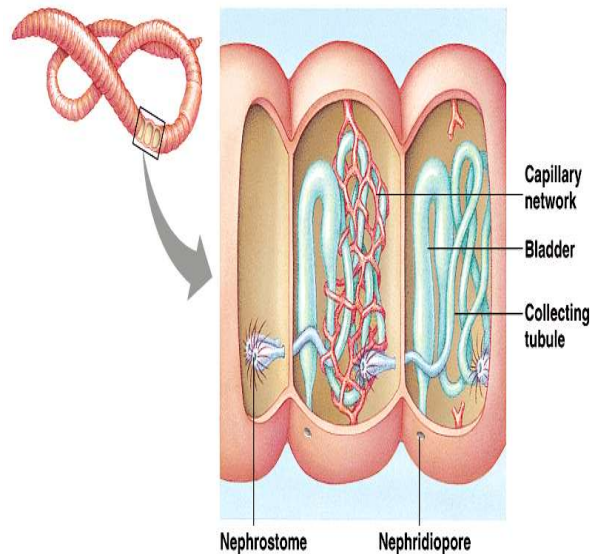


# Excretory Systems

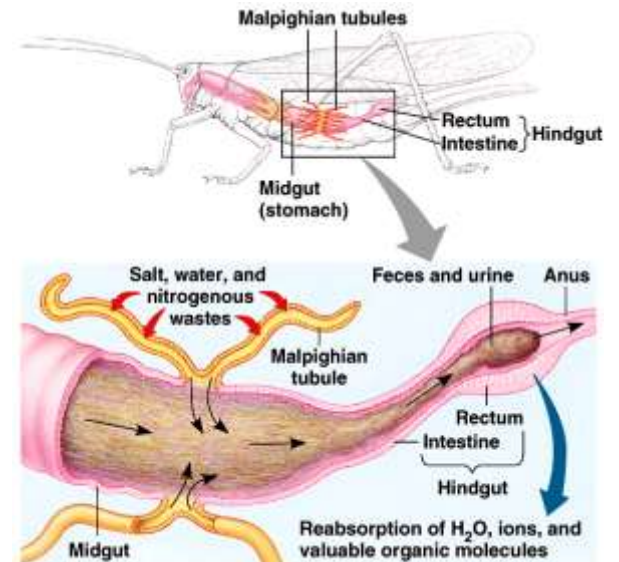
- Production of urine by 3 steps: •
  - Filtration
  - Reabsorption
  - Secretion
- Protonephridia ~ flatworms (“flame-bulb” systems)
- Metanephridia ~ annelids (ciliated funnel system)
- Malpighian tubules ~ insects (tubes in digestive tract)
- Kidneys ~ vertebrates



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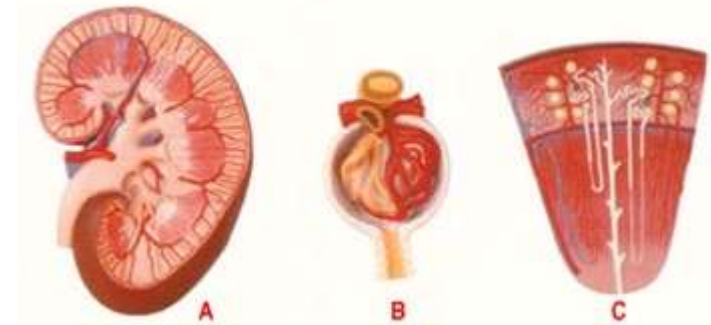
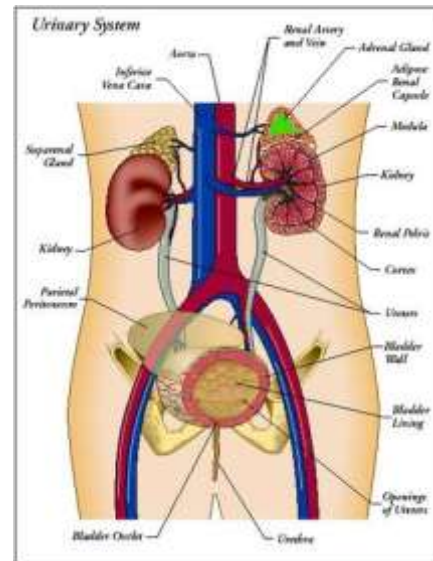
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# Kidney Functional Units

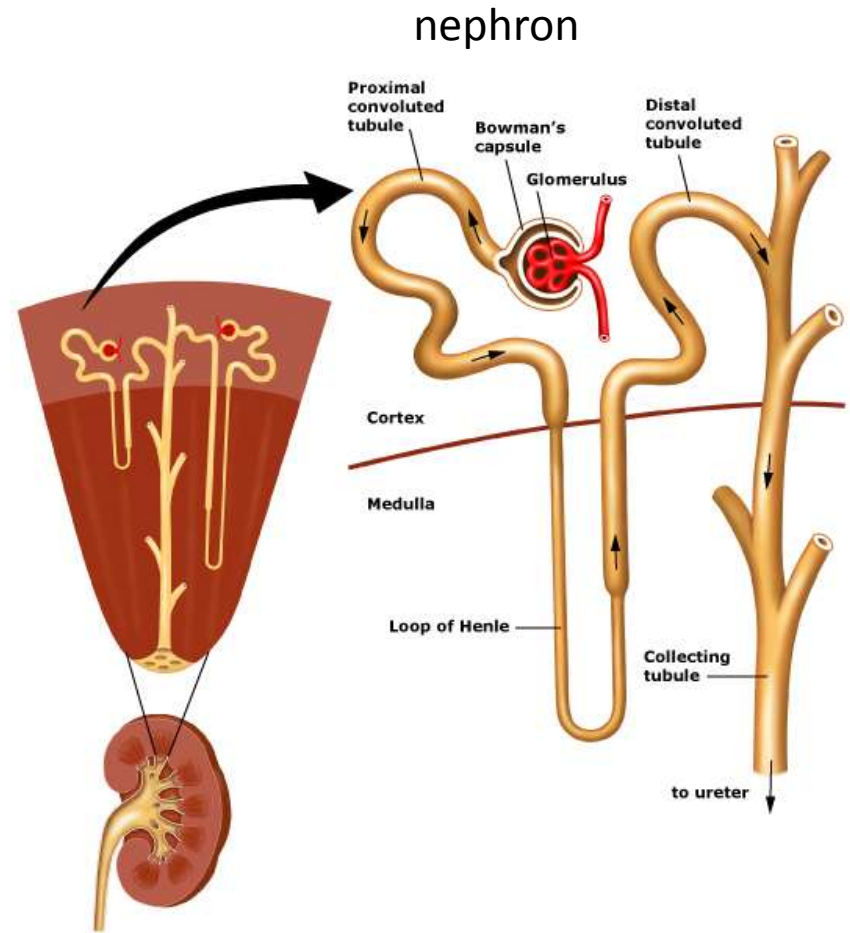
- Renal artery/vein: kidney blood flow
- Ureter: urine excretory duct
- Urinary bladder: urine storage
- Urethra: urine elimination tube
- Renal cortex (outer region)
- Renal medulla (inner region)
- Nephron: functional unit of kidney
- Cortical nephrons (cortex; 80%)
- Juxtamedullary nephrons (medulla; 20%)



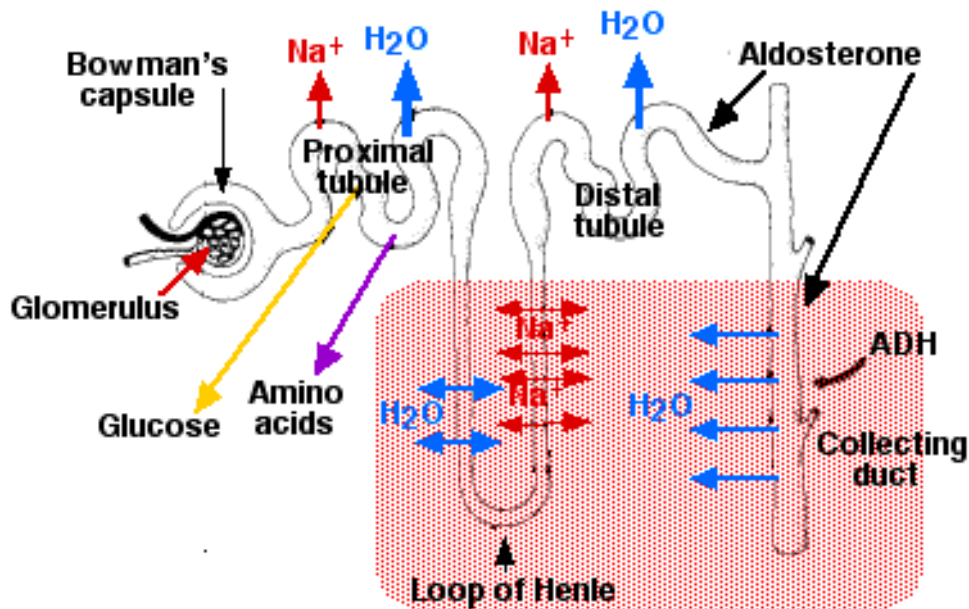


# Nephron Structure

- Afferent arteriole: supplies blood to from renal artery
- Glomerulus: ball of capillaries
- Efferent arteriole: blood from
- Bowman's capsule: glomerulus
- Proximal tubule: reabsorption
- Peritubular capillaries: efferent arteriole; tubules
- Loop of Henle: water & salt balance
- Distal tubule: secretion & reabsorption
- Collecting duct: renal pelvis



# In and Out in the Kidney



- Active AND passive transport
- Different permeability in each region
- Osmolarity

# Kidney regulation: hormones

- **Antidiuretic hormone (ADH)** ~ secretion increases permeability of distal tubules and collecting ducts to water (H<sub>2</sub>O back to body); inhibited by alcohol and coffee
- **Juxtaglomerular apparatus (JGA)** ~ reduced salt intake--->enzyme renin initiates conversion of angiotensin (plasma protein) to angiotensin II (peptide); increase blood pressure and blood volume by constricting capillaries
- **Angiotensin II** also stimulates adrenal glands to secrete aldosterone; acts on distal tubules to reabsorb more sodium, thereby increasing blood pressure (renin-angiotensin-aldosterone system; RAAS)
- **Atrial natriuretic factor (ANF)** ~ walls of atria; inhibits release of renin, salt reabsorption, and aldosterone release

