

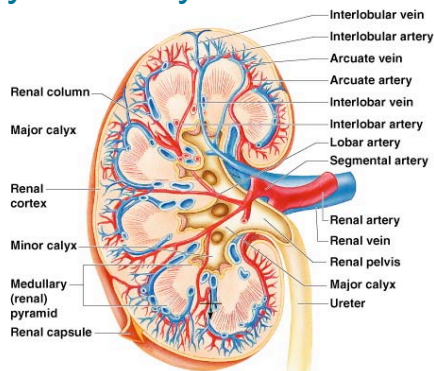
## The urinary system

- Structure and physiology of the kidney
- Major urinary structures and their function
- Urine: formation of and normal components and characteristics of
- Role of the renal system in fluid and electrolyte balance

## Kidney location



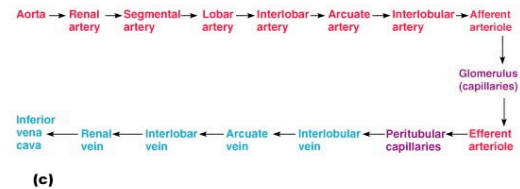
## Kidney anatomy



## Blood supply to the kidneys

Approximately 1/4 of our blood is filtered by the kidneys every minute!

Kidneys are partly responsible for blood composition



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## Nephrons

Structural and functional unit of kidneys;  
responsible for urine formation

Consists of two main structures:

*glomerulus*

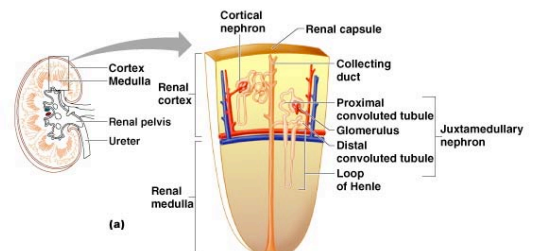
*renal tubule*

Two types of nephrons:

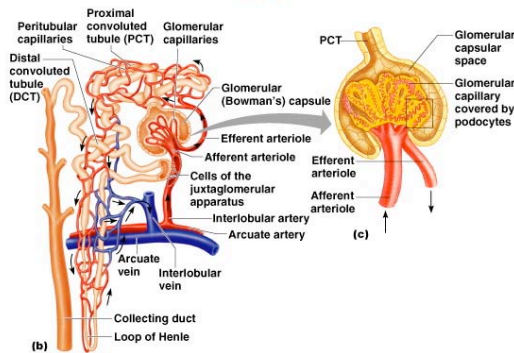
*juxtamedullary*

*cortical*

## Nephron anatomy



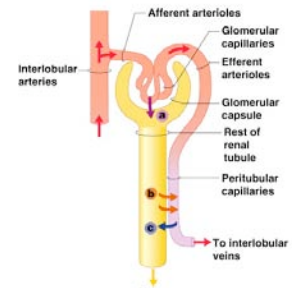
# Nephron anatomy



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# Urine formation

- Filtration
- Tubular reabsorption
- Tubular secretion



## Filtration

- Takes place at *glomerulus*
- Non-selective, passive process
- Filtrate* is essentially blood plasma without any proteins
- Normal blood pressure is normally sufficient for filtrate formation

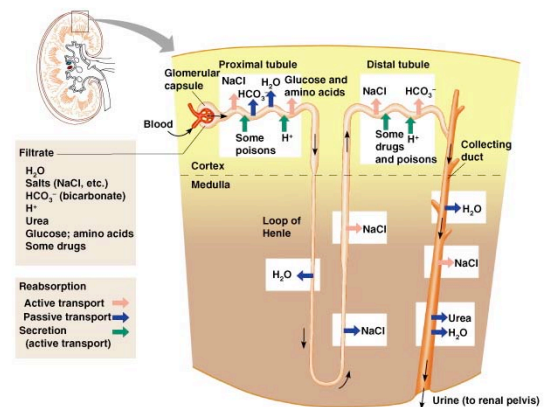
## Tubular reabsorption

- Mostly occurs in *proximal convoluted tubule*
- Many useful substances must be reclaimed by the blood (water, glucose, amino acids, ions)
- Some is done *passively* (water --> *osmosis*)
- Most is done *actively* (requires ATP); tubules contain selective transporters
- Waste products (*urea, uric acid, creatinine*) are hardly reabsorbed at all
- Ions are reabsorbed selectively, depending on need

## Tubular secretion

- Essentially reabsorption in reverse
- Important for getting rid of substances not already in the filtrate such as drugs
- Can also be used to control blood pH

## Urine formation



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## Urine

In 24 hours, you filter about 175 liters of blood plasma

You only produce 1-1.8 liters of urine

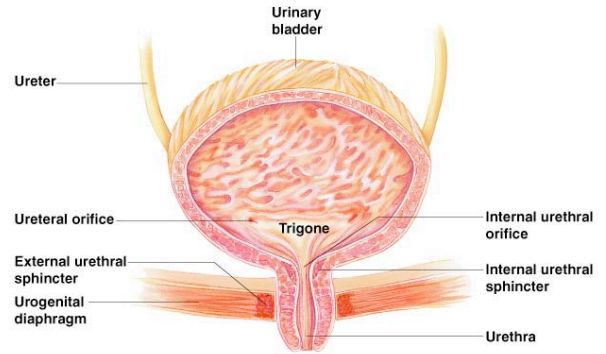
Urine contains nitrogenous wastes and unneeded substances

Generally clear to deep yellow (yellow is due to *urochrome*)

Urine is sterile

Smells like ammonia only after bacteria have invaded it

## Other urinary anatomy



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## Kidney functions

- (1) Excretion of nitrogenous wastes
- (2) Water and
- (3) Electrolyte balance of the blood
- (4) Ensuring proper blood pH

## Water balance

Water is probably between 50-60 percent of your body mass

Even though water plays a large role in our body, salts (electrolytes) must also be taken into consideration

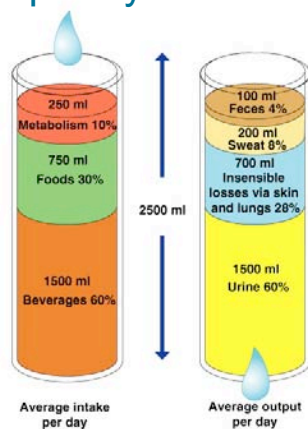
Total body water volume = 40 L, 60% body weight		
Extracellular fluid (ECF) volume = 15 L, 20% body weight		
Intracellular fluid volume = 25 L, 40% body weight	Interstitial fluid volume = 12 L, 80% of ECF	Plasma volume = 3 L, 20% of ECF

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## Maintaining proper hydration

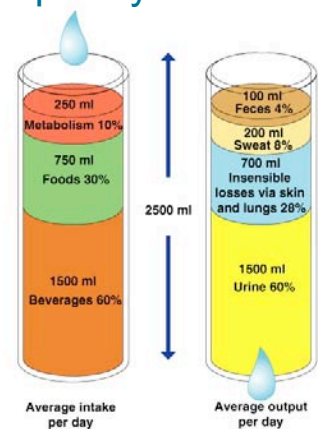
Water and electrolyte *reabsorption* in the kidneys is regulated by *hormones*

When blood pressure drops, *osmoreceptors* signal the release of *antidiuretic hormone*, which causes increased water *reabsorption*



## Maintaining proper hydration

When blood is too dilute, *aldosterone* inhibits the absorption of sodium, which causes water to flow into the blood



## Blood acid-base balance

Blood pH must be maintained between 7.35-7.45

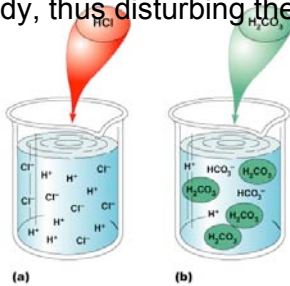
Hydrogen ions continuously are produced in the body, thus disturbing the **acid-base balance**

The three major blood buffers are:

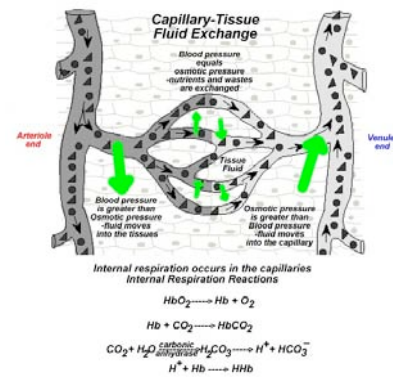
Bicarbonate

Phosphate

Protein buffers



## Respiratory system controls



## Renal control

Kidneys maintain acid-base balance by:

excreting bicarbonate ions

reabsorbing bicarbonate ions