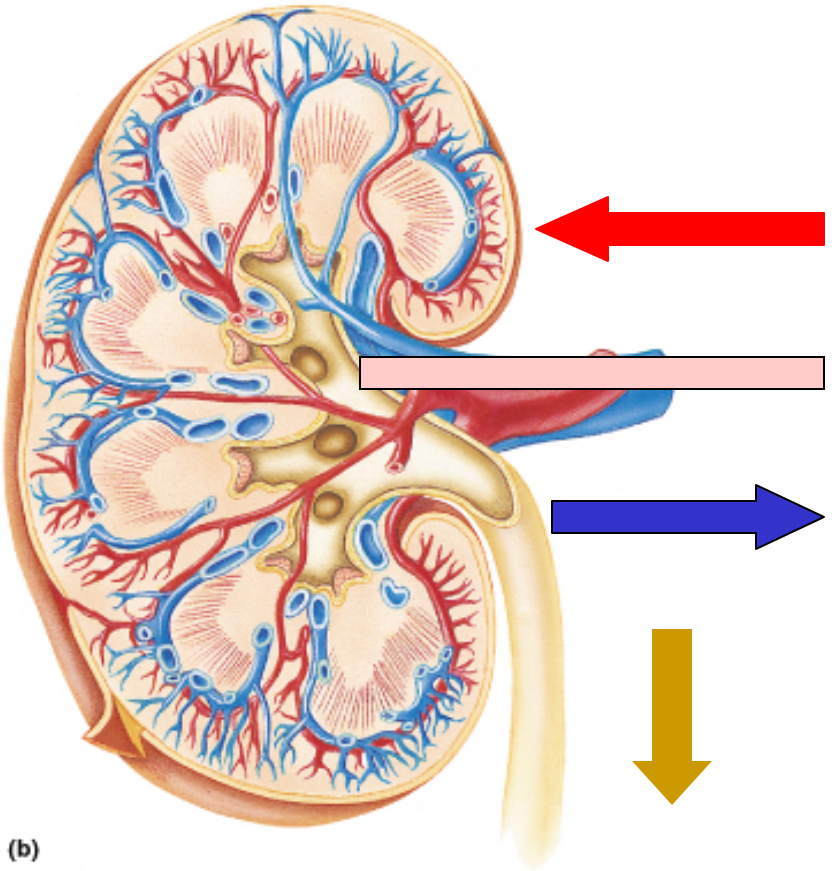
Kidney



(b)

4 fluids:

arterial blood enters

kidney filtrate stays

veinal blood leaves

urine leaves

Blood & Urine Changes

Blood changes (arterial -> veinal)

- **blood becomes cleaner**
- **retained: cells, proteins, glucose, ions, water**
- **removed: wastes, excess (water, acid, ions)**

Urine changes (filtrate ->urine)

- **urine becomes concentrated**

1) **normal: wastes, excess (water, acid, ions)**
2) **abnormal: cells, proteins, glucose, ions, water**

Nephron - 2 Flows

Urine Flow	Blood Flow
1) Bowman's cap.	1) interlobular art.
(glomerular cap.)	2) afferent arteriole
2) PCT	3) glomerulus*
3) loop of Henle	4) efferent arteriole
- descending limb	5a) peritub. cap.* (cortex)
4) loop of Henle	5b) vasa recta* (medulla)
- ascending limb	6) interlobular vein
5) DCT	
6) collecting duct	*3 capillaries

Secretion Process

secretion: blood loses wastes
force: A/T, diffusion

wastes:

1) metabolic - natural, prod. by body

- urea, creatinine, uric acid, ammonium,

NT (epinephrine, ACH, dopamine), bile pigments

2) foreign - drugs, chem. not prod. by body

- penicillin, atropine, cocaine, morphine, marijuana, preservatives, pesticides, saccharin

Reabsorption Process

reabsorption: blood regains plasma
force: A/T (salt), diffusion (water)

4 phases reabsorption :
R1 PCT -> peritub. cap. (65%)*
R2 loop of Henle -> vasa recta (20%)**
R3 DCT -> peritub. cap (1-14%)**
R4 coll. duct -> peritub. cap (1-14%)**

***water, salt, plasma solutes**
**** water & salt only**

Loop of Henle

counter-current multiplier mech.

a) descending limb

- **water moves out (osmosis)**
- **filtrate becomes concentrated**
- **isotonic (300) → hypertonic (900)**
- **walls: salt imperm; water perm.**

b) ascending limb

- **salt moves out (active transport)**
- **filtrate becomes dilute**
- **hypertonic (900)→ hypotonic (100)**
- **walls: salt perm; water imperm.**

Vasa Recta

counter-current exchanger mech.

a) descending limb

- **water moves out; salt moves in accord. to IF salt gradient**
- **filtrate becomes concentrated**
- **isotonic (300) → hypertonic (900)**
- **walls: salt & water perm.**

b) ascending limb

- **water moves in; salt moves out accord. to IF salt gradient**
- **filtrate becomes dilute**
- **hypertonic (900)→ isotonic (300)**
- **walls: salt & water imperm.**

R3 & R4 (2)

1) DCT & collecting duct
   - filtrate releases water, salt, urea

2) IF = transport medium w/ salt gradient

3) peritubular capillary
   - blood regains water (1-14%) & salt
   - "obligatory water loss" (1%) to excrete wastes

4) hormonal & neural reg.
   - Δ salt & water perm. on DCT & coll. duct
     → Δ diuresis (urine prod/rel.) &/or thirst

Excretion Process

excretion*: urine removed from body

force: urination (muscle contraction)

urine = water, wastes (natural & foreign), and excess plasma (ions, acids, water)

urine types:

1) sparse: ↓ vol , ↑ salt (usu. concentrated)
2) copious: ↑ vol , ↓ salt (usu. dilute)

***note:** excretion also refers to urine formation

Diuresis

diuresis = urine prod. & release

↑fluid intake → diuresis → ↑ excretion (urine)

diuretic mech. (hormonal & neural):

1) **↓ADH → ↓H_20 perm. →↓H_20 reab.**
2) **↓aldosterone → ↓salt perm. →↓H_20 reab.**
3) **↓ plasma conc. → osmoreceptors → hypothal. → pituitary → ↓ADH etc.**

Q: Why is happy hour food so salty?

Renal Functions (1)

1) Reg. blood wastes level

Δ metab. → Δblood urea → Δ tissue urea → ↑ toxicity

eg ↑exercise → ↑blood urea→ ↑urine urea→ reg. blood urea

2) Reg. blood pH level (acid-base bal)

Δ acid conc → Δ blood acid → Δ tissue acid → cell prob.

eg ↑ acid intake* →↓blood pH→ ↑urine acid→reg. blood pH**

***acid sources: food (eg orange juice), exercise (lactic acid), breathing (carbonic acid)**

****buffers: excrete H^+, reabsorb HCO_3^-**

Renal Functions (2)

3) Reg. blood fluid level (BP)

Δ fluid vol → Δ blood vol → ΔBP → edema

eg ↑ fluid intake →↑BV→ ↑urine vol →↓BV→reg BP

4) Reg. blood ion levels (ion bal)

Δ salt conc → Δblood ion → Δ tissue ion → thirst

eg ↑salt intake → ↑blood salt→ ↑urine salt→reg blood salt