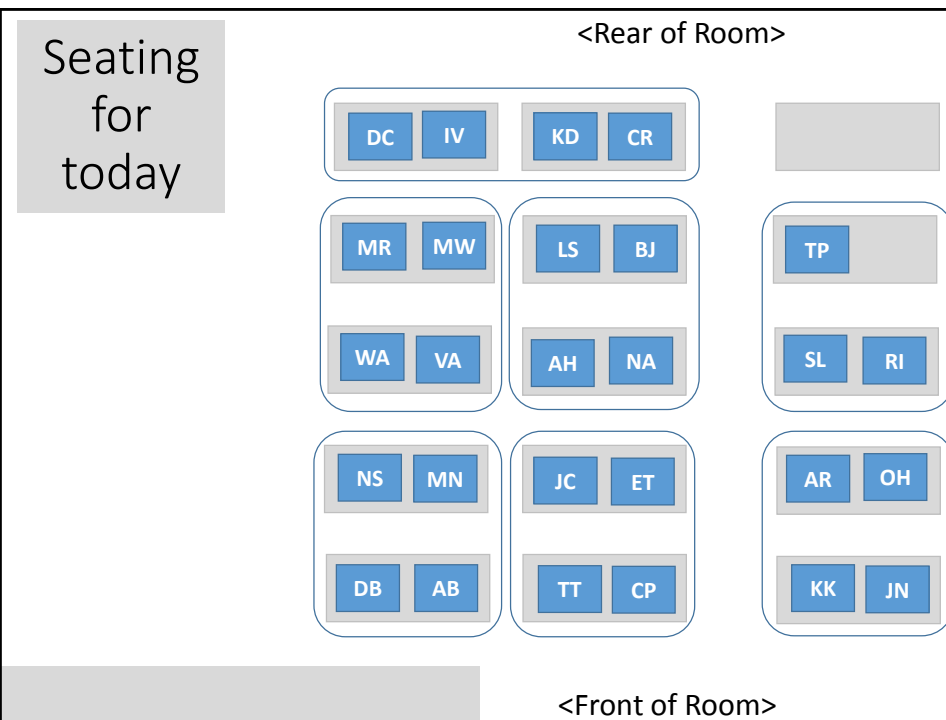


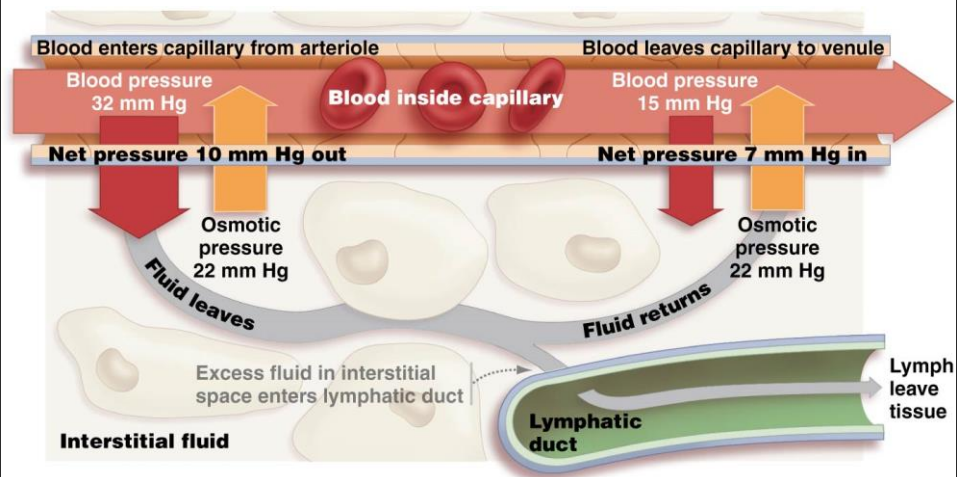
BBio 242 – August 6, 2015

- Finish Chapter 24 (The Digestive System)
 - Digestion
 - Absorption
 - Accessory organs
- Chapter 26: The Urinary System
 - Overview: structures and processes
 - Glomerular filtration
 - Journey through the nephron



[Review figure from Chapters 21 and 23]

The capillaries: hydrostatic vs. osmotic pressure



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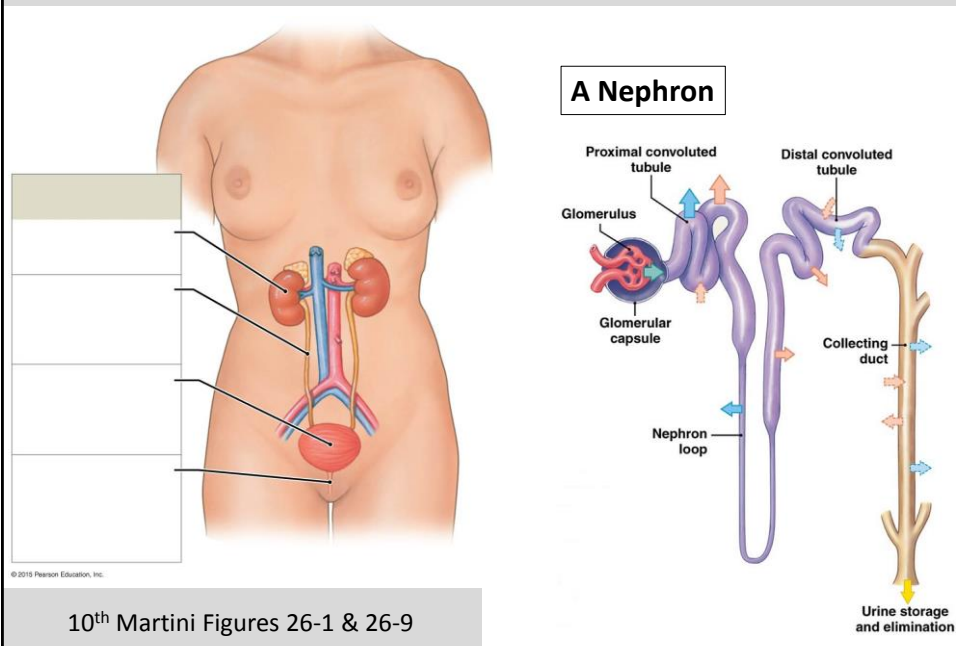
Freeman et al., *Biological Science* (5th edition)

[Review slide from Chapter 21]

Baroreceptors and negative feedback

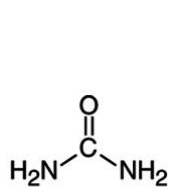
- ↑ blood volume → ↑ BP
- LONGER-TERM: hormones (how does each help?)
 - Antidiuretic Hormone (ADH) → pee less, retaining more H_2O (see ch. 26)
 - Aldosterone → retain salt and thus retain H_2O
 - Erythropoietin (epo) → ↑ RBC production

Components of the Urinary System



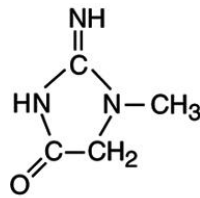
5 (or 2) functions of the urinary system

3 main waste products: urea, creatinine, uric acid



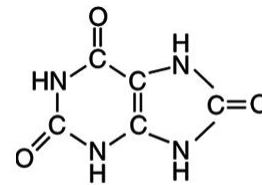
Urea

molecular weight
= 60



Creatinine

molecular weight
= 113



Uric acid

molecular weight
= 168

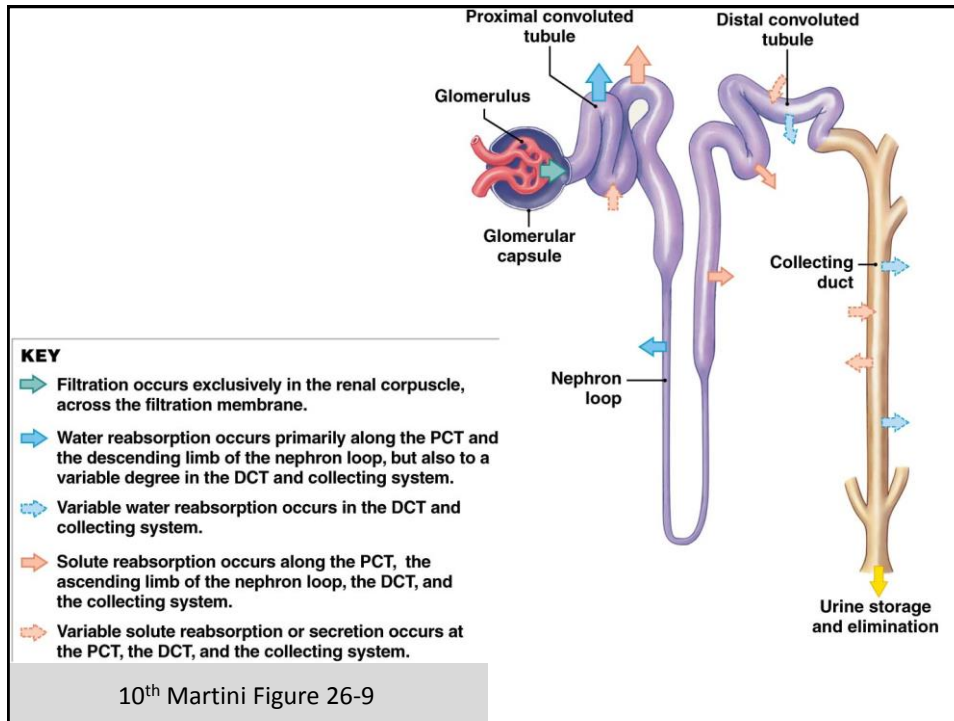
slideshare.net/paripreeshay/702-kidney

3 processes: filtration, secretion, reabsorption

	Direction	Protein carriers used?
Filtration		
Secretion		
Reabsorption		

Filtration rate + secretion rate – reabsorption rate = excretion rate!

10th Martini Figure 26-9



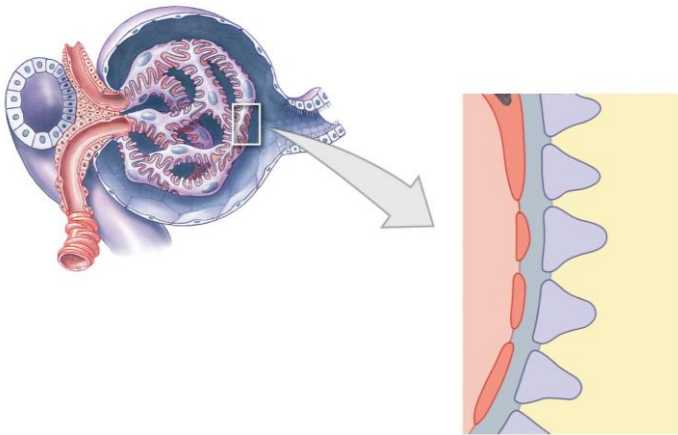
Speculating about evolution

We filter all small solutes, then have to reabsorb everything we want to keep, using lots of ATP.

Theoretical alternative: don't filter, only secrete bad stuff.

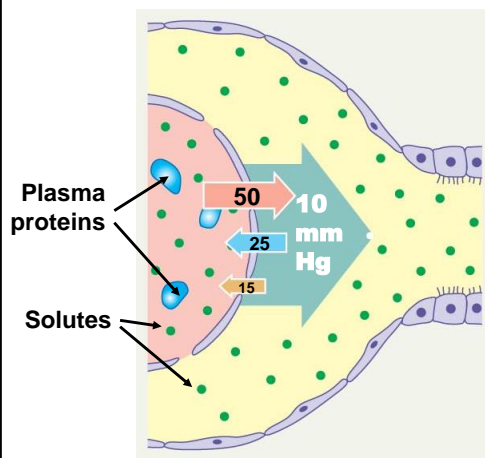
Why do we do it the way we do?

Glomerular filtration



10th Martini Figure 26-10a

Pressures controlling glomerular filtration rate (GFR)



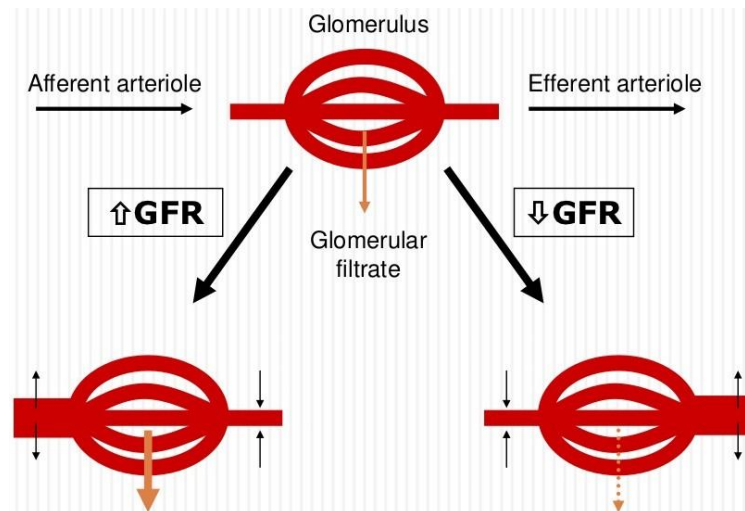
10th Martini Figure 26-10b

Regulation of GFR

Why regulate GFR?

Local vs. systemic regulation

Local regulation of GFR (autoregulation)



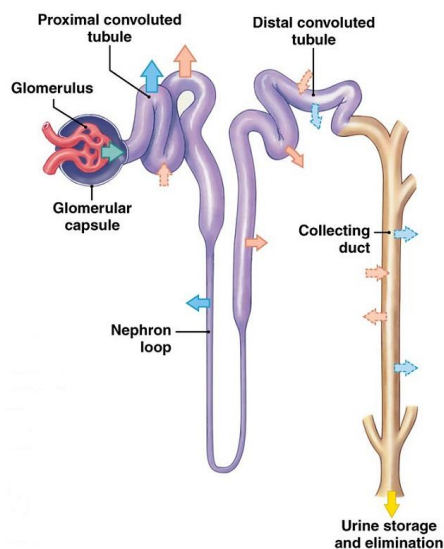
slideshare.net/MohammedGawad/renal-physiology-ii-glomerular-structure-filtration

The human heart pumps about 7000 liters of blood per day. ~20% goes to the kidney, and ~20% of the kidney's fluid is filtered into Bowman's capsules.

If there were no reabsorption of fluid from the nephron lumen back into the blood, how much urine would you generate?

- A. 0 liters per day
- B. 2.8 liters per day
- C. 14 liters per day
- D. 280 liters per day
- E. 1400 liters per day








Journey through the nephron

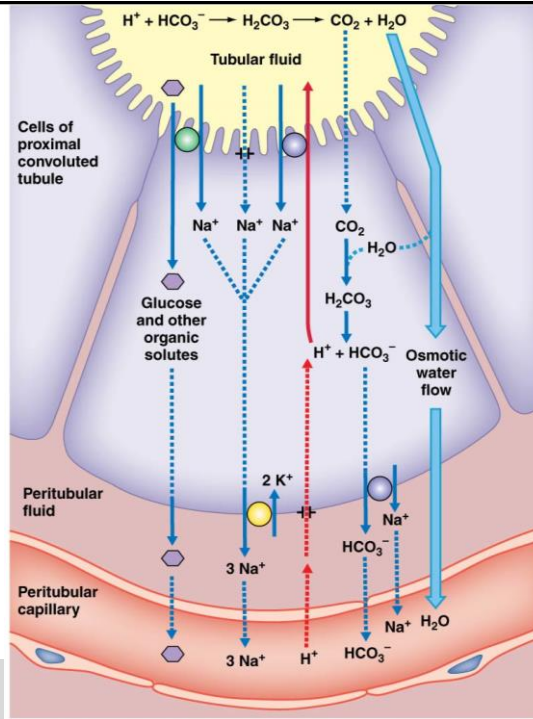


10th Martini Figure 26-9

Proximal Convoluted Tubule

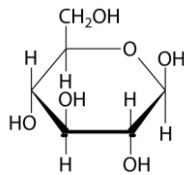
KEY

-  Leak channel
-  Countertransport
-  Exchange pump
-  Cotransport
-  Diffusion
-  Reabsorption
-  Secretion



10th Martini Figure 26-12b

Glucose in the urine?



Glucose
(mg/min)

How much is...
...filtered?
...secreted?
...reabsorbed?

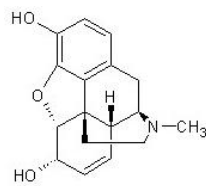
100

200

Plasma [glucose] (mg/dL)

Glucose structure: chemeddl.org

Morphine in the urine?



Morphine
(mg/min)

How much is...
...filtered?
...secreted?
...reabsorbed?

Plasma [morphine]

Morphine structure: sciencebase.com

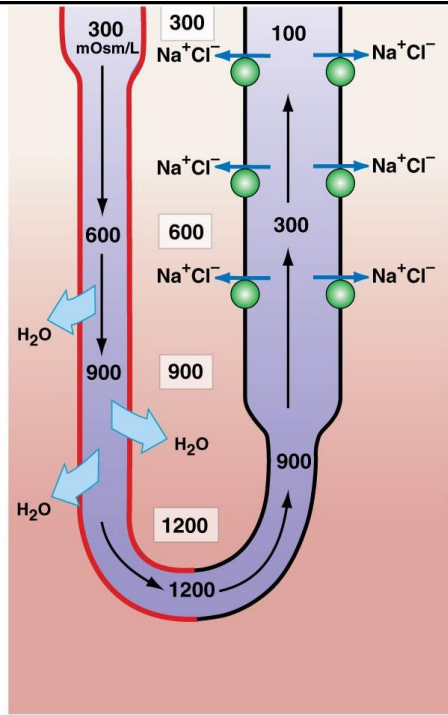
Protein in the urine?

Protein
(mg/min)

How much is...
...filtered?
...secreted?
...reabsorbed?

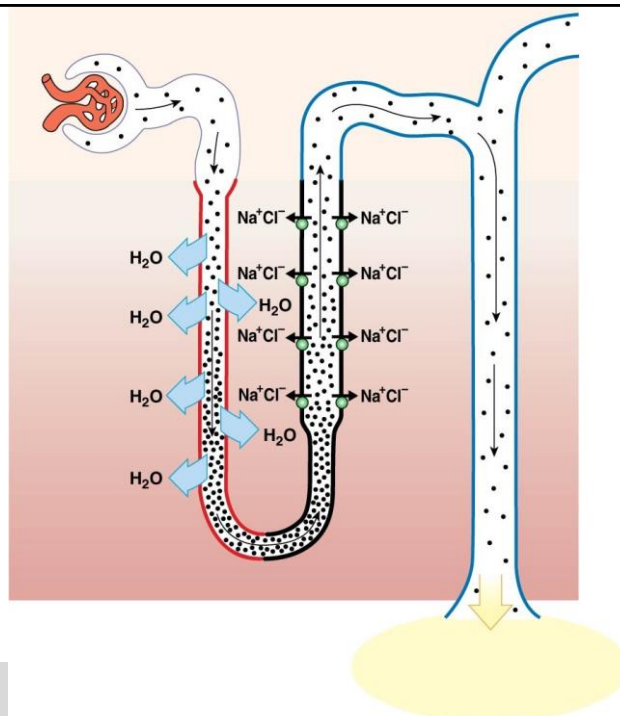
Plasma [protein]

Loop of Henle



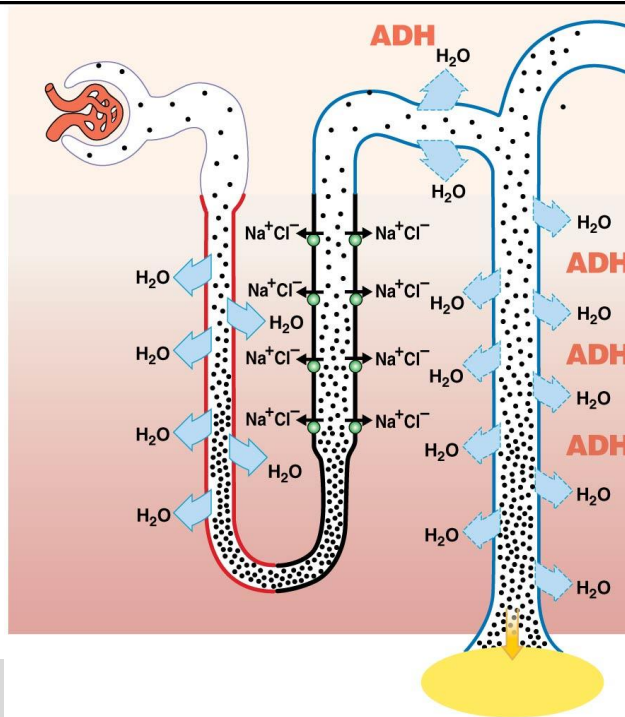
10th Martini Figure 26-13b

Collecting duct



10th Martini Figure 26-15a

Collecting duct



10th Martini Figure 26-15b

“Henle’s Water Music”

Where osmolarity is high
In the renal interstitium,
That's where water will diffuse
If the pores are in position.

So when ADH is high,
And it's water that you're missin',
Aquaporins in the duct
Lower water loss from pissin'!

<http://faculty.washington.edu/crowther/Misc/Songs/osmolarity.shtml>

Why not just have aquaporins permanently installed in the collecting duct?

End-of-chapter questions

16. When the renal threshold for a substance exceeds its tubular maximum

- (a) More of the substance will be filtered
- (b) More of the substance will be reabsorbed
- (c) More of the substance will be secreted
- (d) The amount of the substance that exceeds the tubular maximum will be found in the urine
- (e) Both A and D

25. In a normal kidney, which of the following conditions would cause an increase in glomerular filtration rate (GFR)?

- (a) Constriction of the afferent arteriole
- (b) A decrease in the pressure of the glomerulus
- (c) An increase in the capsular hydrostatic pressure
- (d) A decrease in the concentration of plasma proteins in the blood
- (e) A decrease in the net glomerular filtration process

10th Martini, p. 1014

End-of-chapter questions

27. In response to excess water in the body,

- (a) Antidiuretic hormone is secreted by the anterior lobe of the pituitary gland
- (b) The active transport mechanisms in the ascending limb of the loop of Henle cease functioning
- (c) The permeability of the distal convoluted tubules and collecting ducts to water is decreased
- (d) The permeability of the ascending limb of the loop of Henle is increased
- (e) The glomerular filtration rate is reduced

27. Mannitol is a sugar that is filtered, but not reabsorbed, by the kidneys. What effect would drinking a solution of mannitol have on the volume of urine produced?

10th Martini, p. 1014

PhysioEx Exercise 9: Renal System Physiology

Activity 1: The Effect of Arteriole Radius on Glomerular Filtration

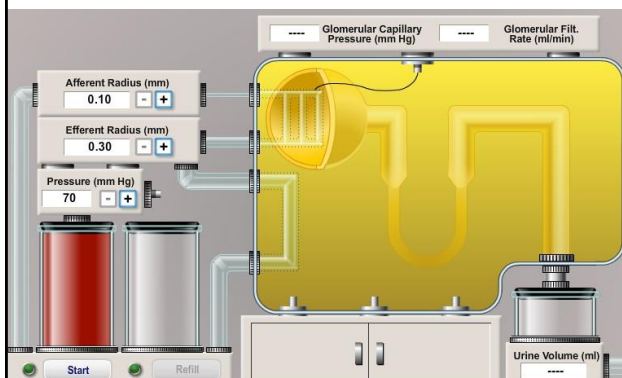
Activity 2: The Effect of Pressure on Glomerular Filtration

Activity 3: Renal Response to Altered Blood Pressure

Activity 4: Solute Gradients and Their Impact on Urine Concentration

Activity 5: Reabsorption of Glucose via Carrier Proteins

Activity 6: The Effect of Hormones on Urine Formation



Due date moved
back to Aug. 18
(but don't wait 'til
the last minute...)