**Exam 13**
**Apr 14th Monday**

## Filtration of plasma figure 14-7, 14-8

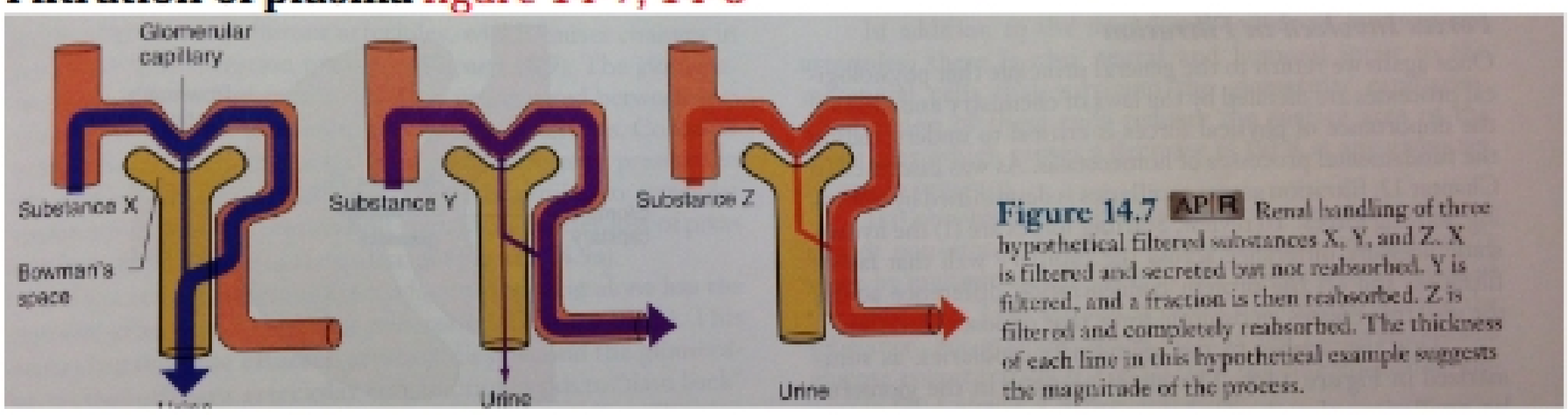
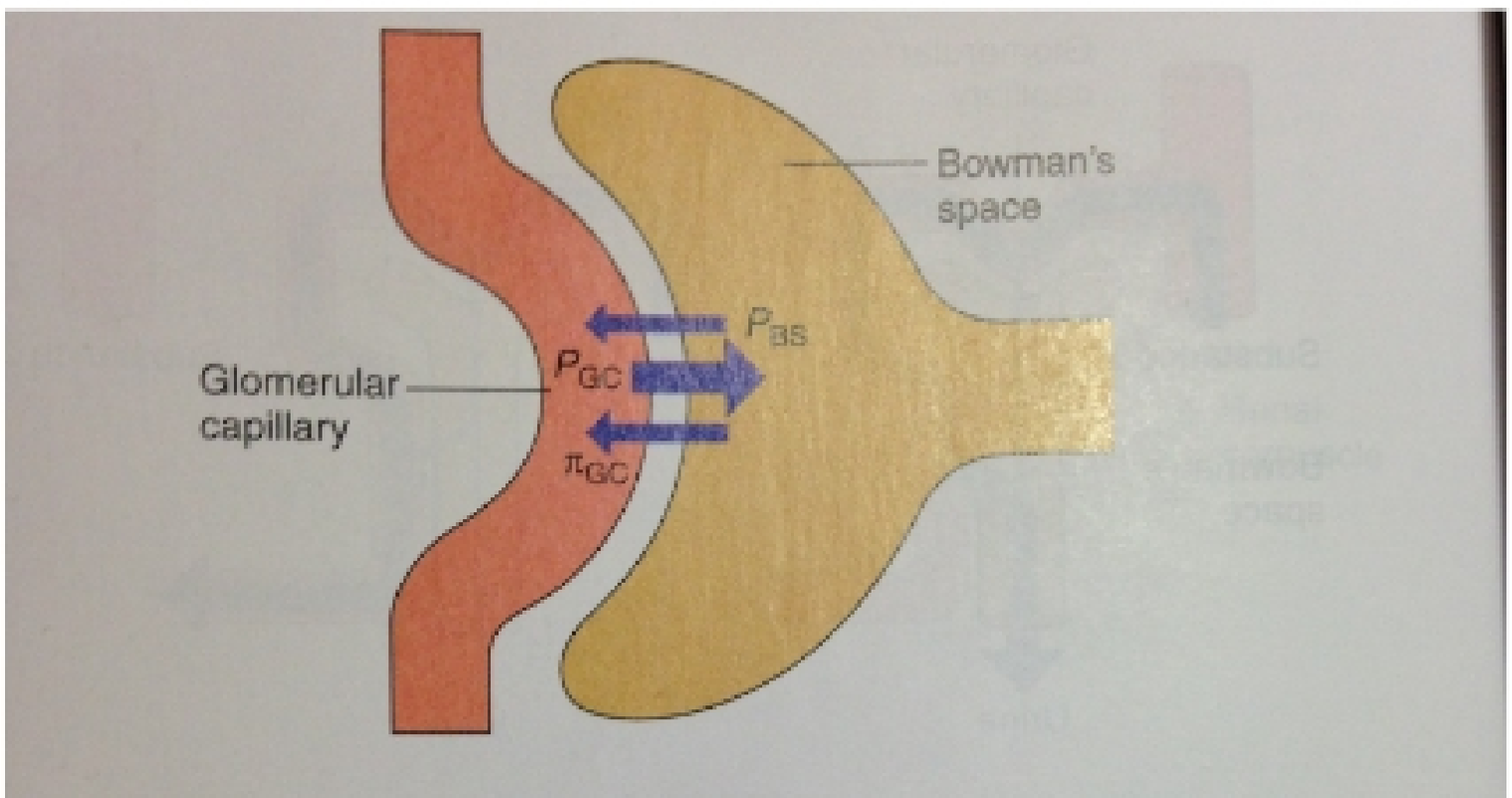



**Figure 14.7** AP|R Renal handling of three hypothetical filtered substances X, Y, and Z. X is filtered and secreted but not reabsorbed. Y is filtered, and a fraction is then reabsorbed. Z is filtered and completely reabsorbed. The thickness of each line in this hypothetical example suggests the magnitude of the process.




| Forces | mmHg |
|---|---|
| **Favoring filtration:** | |
| Glomerular capillary blood pressure ($P_{GC}$) | 60 |
| **Opposing filtration:** | |
| Fluid pressure in Bowman's space ($P_{BS}$) | 15 |
| Osmotic force due to protein in plasma ($\pi_{GC}$) | 29 |
| **Net glomerular filtration pressure = $P_{GC} - P_{BS} - \pi_{GC}$** | 16 |

**Figure 14.8** AP|R Forces involved in glomerular filtration. The symbol π denotes the osmotic force due to the presence of protein in glomerular capillary plasma. (*Note:* The concentration of protein in Bowman's space is so low that $\pi_{BS}$, a force that would favor filtration, is considered zero.)

- Glomerular filtration rate (GFR) = volume/time
  (Taking components out of blood, and
  - ~180 L/day but only 1.8 L excreted
  - Regulation via N and E
- Reabsorption: F back to P (historically, original kidneys, outside the body, moving things from the filtrate back to the plasma)
  - Glu and AA reabsorbed: PCTs via AT depending on how much but normal levels can handle

    - Most water and ions reabs: most of the time, not always blood pressure, depend on how much we have put back, even have to put back more
    - Metabolic wastes (e.g., urea): most excreted, osmolarity: might want to keep in though toxic to keep the osmolarity
- Secretion: P to F; intentional (e.g. H+, K+)

Water and Sodium

- Daily intake typically balanced by daily loss

| **In** | **Water (mL)** | **Sodium (mg)** |
|---|---|---|
| Food intake | 1000 | 10.5 |
| Liquid intake | 1200 | - |
| Metabolic | 350 | - |
| **Total** | **2550** | **10.5** |
| | | |
| **Out** | | |
| Urine | 1500 | 10.0 |
| Sweat | 50 | 0.25 |
| Feces | 100 | 0.25 |
| Evaporation | 900 | - |
| **Total** | **2550** | **10.5** |

- Renal system: deals with variation in diet, environment, activity, etc
- Reabsorption
    - Na+ all tubules, except descending loop
    - Water follows Na+ via diffusion = osmosis
        - Requires permeability = aquaporins
            - PCT = high
            - Loop and DCT = variable
            - CD = regulated by ADH (makes present)
- Con. Urine = hyperosmotic
    - Medulla critical
    - Counter-current multiplier figure 14-10

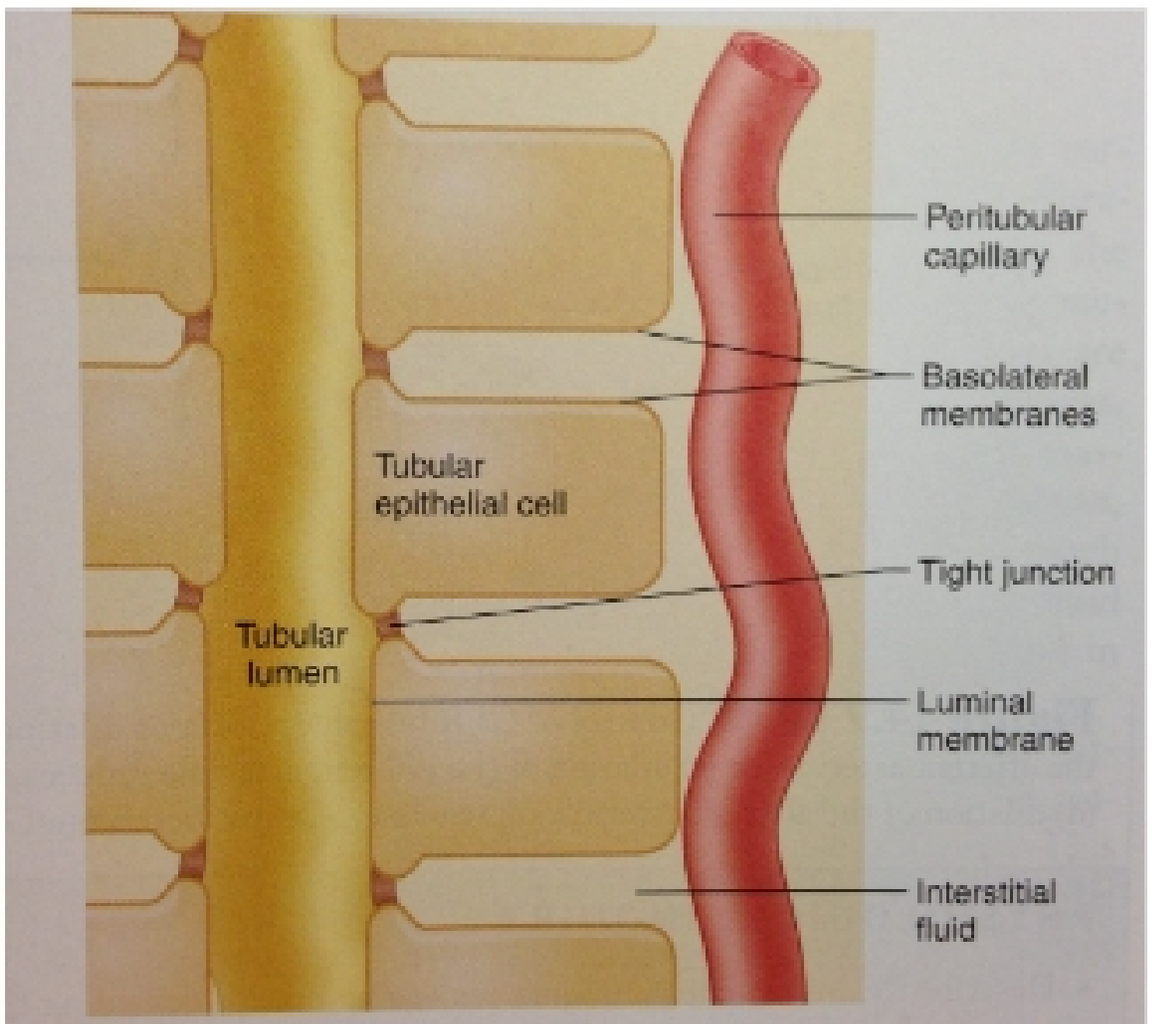



**Figure 14.10** AP R Diagrammatic representation of tubular epithelium. The luminal membrane is also called the apical membrane.

Concentrated Urine

- CCM in loop: key characteristics
  - Start = flow down D limb
    - Lumen osm = IF osm → no change in osm
  - Up A limp where NaCl pumped to IF
    - Lumen osm decreases and IF osm increases
  - New flow down D limb
    - Lumen osm is not th same as IF osm → lumen osm increases figure 14-16

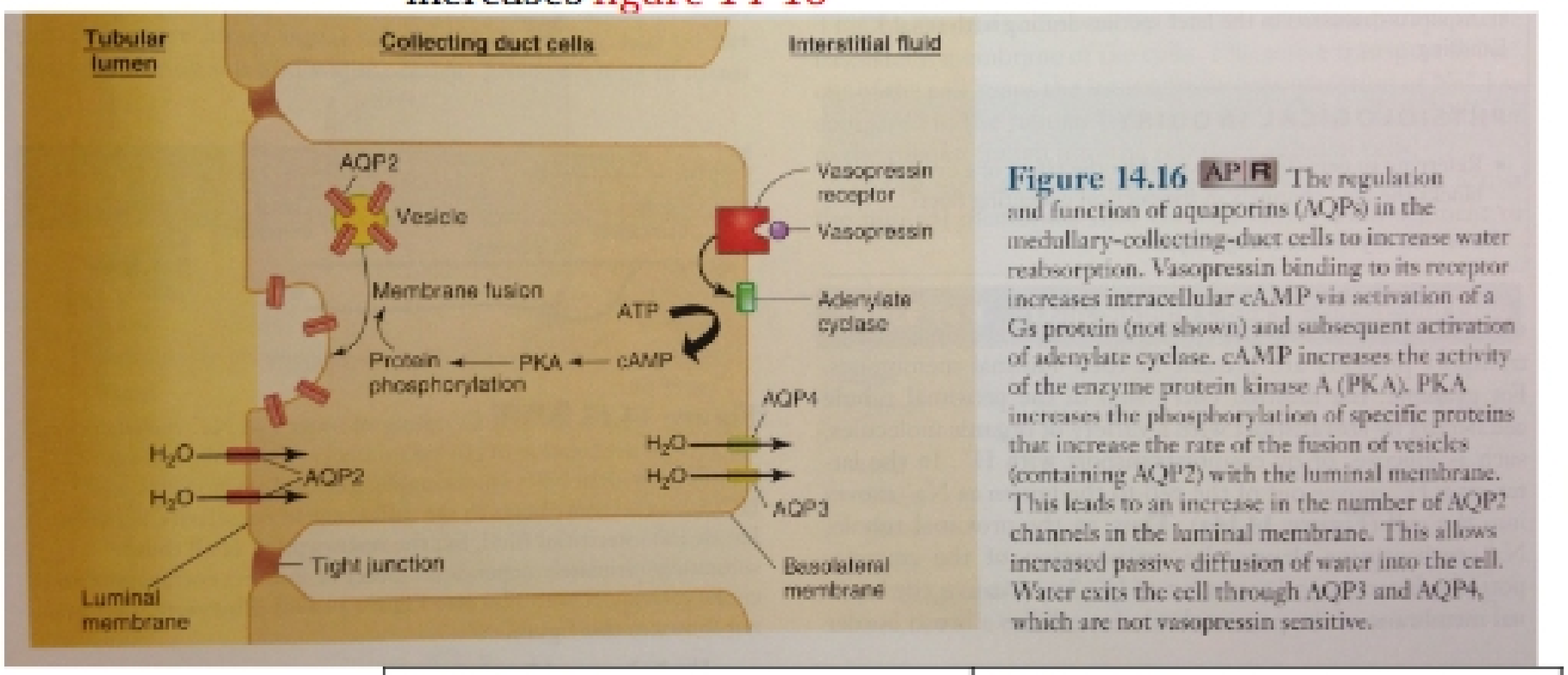



**Figure 14.16** AP R The regulation and function of aquaporins (AQPs) in the medullary-collecting-duct cells to increase water reabsorption. Vasopressin binding to its receptor increases intracellular cAMP via activation of a Gs protein (not shown) and subsequent activation of adenylate cyclase. cAMP increases the activity of the enzyme protein kinase A (PKA). PKA increases the phosphorylation of specific proteins that increase the rate of the fusion of vesicles (containing AQP2) with the luminal membrane. This leads to an increase in the number of AQP2 channels in the luminal membrane. This allows increased passive diffusion of water into the cell. Water exits the cell through AQP3 and AQP4, which are not vasopressin sensitive.

| | |
|---|---|
| H2O = yes | H2O = no |
| Na+ = no | Na+ = yes |

Osm = # things/vol

- Continual new flow: process repeats figure 14-17, 14-18
  - Osmotic gradient in medulla (longer = increased gradient)
  - Just the "set up" need the CD
- NOTE: DCTs "fine tune"
- CD: flows through gradient