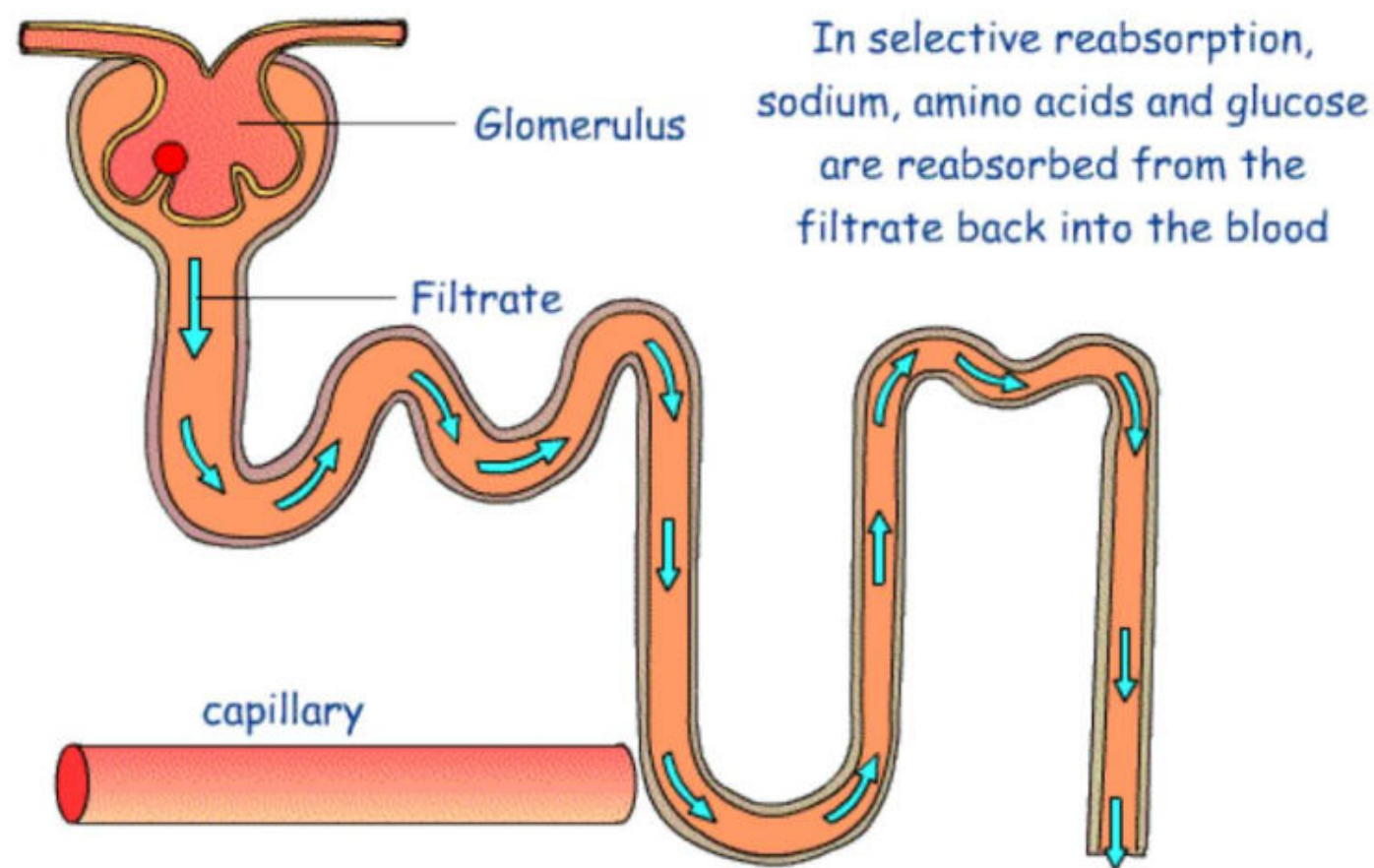


# Tubular Processes – Handling of TF



## Learning Objectives

### To understand

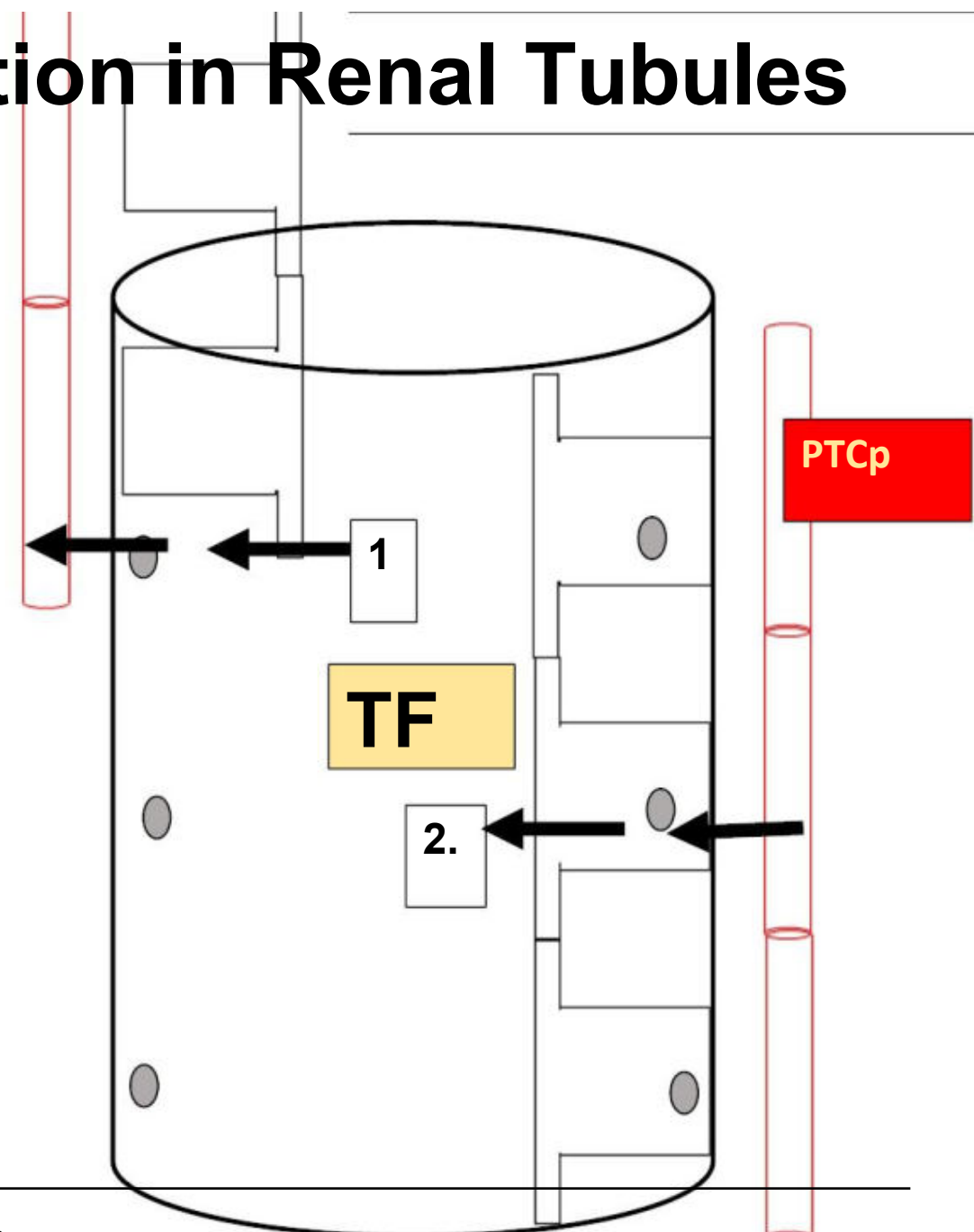
- **Terminology** to know processes of handling **tubular fluid** –
  - Renal **Tubular** Reabsorption or Secretion- **Transcellular** & paracellular pathway
  - **Tubular** Cells –Tight Junctions
  - **To calculate** secretion or reabsorption rate of any solute
  - Nephron **Terminology**
- Various **transport** mechanisms in proximal **convoluted** tubules
  - **Glomerulo-tubular balance**, and it's physiologic importance
  - **Glucose** transport maximum

## Terminology to know processes of handling tubular fluid

### Tubular Reabsorption or Secretion in Renal Tubules

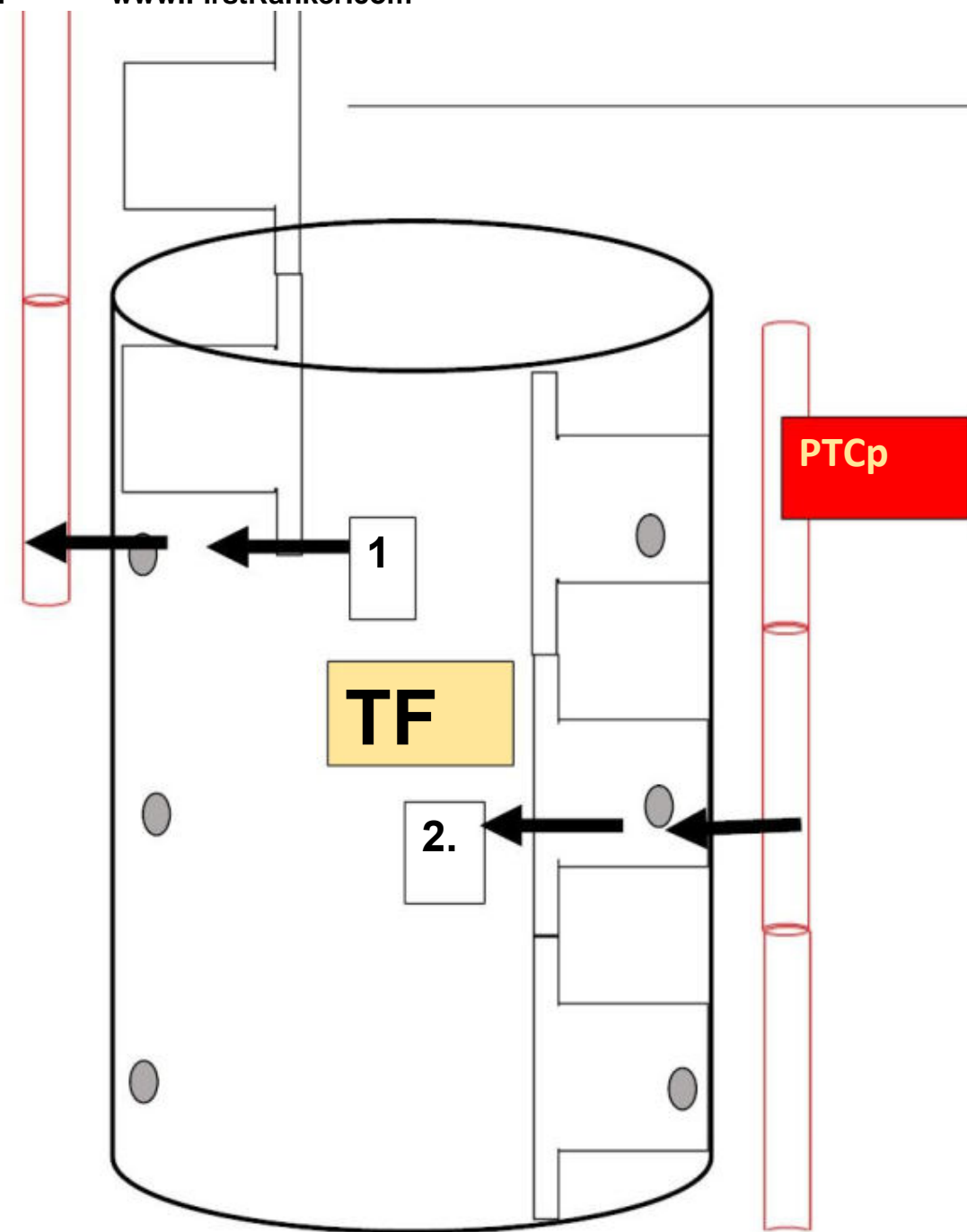
1. Reabsorption:

2. Secretion:



# Tubular Cells –Tight Junctions

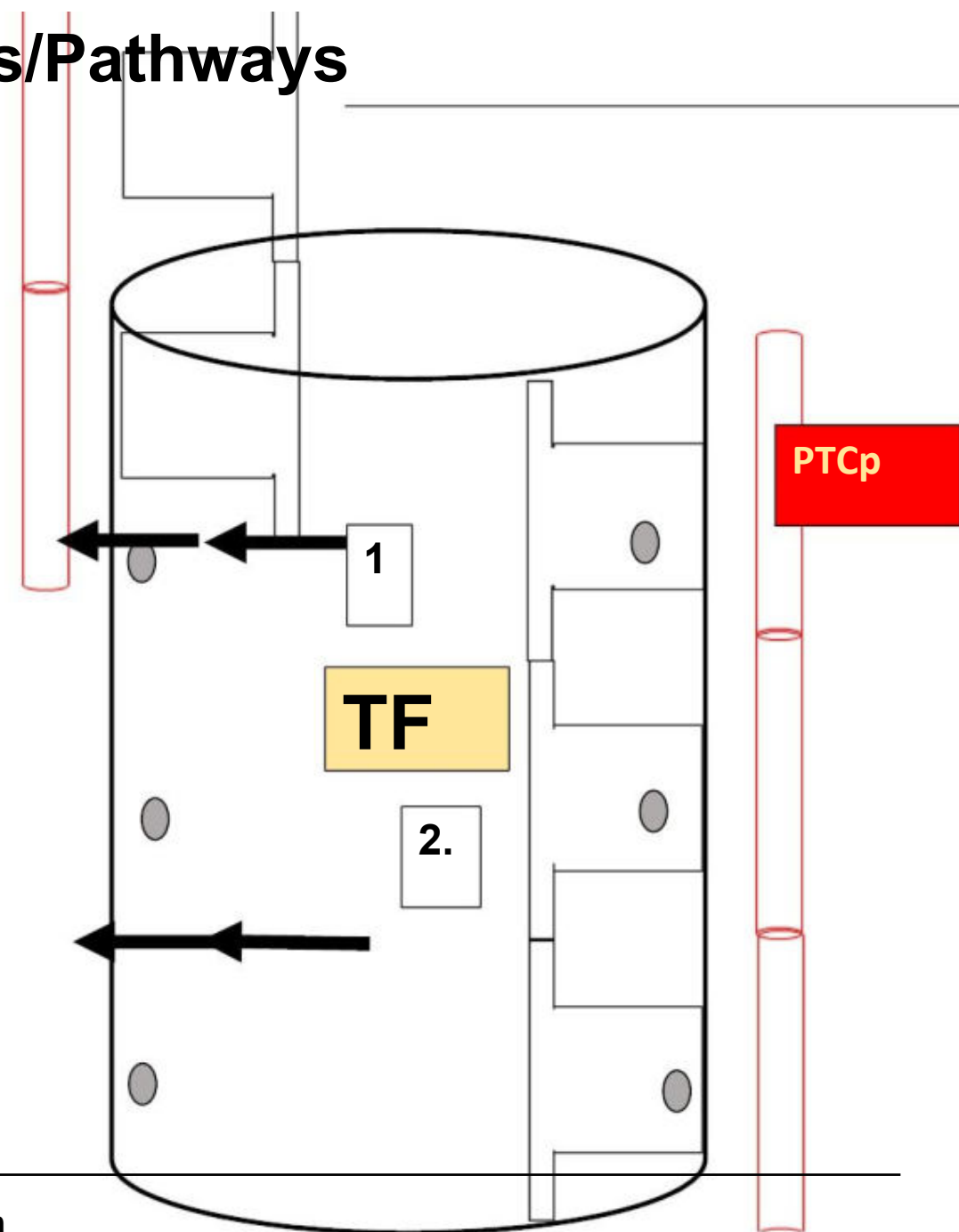
- Tight junctions
- Tight junctions – claudins and occludins.



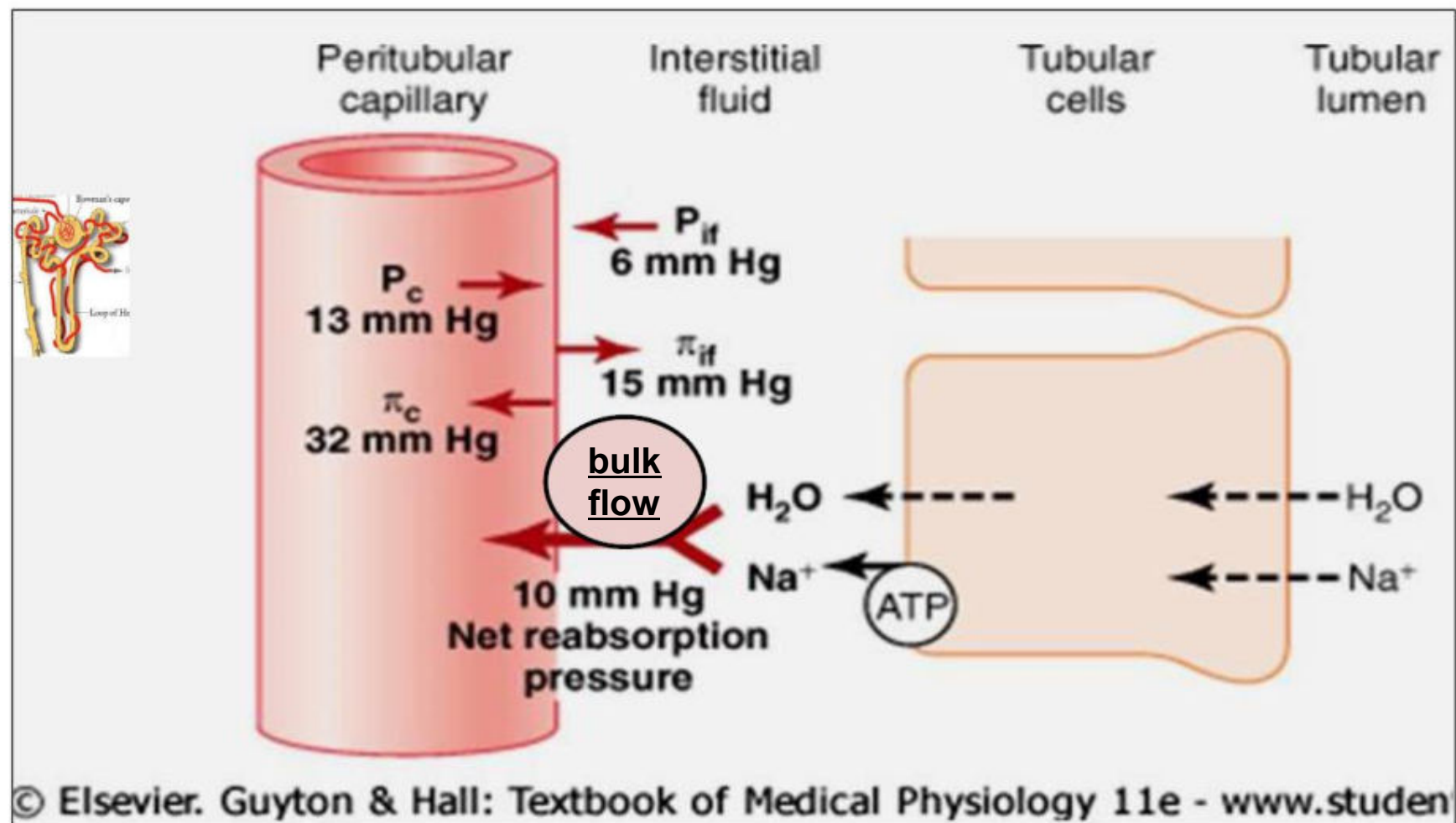
## Tubular Reabsorption/Secretion - Routes/Pathways

Transcellular pathway:

Paracellular pathway:



# Pressures favoring reabsorption by bulk flow into peritubular Cps

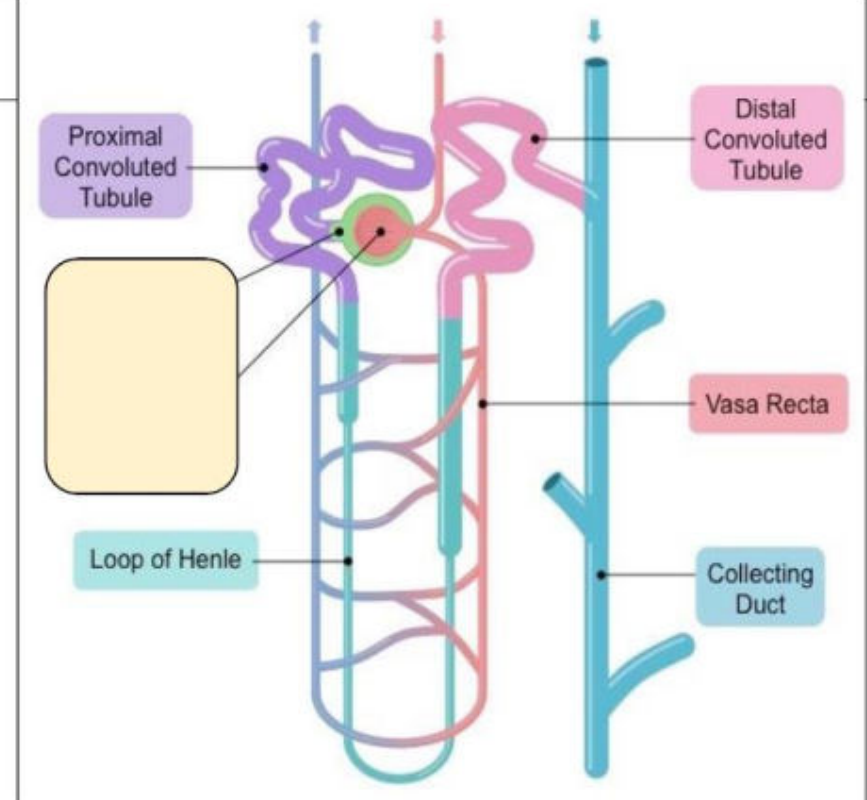


## GENERAL PRINCIPLES OF MEMBRANE TRANSPORT – across cell membranes

- Passive transport of substances (without expenditure of energy):
- Active transport of substances (with the expenditure of energy):

## Solvent drag-

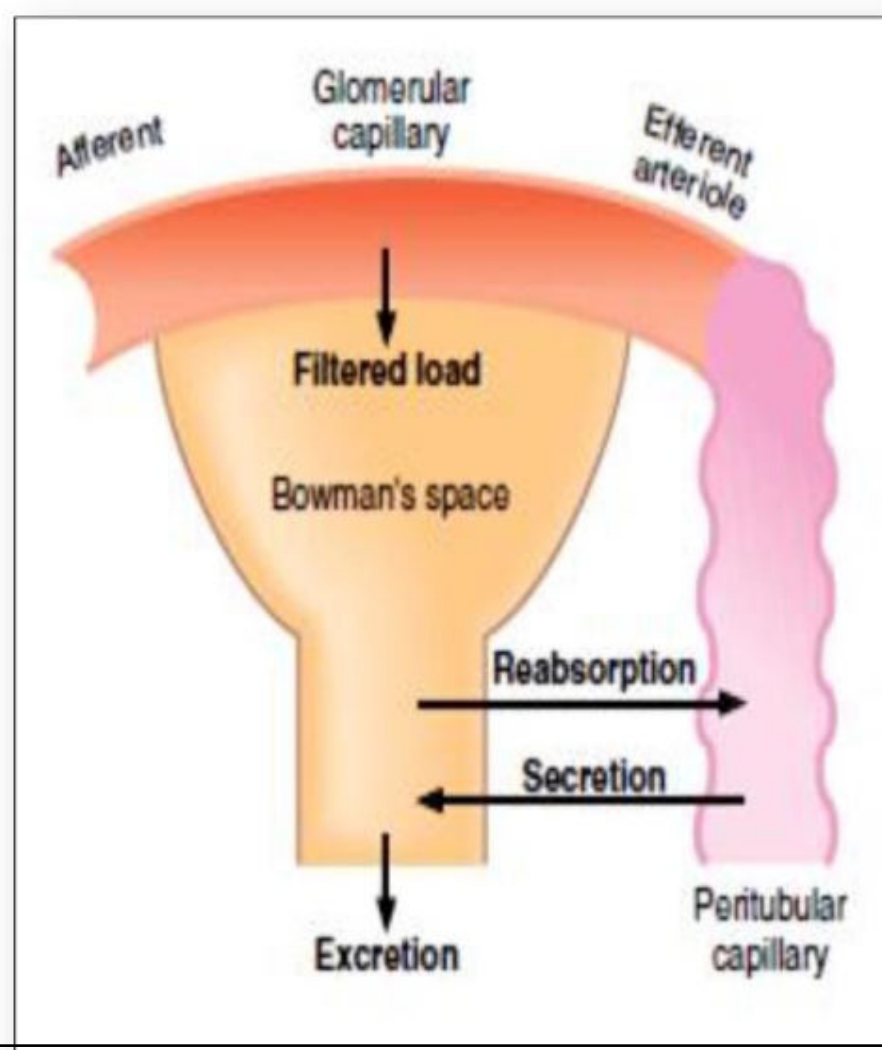
# Nephron : Tubular Segments



## Three major segments:

- These segments determine the **composition & volume of the urine** by the

## Reabsorption and Secretion Rates of substances in renal tubules



# Nephron Terminology

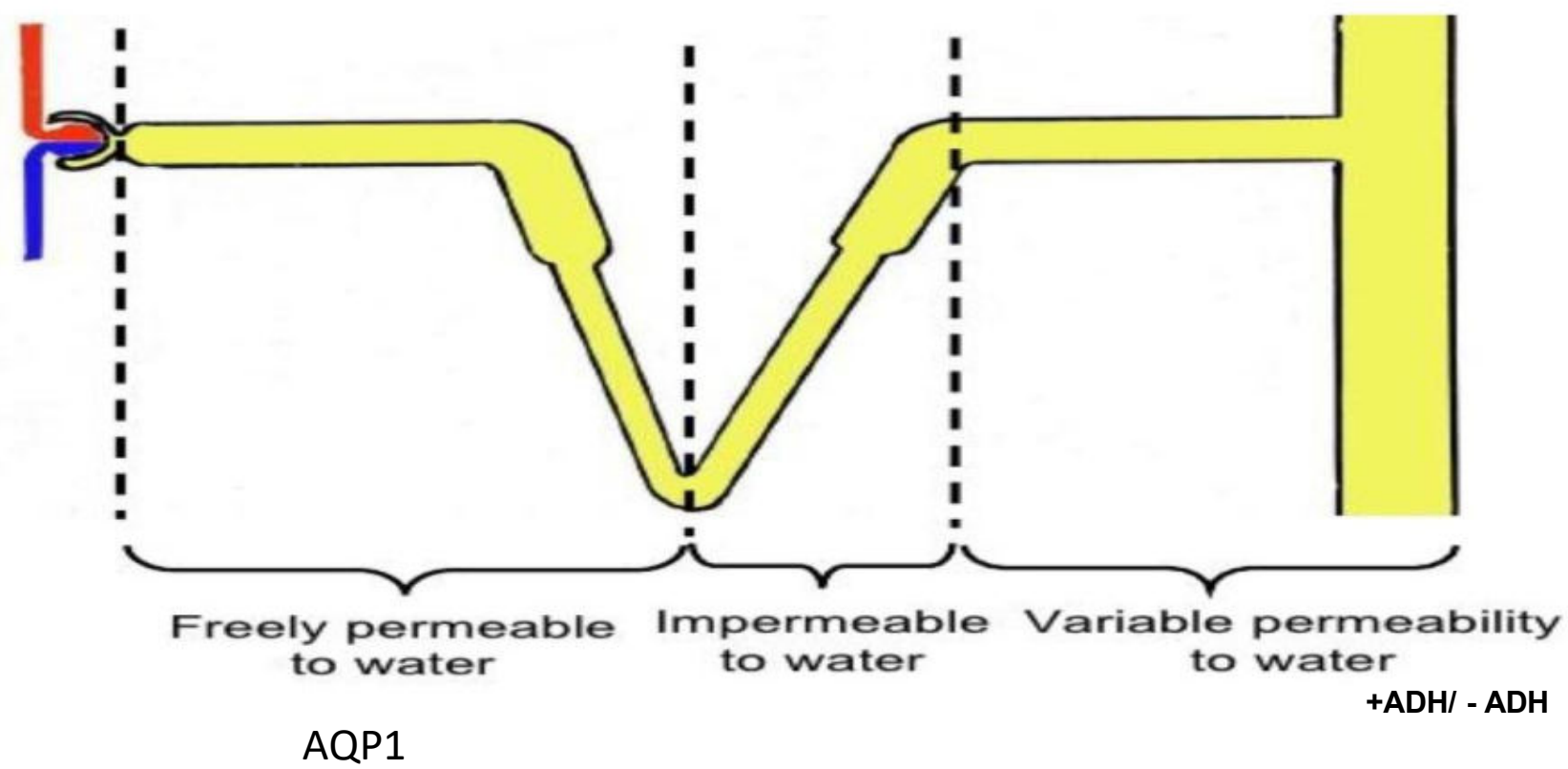
TF/P ratio

2.  $\text{TF/P}_{\text{inulin}}$

3.  $[\text{TF/P}]_x / [\text{TF/P}]_{\text{inulin}}$  ratio

Exercise questions



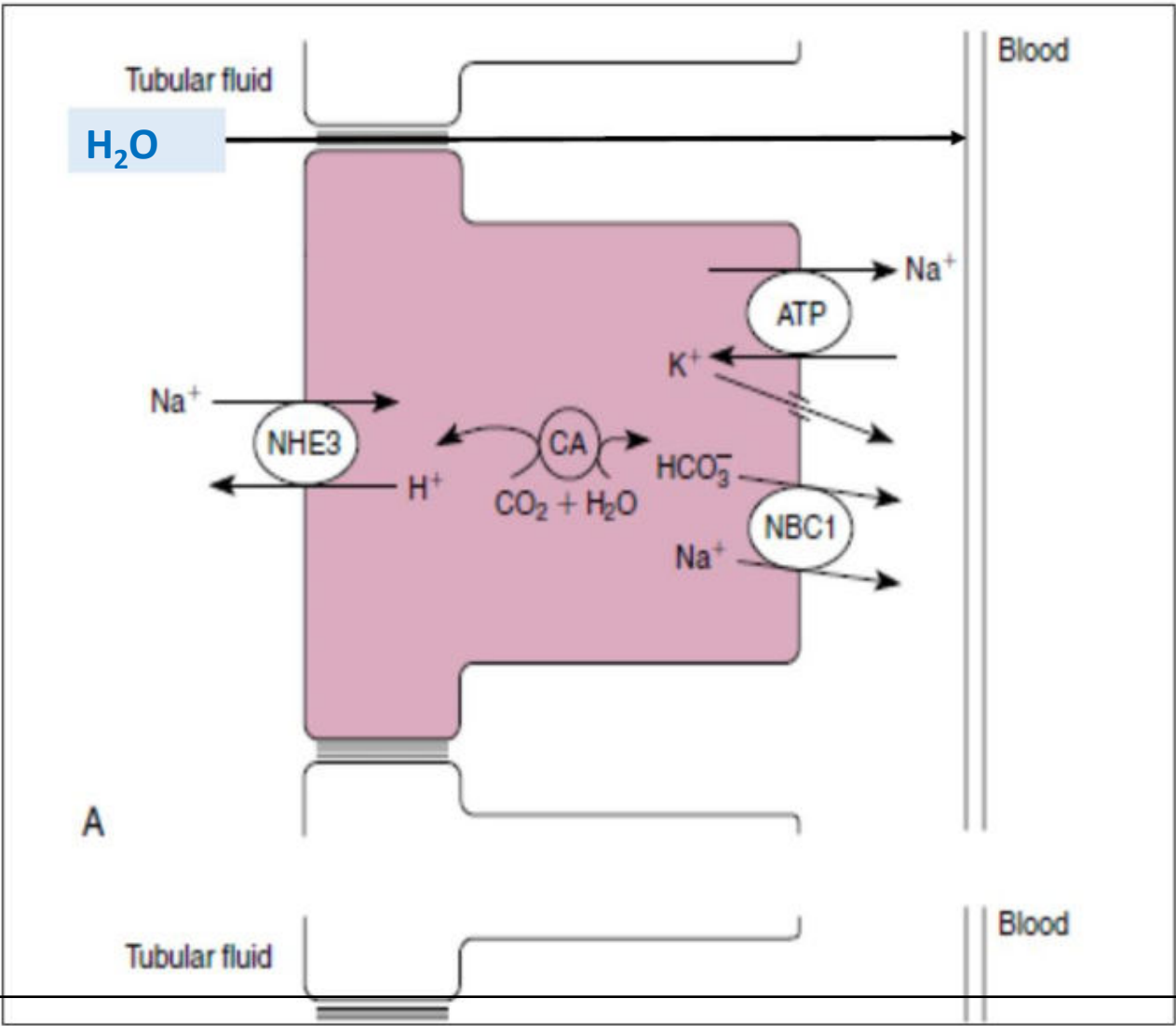


Transport mechanisms of different solutes of **TF** – PxC7

First half of Px CT

Early Part of Proximal Convoluted Tubule	PxCT	Active NaCl Transport	H2O	NaCl	Urea
		++	++	+	+

Na+ Reabsorption

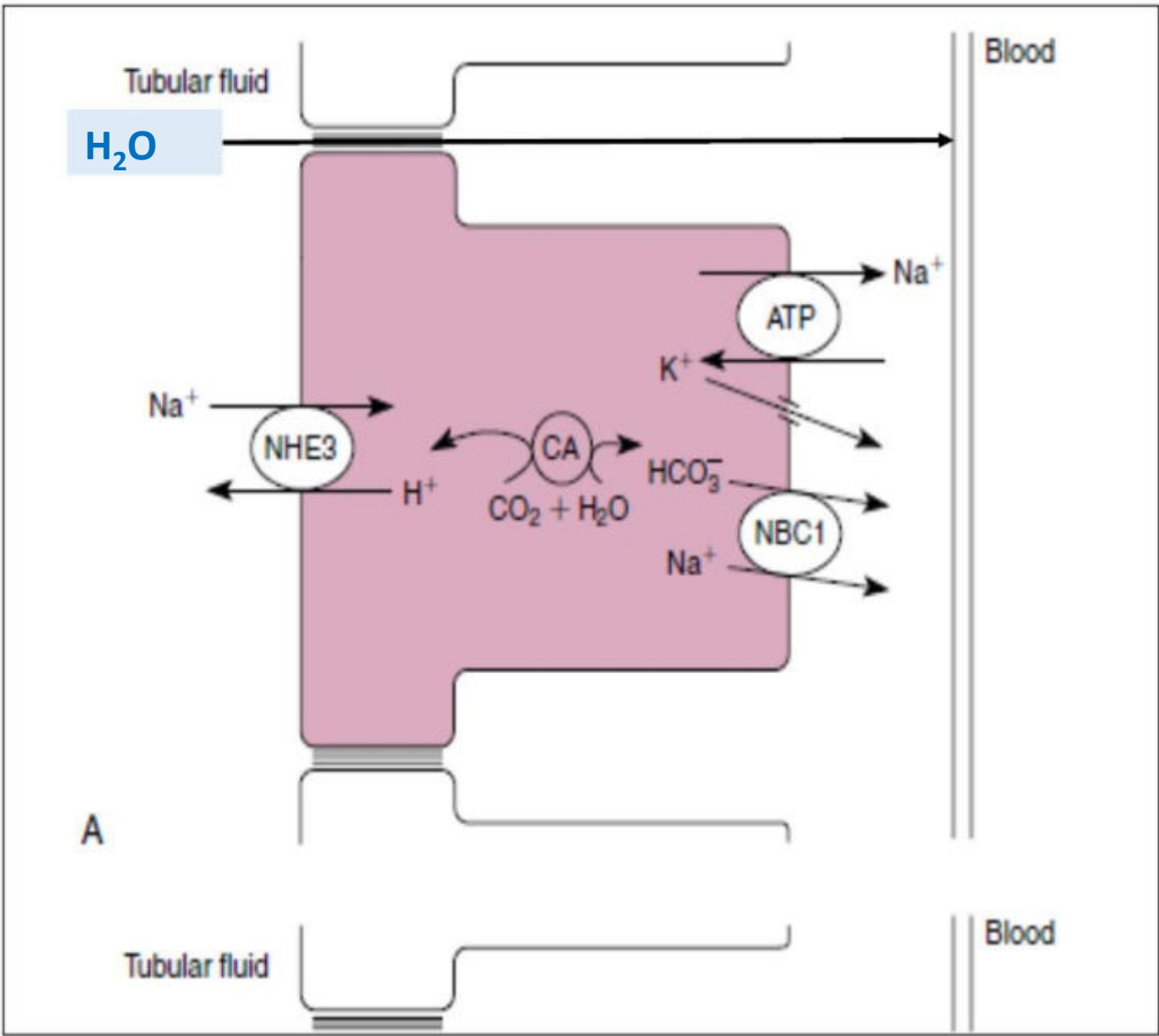




**Early Part of Proximal Convoluted Tubule**

PxCT	Active NaCl Transport	H2O	NaCl	Urea
	++	++	+	+

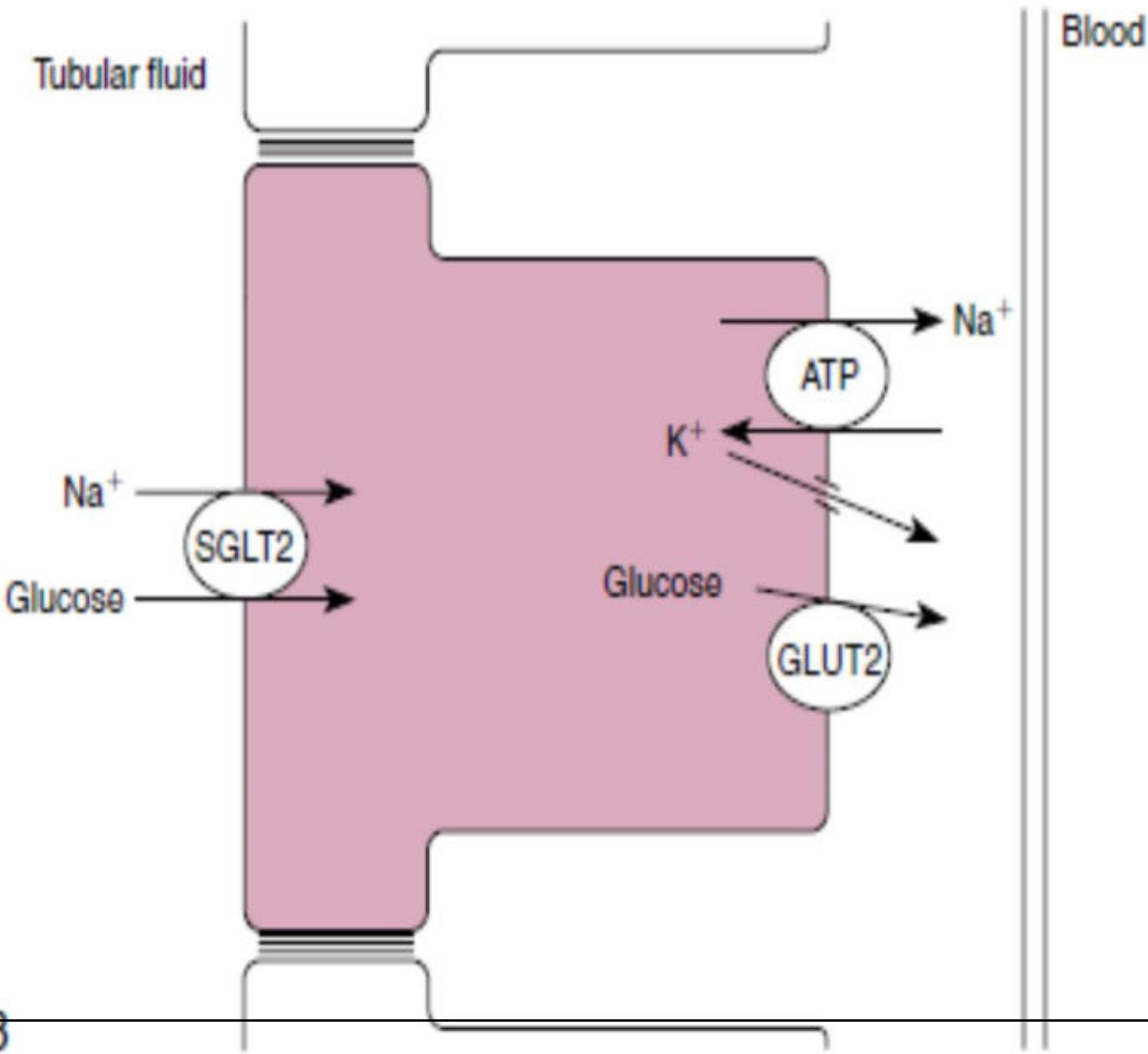
H<sup>+</sup> secretion and  
HCO<sub>3</sub><sup>-</sup>-Reabsorption



**Early Part of Proximal Convoluted Tubule**

PxCT	Active NaCl Transport	H2O	NaCl	Urea
	++	++	+	+

Glucose  
reabsorption



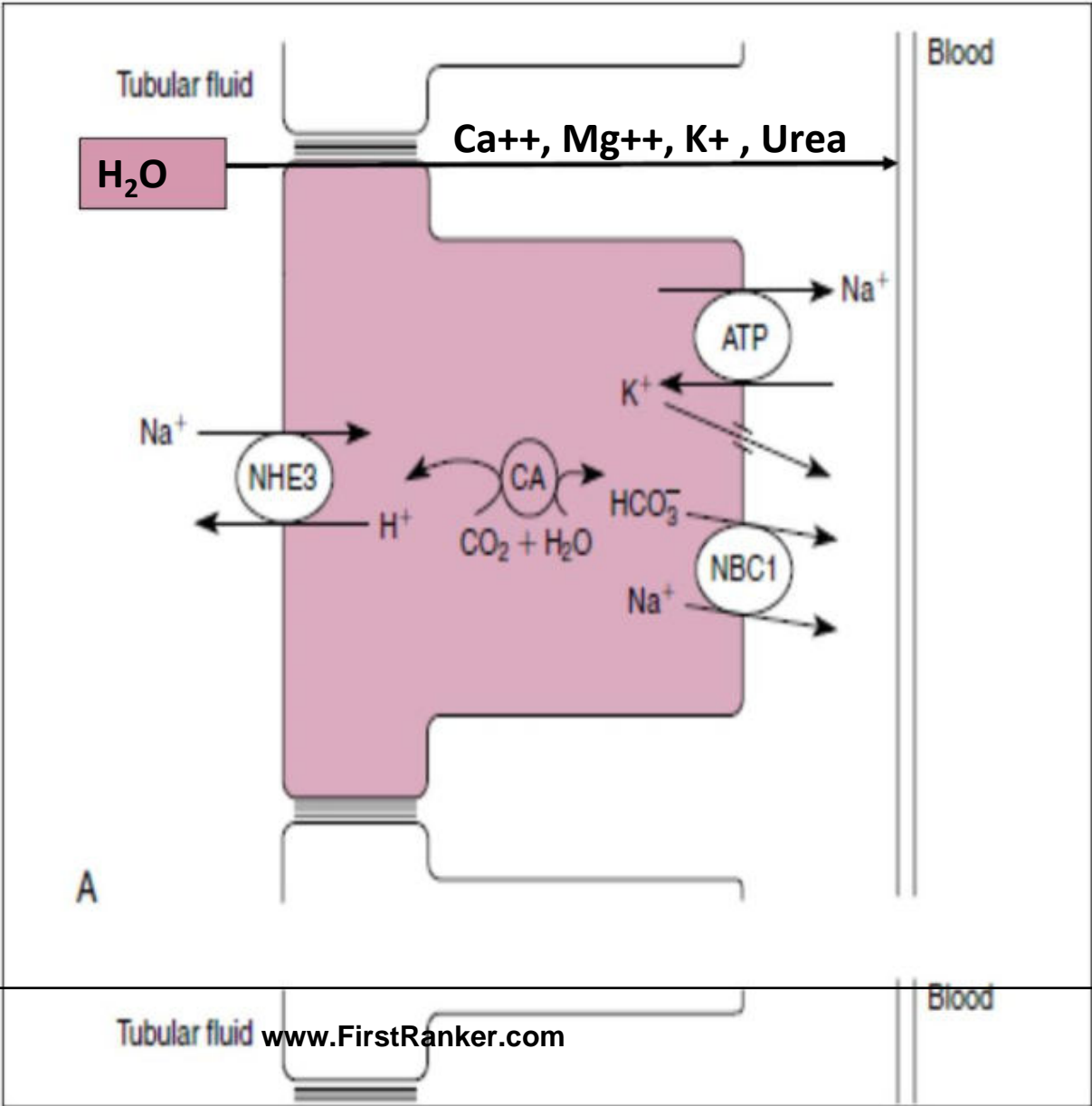
Applied-

Mutations in the **GLUT2** gene

Early Part of Proximal Convoluted Tubule

PxCT	Active NaCl Transport	H2O	NaCl	Urea
	++	++	+	+

Paracellular  
reabsorption



Second half of Px CT

Second half of PxCT

PxCT

Active NaCl Transport

H2O

NaCl

Urea

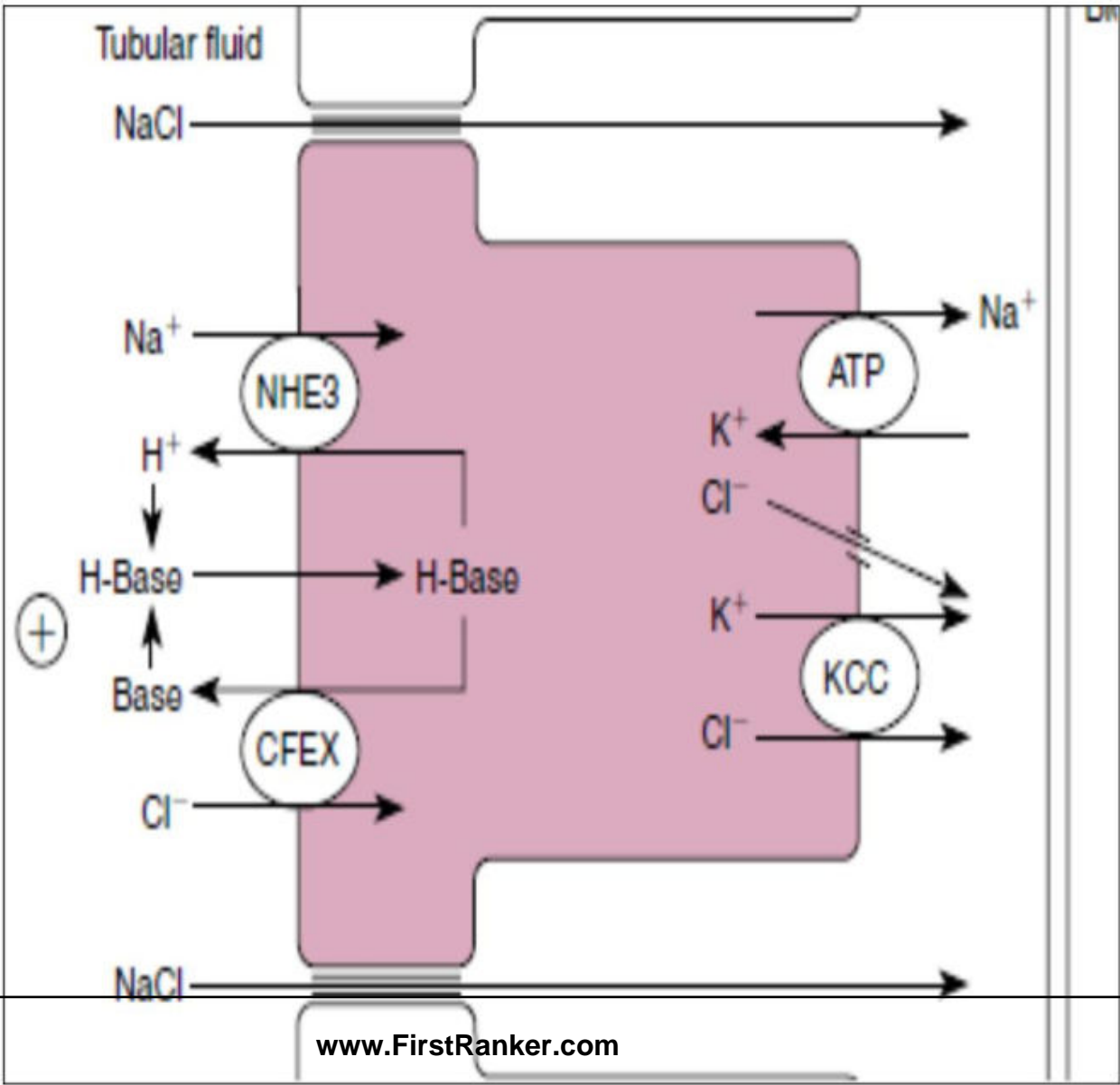
++

++

+

+

Na<sup>+</sup> and Cl<sup>-</sup> reabsorption



# Second half of PxCT

PxCT

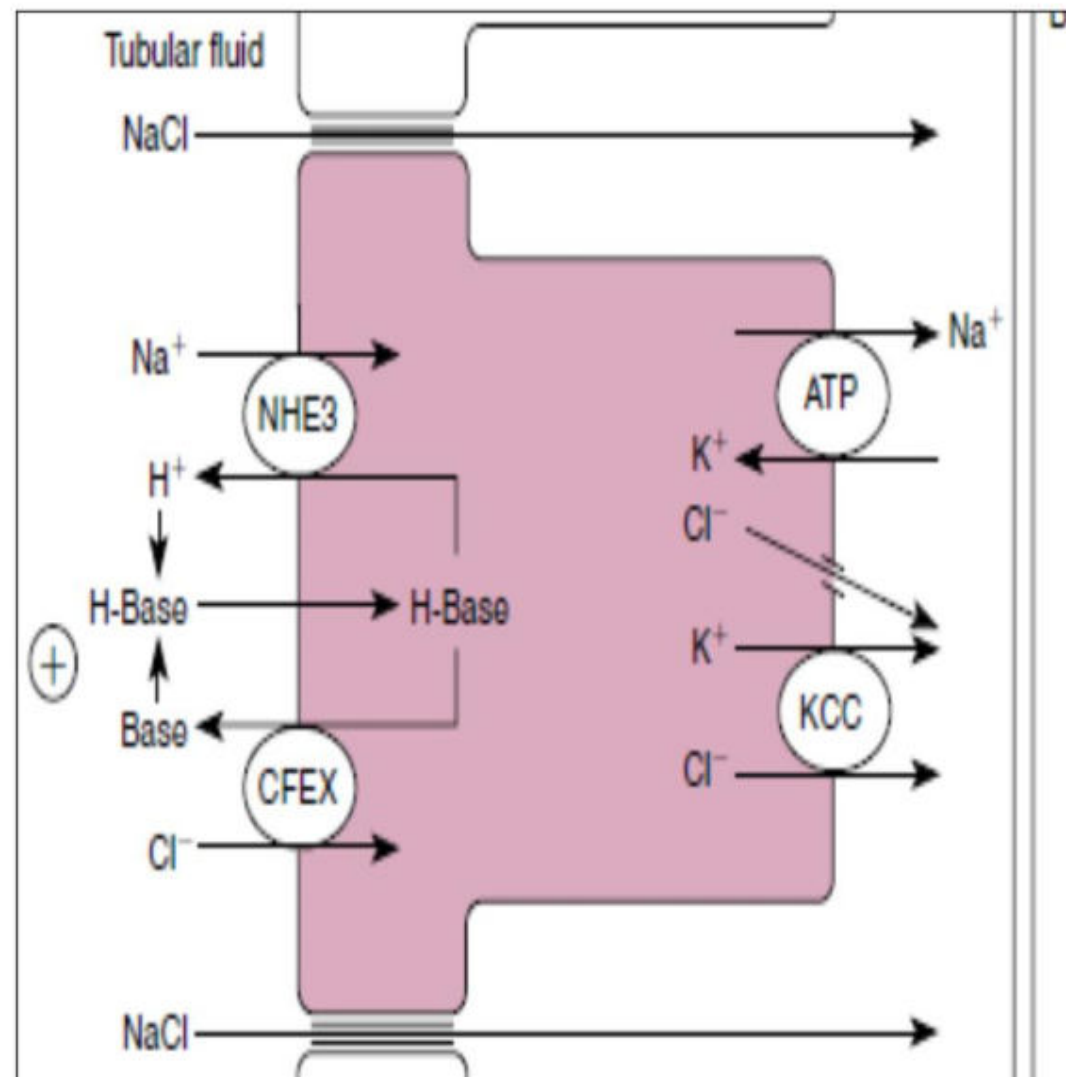
Active NaCl Transport  
++

H<sub>2</sub>O  
++

NaCl  
+

Urea  
+

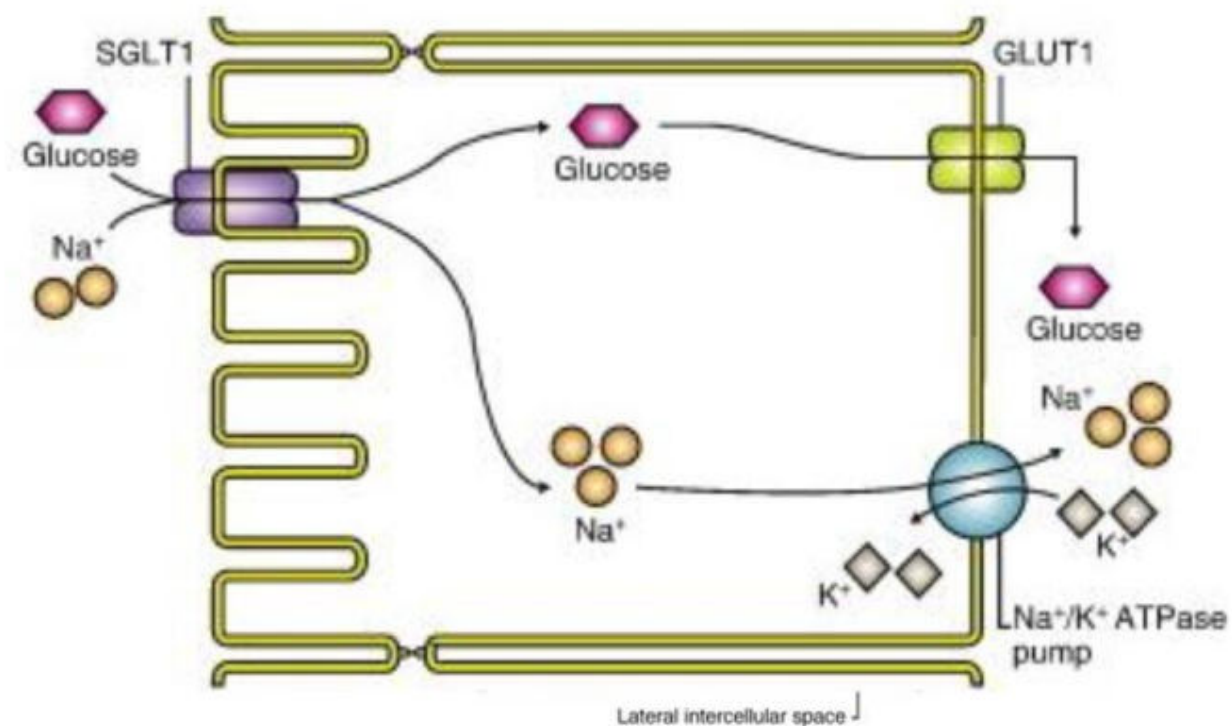
(Mechanism: Na<sup>+</sup>H<sup>+</sup> - Cl<sup>-</sup>Anion Antiporters)



# Second half of PxCT

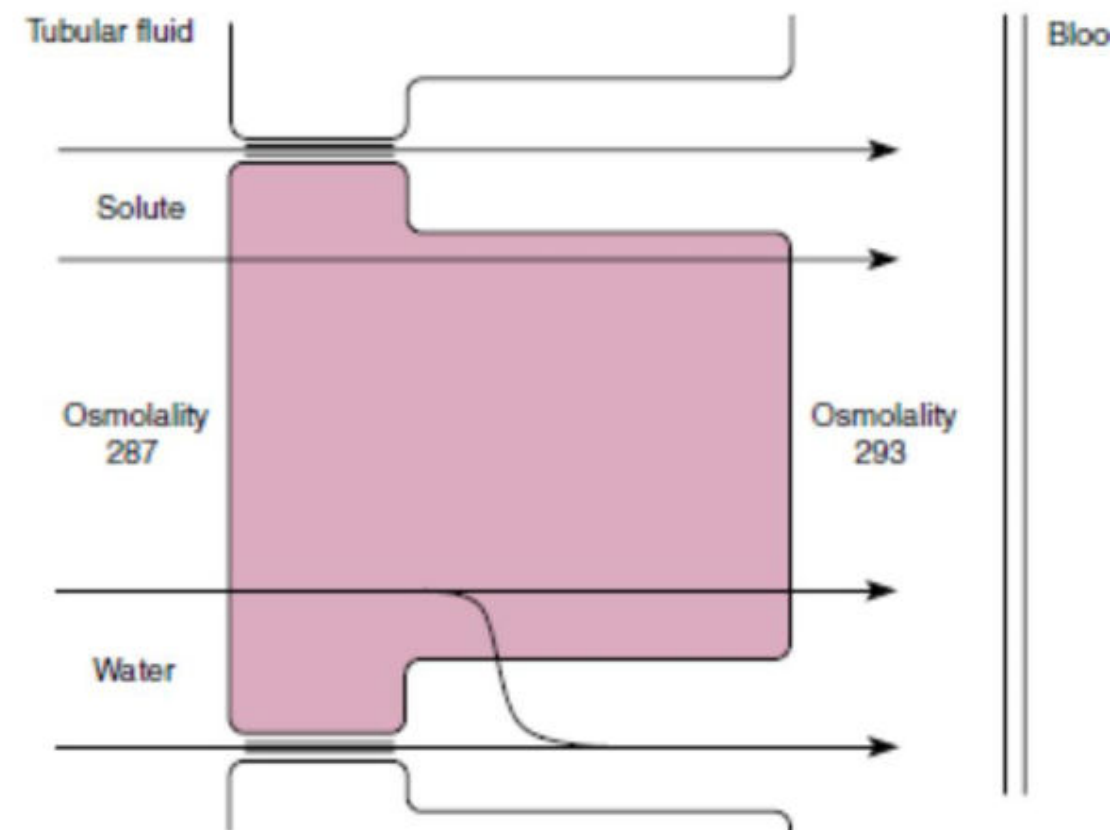
## Na<sup>+</sup>-glucose symporter (SGLT1)

Distal proximal tubule

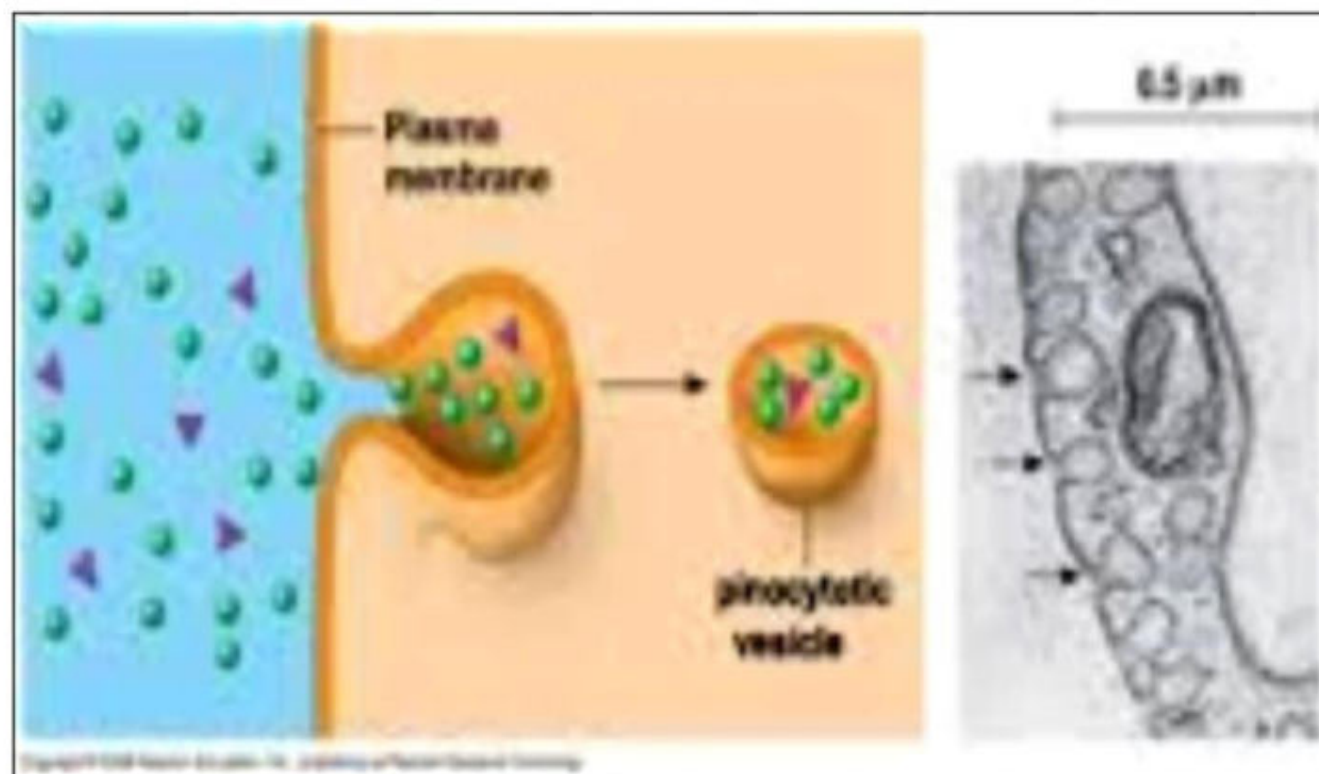


# Second half of Proximal Convoluted Tubule

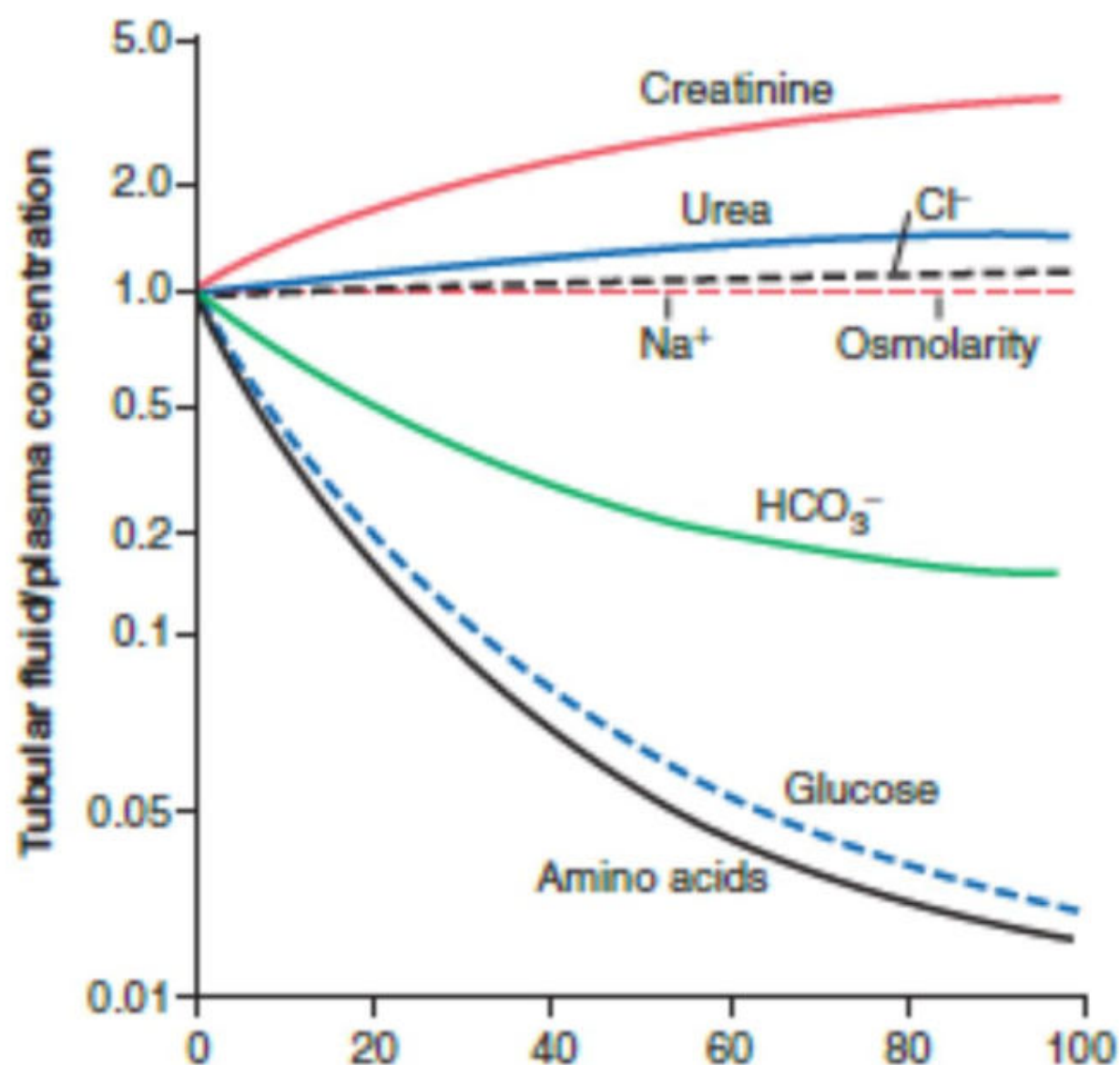
- Water reabsorption
- Urea reabsorption



**Pinocytosis—An Active Transport Mechanism for Reabsorption of large molecules such as Proteins in PXT**



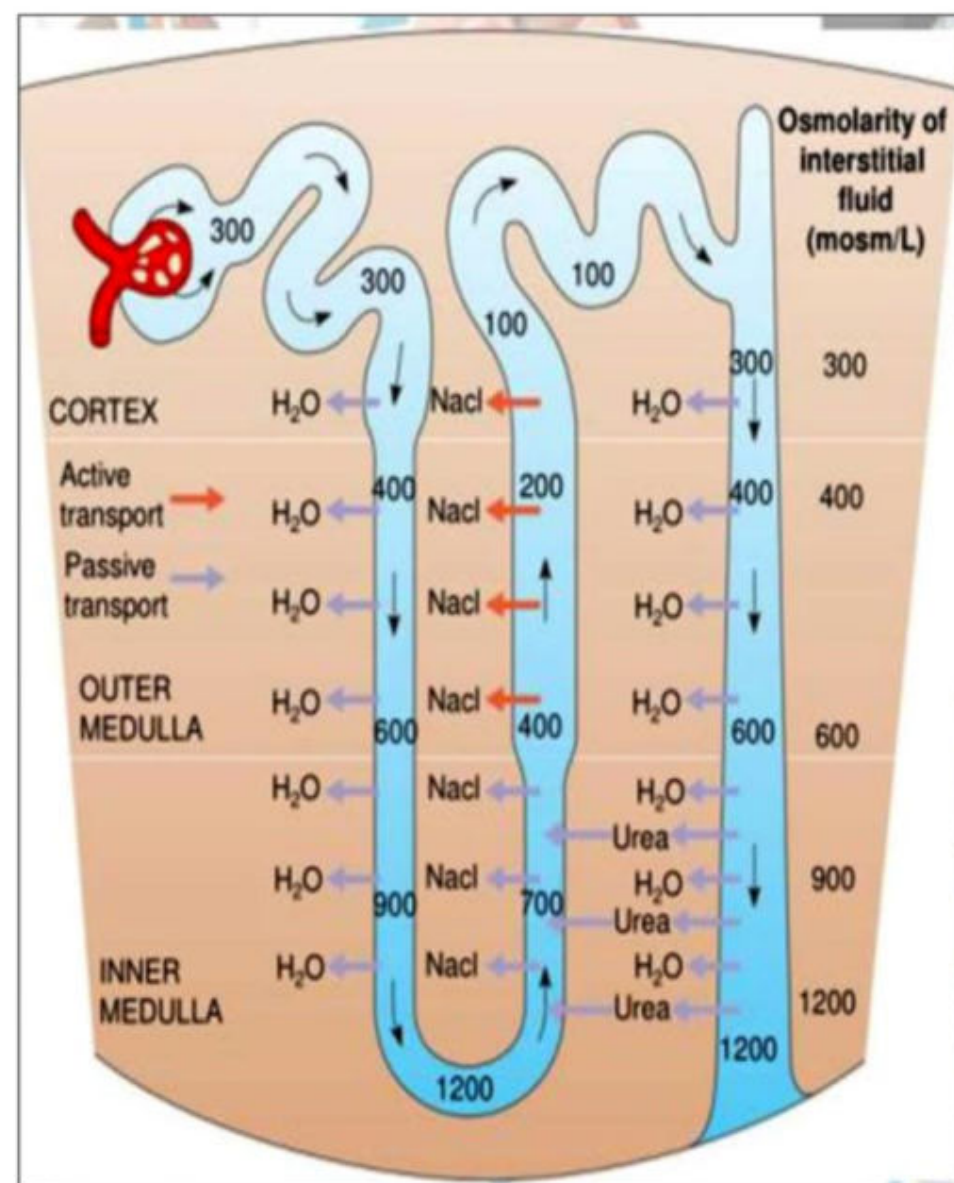
# Summary of handling of % of water & solutes – Px CT



## Summary of Transporters in Px CT

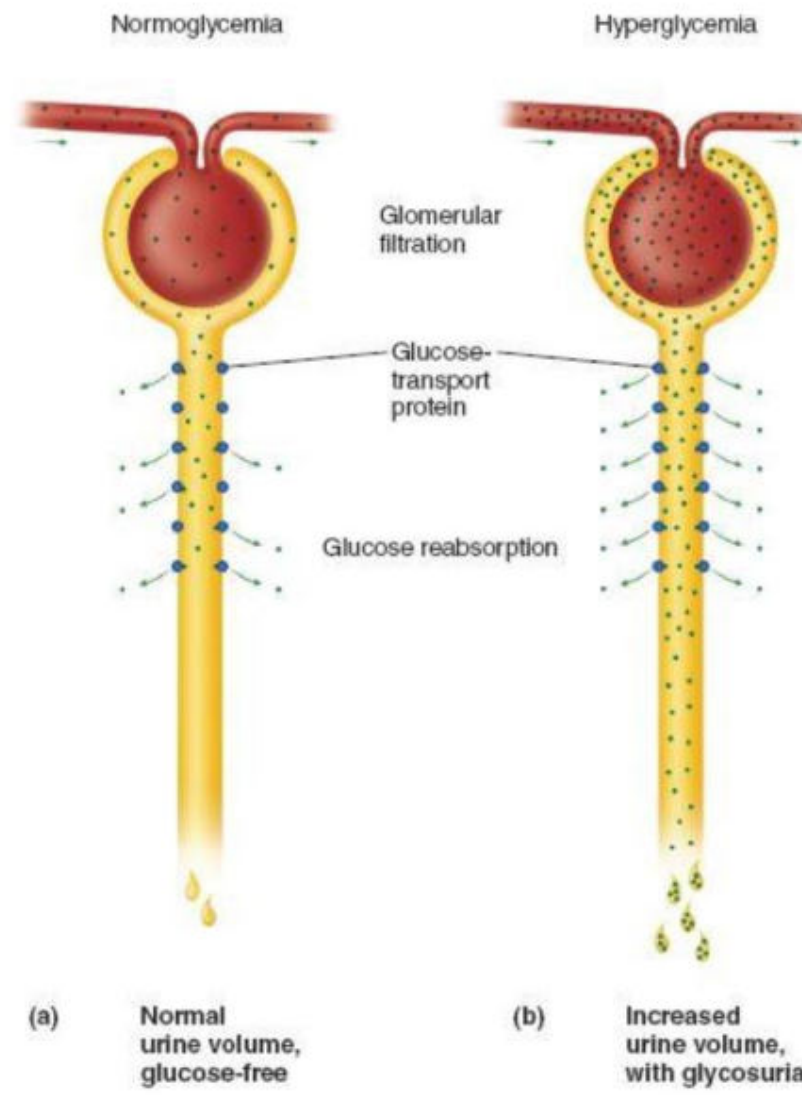


# Osmolality of TF Leaving PxCT



**Clinical Relevance – Acute Tubular Necrosis (ATN )**

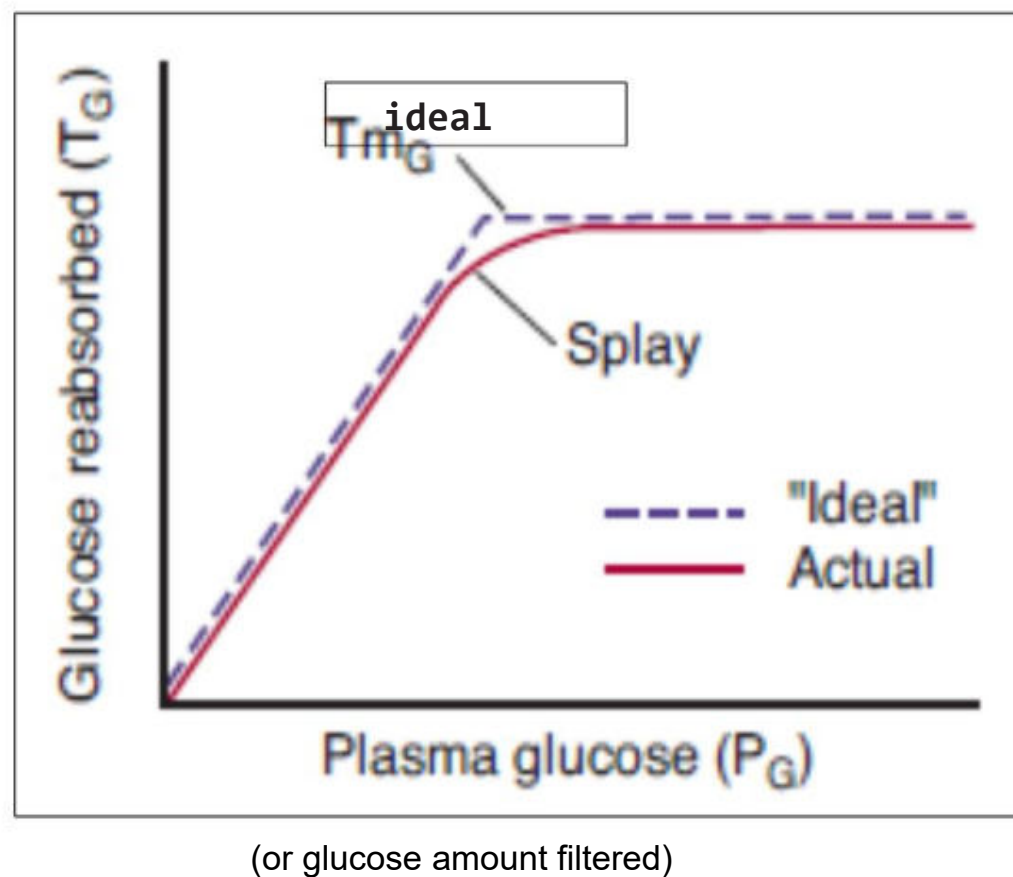
# Transport Maximum (T<sub>m</sub>)



## Blood glucose level and corresponding Glucose tubular load

This glucose blood concentration (200 mg/dl) and the filtered load of 250 mg/min are termed as the renal threshold for glucose.

# Cause of difference of $T_mG$ and Renal threshold for glucose Phenomenon of SPLAY

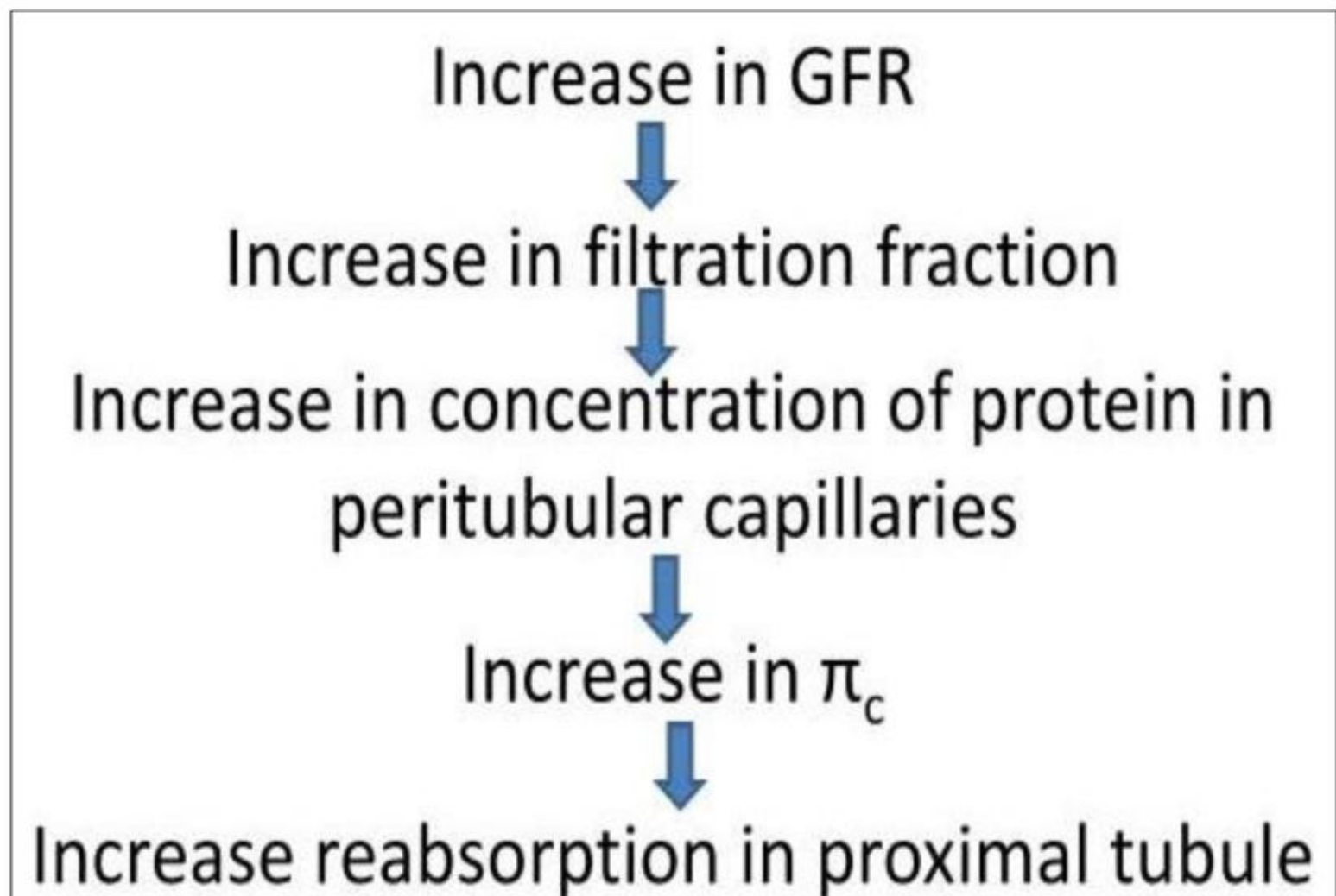


## Regulation of Tubular processes

Because it is essential to maintain a precise balance between tubular reabsorption and glomerular filtration, there are multiple **nervous**, **hormonal**, and **local control** mechanisms that regulate tubular reabsorption.

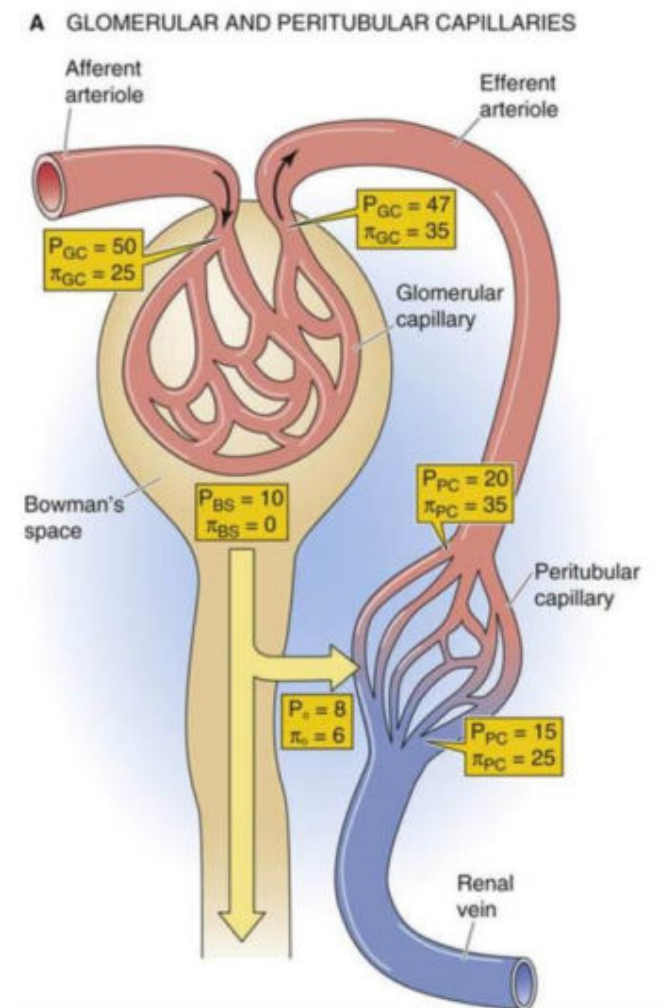
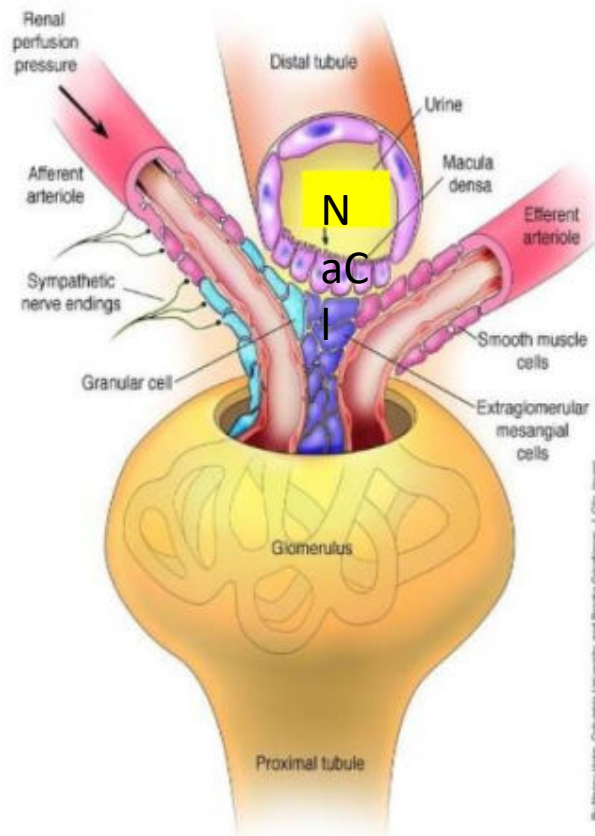
## Glomerulo-tubular Balance

### Glomerulo-tubular balance - Mechanism





# Tubuloglomerular feedback vs Glomerulo-tubular balance



## Self Assessment

Percentage of filtered urea, reabsorbed by Px CT is about :

1. 00-25
2. 50 -65
3. 70-95
4. 80-100

If there is increased load of NaCl and water, what will happen in Px CT

- 1) There will be an increase in NaCl and water reabsorption.
- 2) There will be a decrease in NaCl and water reabsorption.
- 3) There will be an increase in NaCl but water reabsorption will decrease
- 4) There will not be any change

Water channel present in proximal convoluted tubule is:

1. Aquaporin 1
2. Aquaporin 2
3. Aquaporin 3
4. Aquaporin 4

At the leaving end of PxCT, percentage of filtered solute and water is approximately:

- 1) 35% solute and 35% water
- 2) 45% solute and 45% water
- 3) 35% solute and 45% water
- 4) 45% solute and 35% water

Thank you

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