

## Success Criteria:

ALL will recall ultrafiltration (Grade E)

MOST will describe the process of selective reabsorption in the proximal convoluted tubule (PCT) (Grade C)

SOME will explain adaptations of the PCT epithelial cells for selective reabsorption and the absorption of amino acids (Grade A)

## Selective reabsorption

Learning Objective:

To be able to understand the process of selective reabsorption in the nephron

Starter (based on last lesson):

**Must** state differences between concentration of substances in blood plasma and concentrations of substances in glomerular filtrate

**Should** discuss reasons for differences

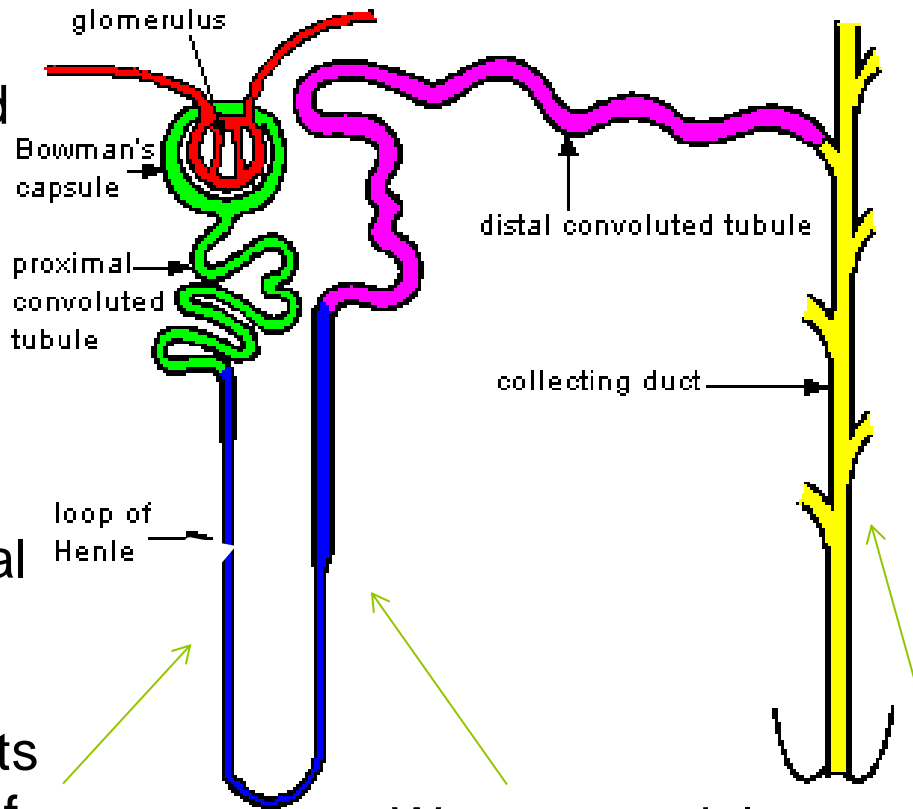
**Could** explain how ultrafiltration results in differences between concentrations of certain substances

Substance	Concentration in blood plasma (g dm <sup>-3</sup> )	Concentration in glomerular filtrate (g dm <sup>-3</sup> )
Water	900	900
Inorganic ions	7.2	7.2
Urea	0.3	0.3
Uric acid	0.04	0.04
Glucose	1.0	1.0
Amino acids	0.5	0.5
proteins	80.0	0.05

# Selective Reabsorption

All sugars,  
most salts and  
some water is  
reabsorbed

Water potential  
of the fluid is  
decreased by  
addition of salts  
and removal of  
water

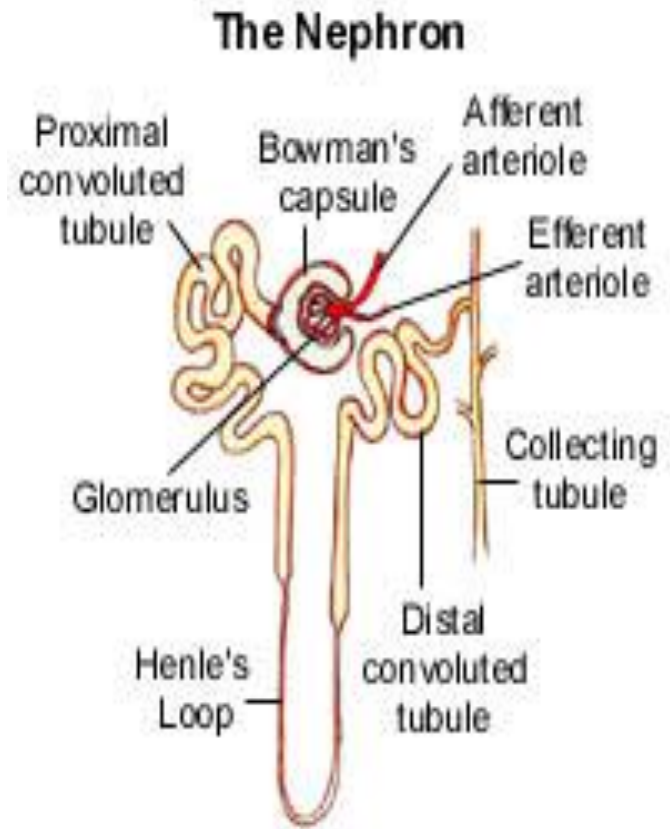


Water potential  
increased as salts  
are removed by  
active transport

Water potential  
decreased  
again by the  
removal of  
water- ensuring  
that urine has a  
low water  
potential. Urine  
has a higher  
concentration of  
solutes than  
blood and tissue  
fluid

# Selective Reabsorption

- Most reabsorption occurs from the proximal convoluted tubule where 85% of filtrate is reabsorbed
- All glucose and amino acids, some salts and some water are reabsorbed



# Adaptations of the PCT Epithelial cells for selective reabsorption

Many mitochondria for active transport

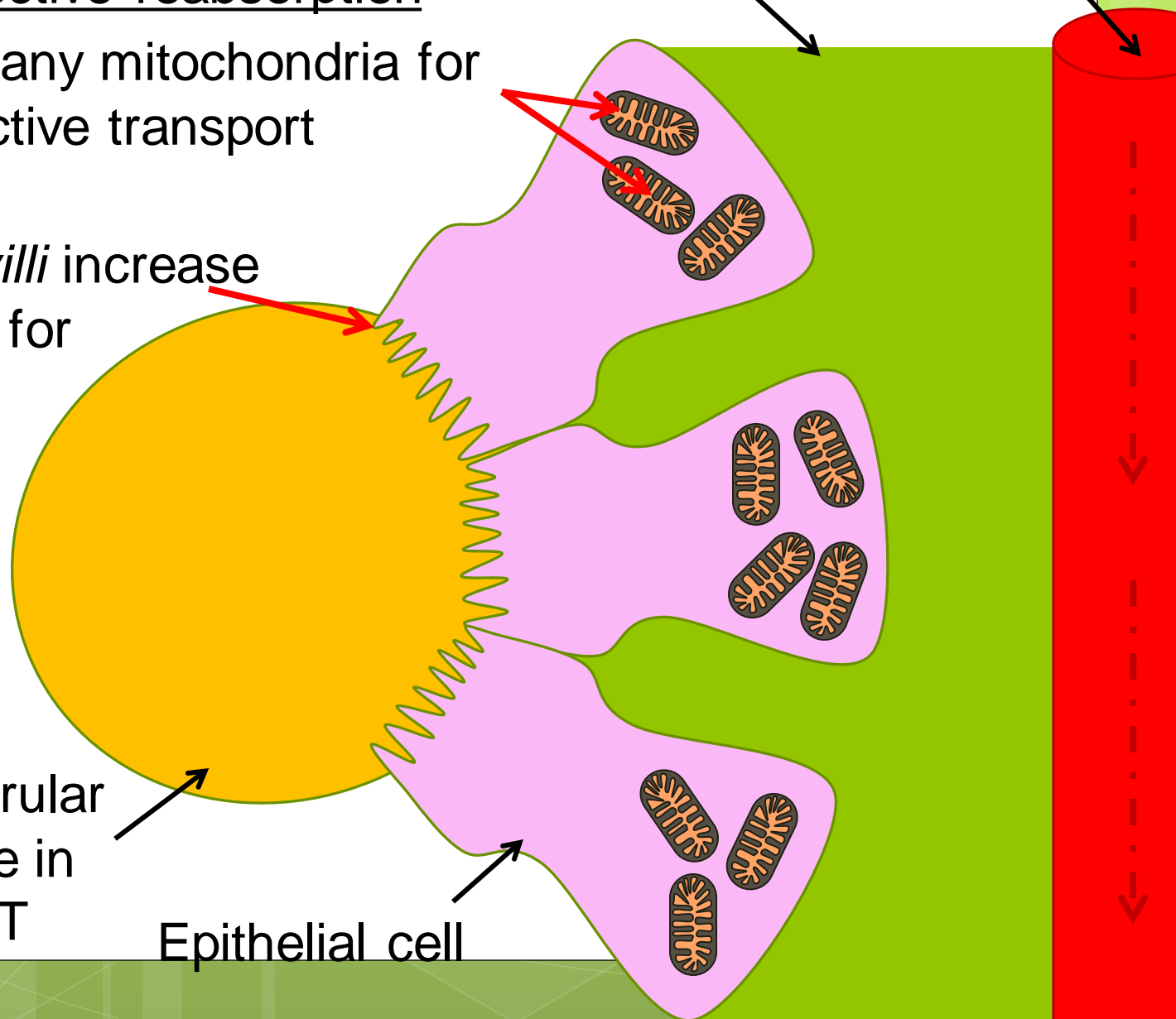
Brush border  
Many *microvilli* increase surface area for reabsorption

Glomerular filtrate in PCT

Epithelial cell

Tissue fluid

Capillary (vasa recta)

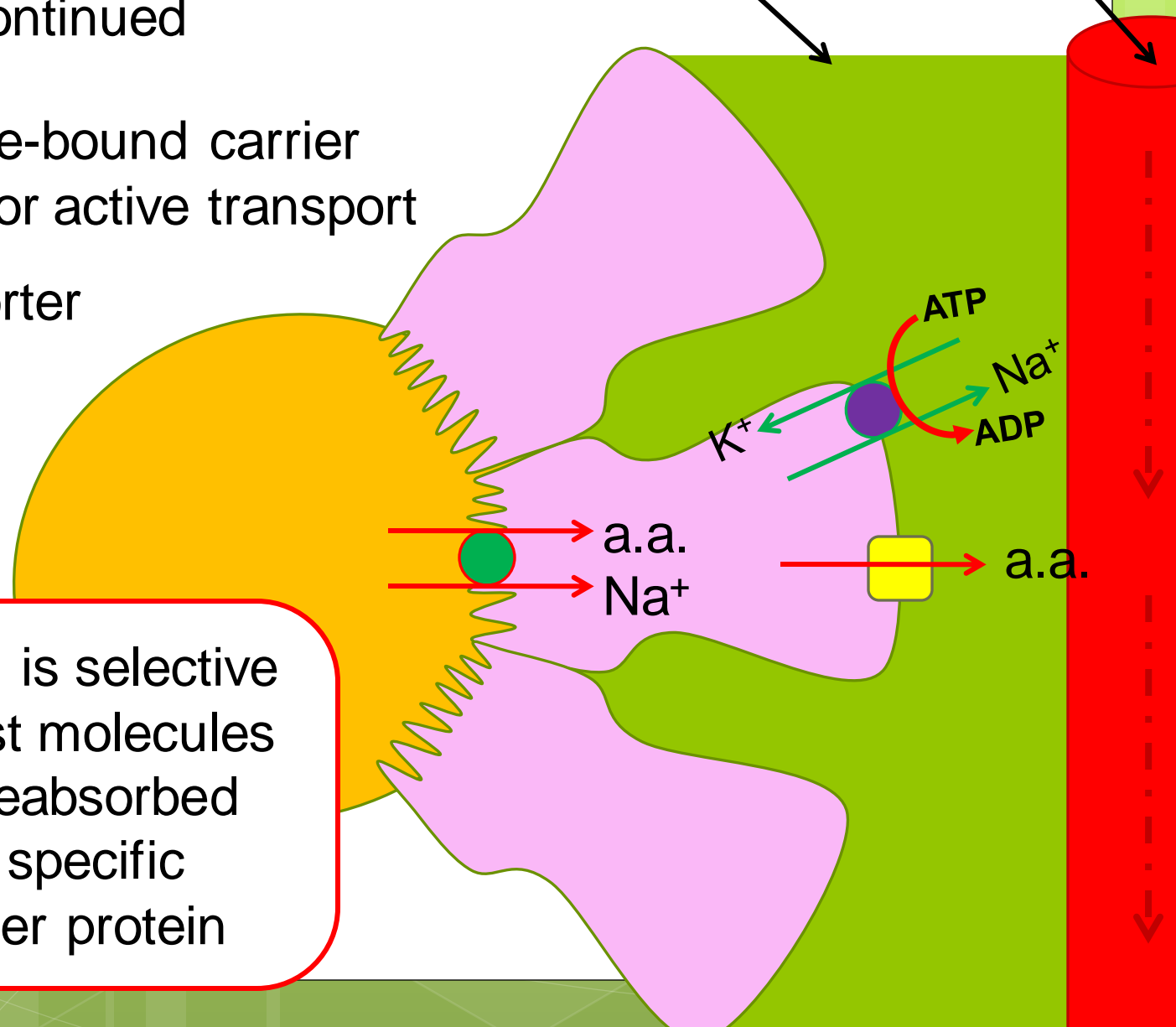


# Adaptations of the PCT Epithelial cells for selective reabsorption continued

Tissue fluid

Capillary (vasa recta)

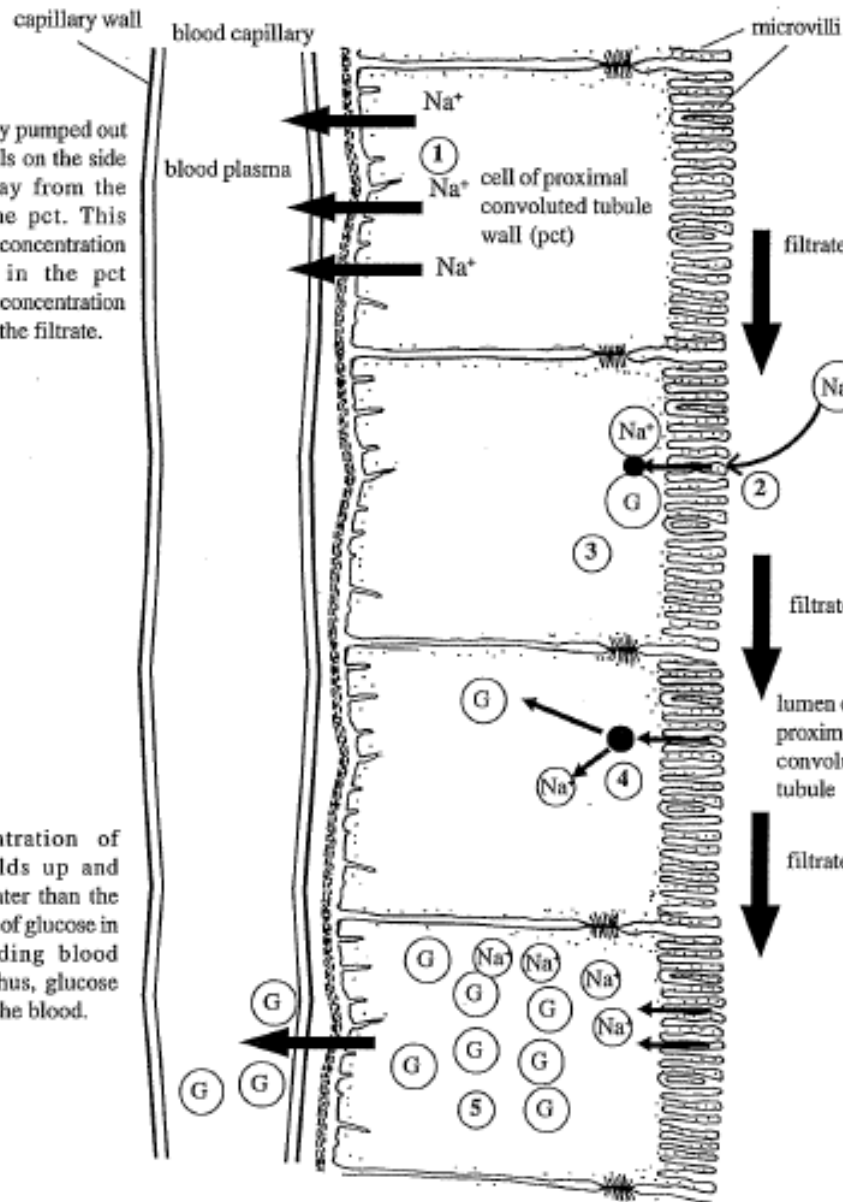
- membrane-bound carrier proteins for active transport
- cotransporter proteins
- channel proteins



Reabsorption is selective because most molecules cannot be reabsorbed without a specific cotransporter protein

①  $\text{Na}^+$  is actively pumped out of the pct cells on the side furthest away from the lumen of the pct. This decreases the concentration of sodium in the pct relative to the concentration of sodium in the filtrate.

⑤ The concentration of glucose builds up and becomes greater than the concentration of glucose in the surrounding blood capillaries. Thus, glucose diffuses into the blood.



② Glucose molecules and sodium ions bind to the glucose transporter proteins in the membrane of the cells of the pct. The sodium ions diffuse down their concentration gradient from the filtrate into the cells.

③ The pull of the  $\text{Na}^+$  ions is sufficient to pull the glucose molecules across the membrane even though the glucose molecules are moving against their concentration gradient.

④ Once inside the cells the glucose and sodium ions become detached from the transport protein.

# Selective reabsorption

- Outer membranes of cells actively transport sodium ions out of cytoplasm (sodium potassium pump)
- Sodium ions diffuse down a concentration gradient back into the cytoplasm, passing through co-transporter proteins that transport glucose or amino acids

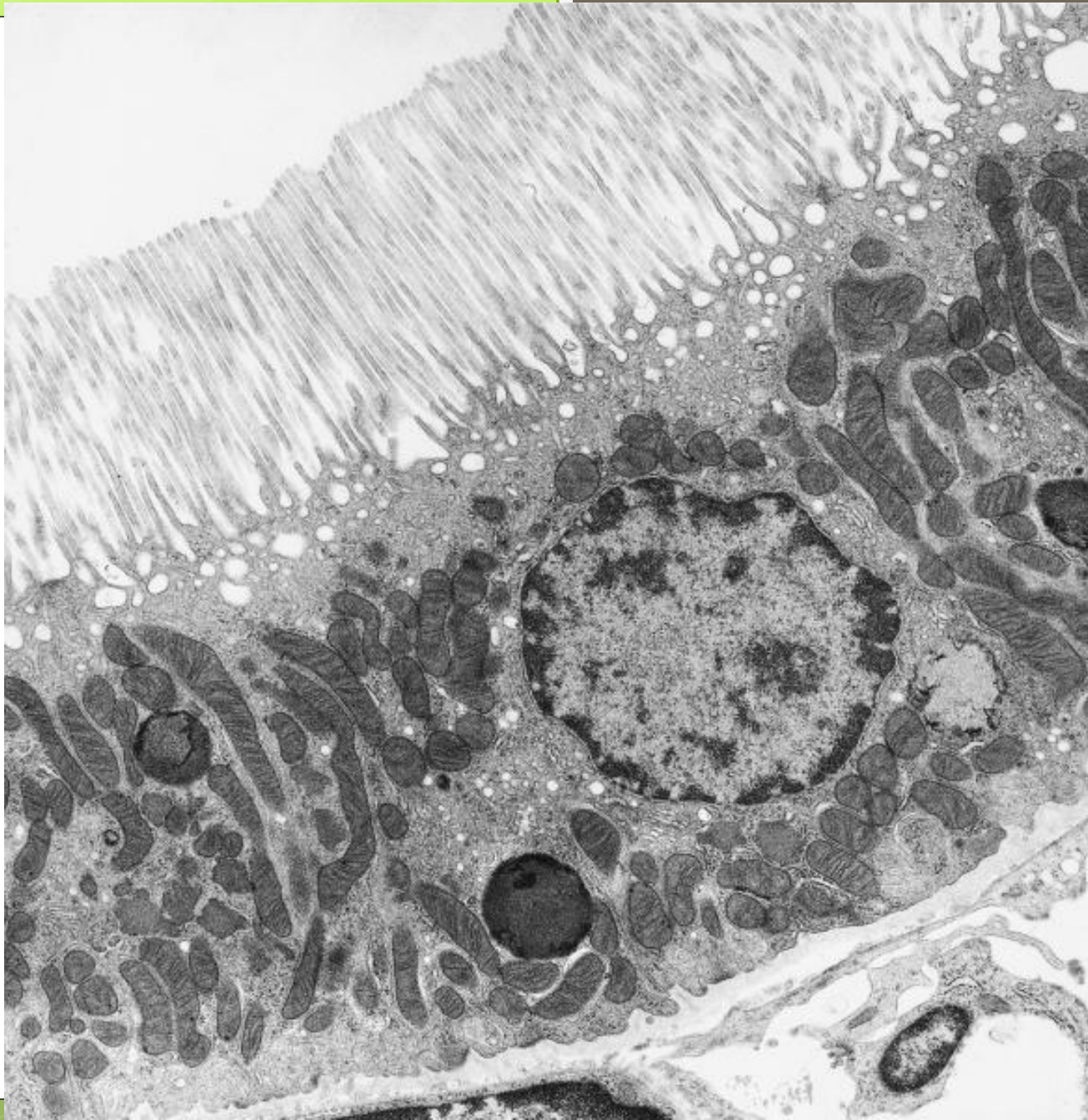


# Selective reabsorption

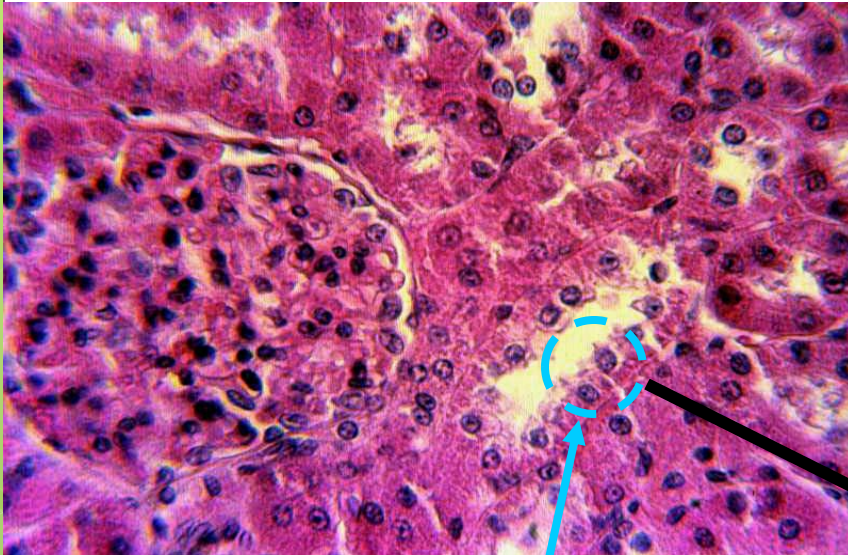
1. Sodium ions are actively transported out of cells into the tissue fluid
2. Glucose or amino acids enter cells with sodium ions by facilitated diffusion
3. Glucose and amino acids diffuse into the blood capillary

# Selective reabsorption

- Reabsorption of salts, glucose and amino acids
  - reduces the water potential of cells
  - Increases water potential in tubule
- Water is reabsorbed into the blood by osmosis

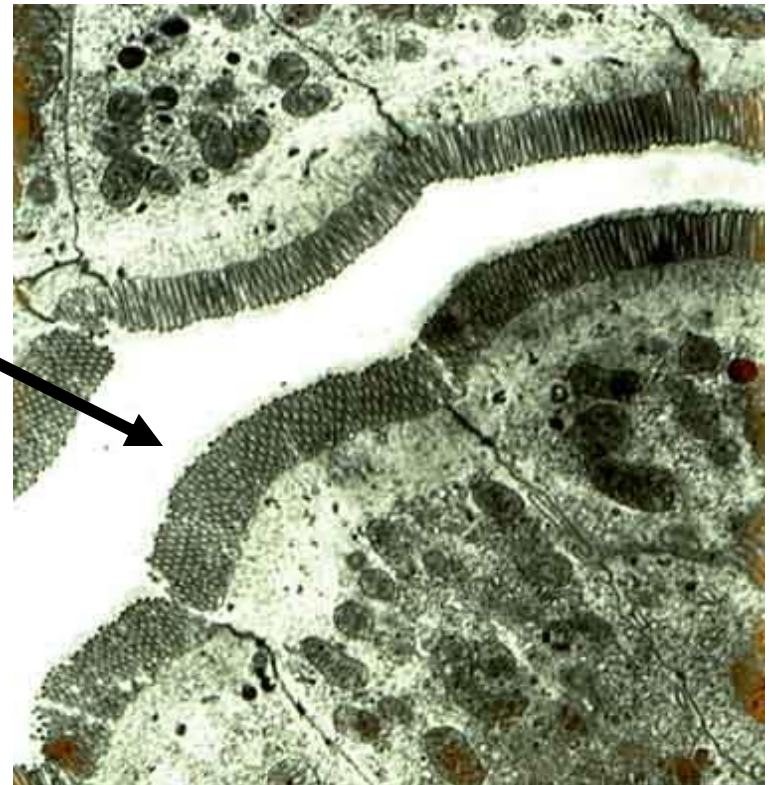


# Reabsorption



Kidney tubule with brush border

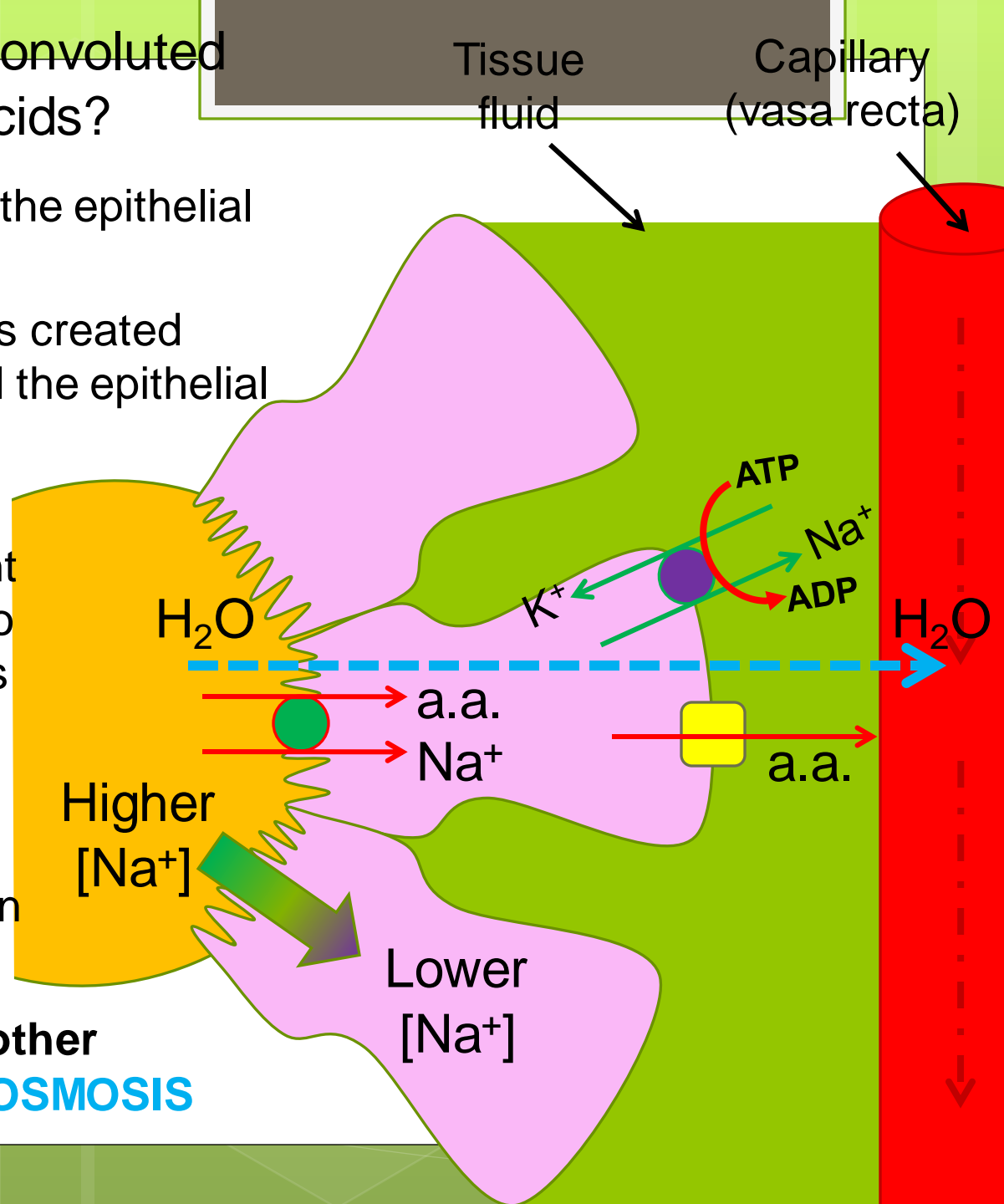
Microvilli on cuboidal epithelial cells



# How does the proximal convoluted tubule reabsorb amino acids?

- $\text{Na}^+$  ions are pumped out of the epithelial cells
- $\text{Na}^+$  concentration gradient is created between the PCT and the epithelial cytoplasm
- Diffusion of  $\text{Na}^+$  down its concentration gradient provides the energy to move the amino acids into the epithelial cell
- Amino acid moves by *facilitated diffusion* down *its* concentration into the capillary

**Water follows sodium and other reabsorbed solutes by... OSMOSIS**



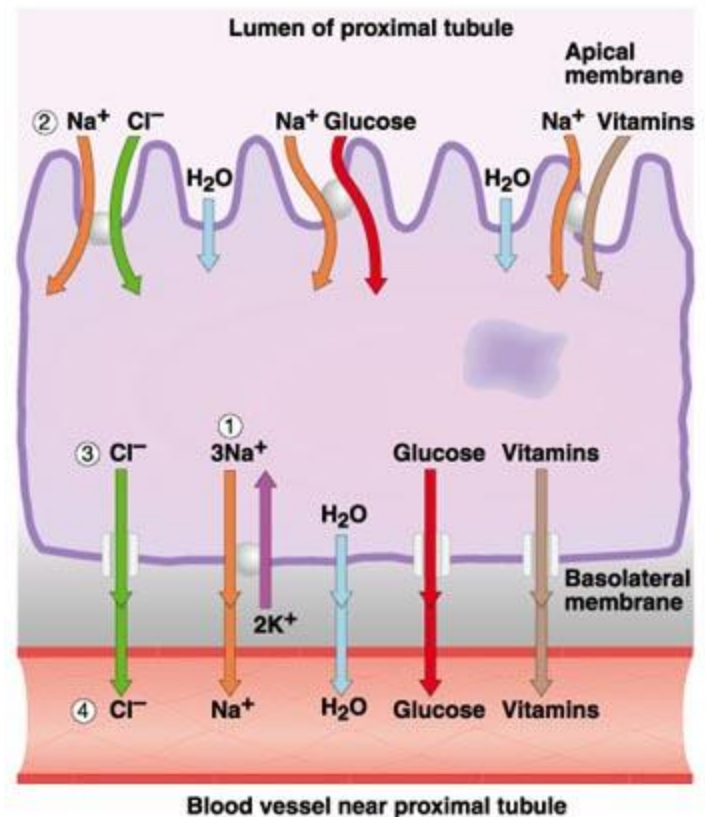
# Task:

- In pairs/groups of 3's, you need to model the process of selective reabsorption
- Use the materials provided and be creative
- You have 20 minutes
- We will then go around to each group as a class and the group must explain their model in detail using correct scientific terminology

# Specialised for Selective Reabsorption

- Microvilli on the cell surface membrane of the tubule provides a large surface area
- Co-transporter proteins in the membrane transport glucose and amino acids in association with sodium ions by facilitated diffusion
- The opposite membrane is folded to increase surface area and contains sodium-potassium pumps that pump sodium out and potassium in
- Cell cytoplasm has many mitochondria indicating that energy is required as ATP

Model of water and solute reabsorption



(iii) *This is a QWC question*

1 selective reabsorption;

2 of glucose and amino acids;

*DO NOT CREDIT if glucose & amino acids & proteins*

3 co-transport / *facilitated diffusion* / uptake described;

*ACCEPT direct uptake, of glucose / amino acids,  
by active transport*

4 water follows by **osmosis** so concentration of, ions / nitrogenous waste / urea / remaining substances, increases;

5 AVP,

*e.g*

- *microvilli provide large surface area for uptake*
- *many mitochondria provide energy for uptake*
- *many brush border enzymes (ATPase) for active uptake*
- *active secretion of nitrogenous waste into lumen*

**3 max**

QWC - technical terms used appropriately and spelt correctly;

*Use of **three** terms from:*

***reabsorption** (or derived term),*

***co-transport** (or derived term),*

***facilitated diffusion, osmosis***



# Plenary:

- In groups of 3 or 4 (different to that of the model task) you need to complete the exam-style question you are provided with
- Move around to another group to PEER ASSESS their answers using the mark scheme provided