



Renal Regulation of pH

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Regulation of pH:

There are three lines of defense (pH fighters) which regulates pH:

- **The 1st line is blood buffers**
- **The 2nd line is the respiratory regulation**
- **The 3rd line is the renal regulation**

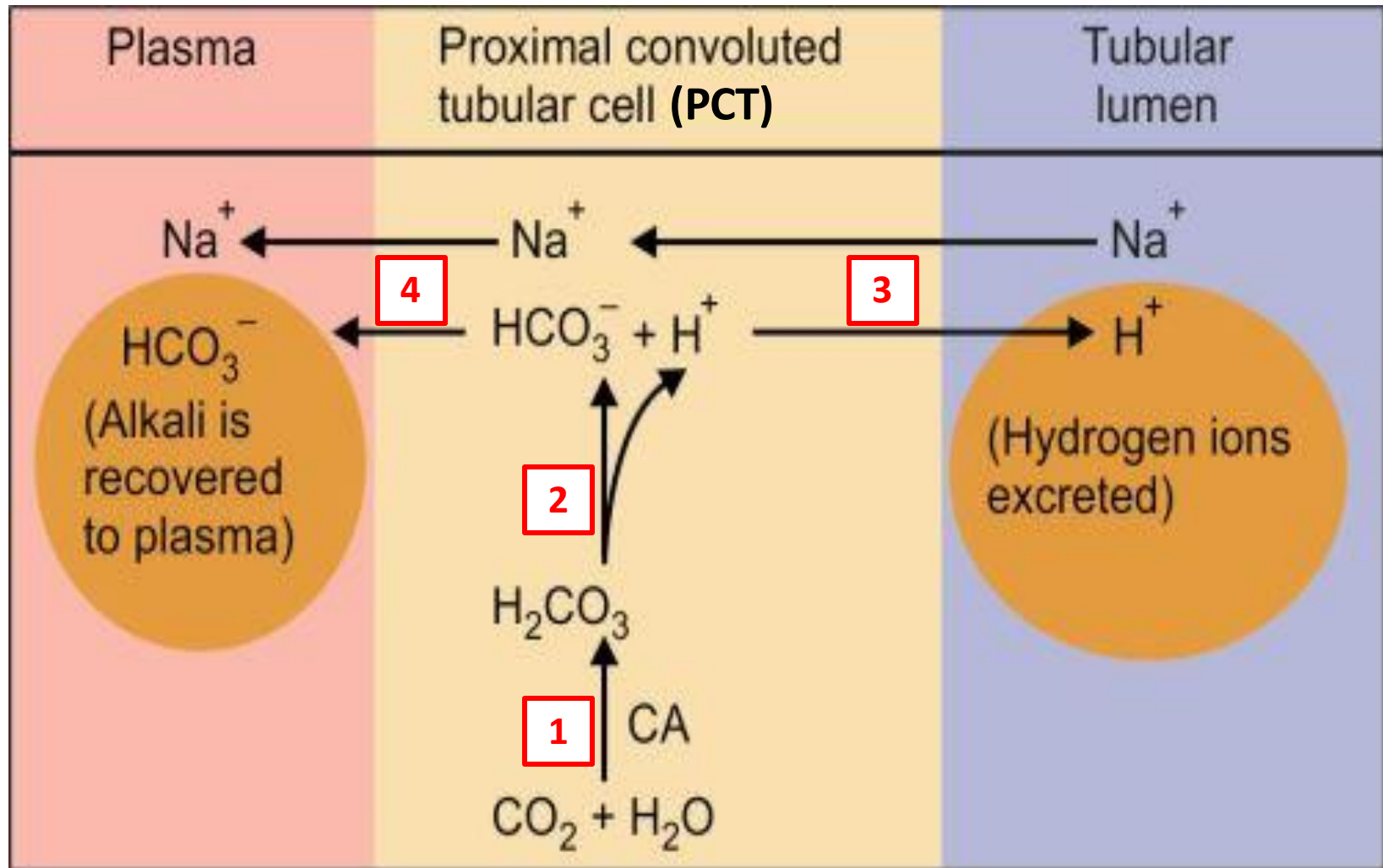
Renal regulation of pH

It is the 3rd line of defense against changes in pH, through;

- 1. Excretion of H⁺; generation of bicarbonate**
- 2. Reabsorption of bicarbonate (recovery of bicarbonate)**
- 3. Excretion of titratable acid (net acid excretion)**
- 4. Excretion of NH₄⁺ (ammonium ions)**

Renal regulation of pH:

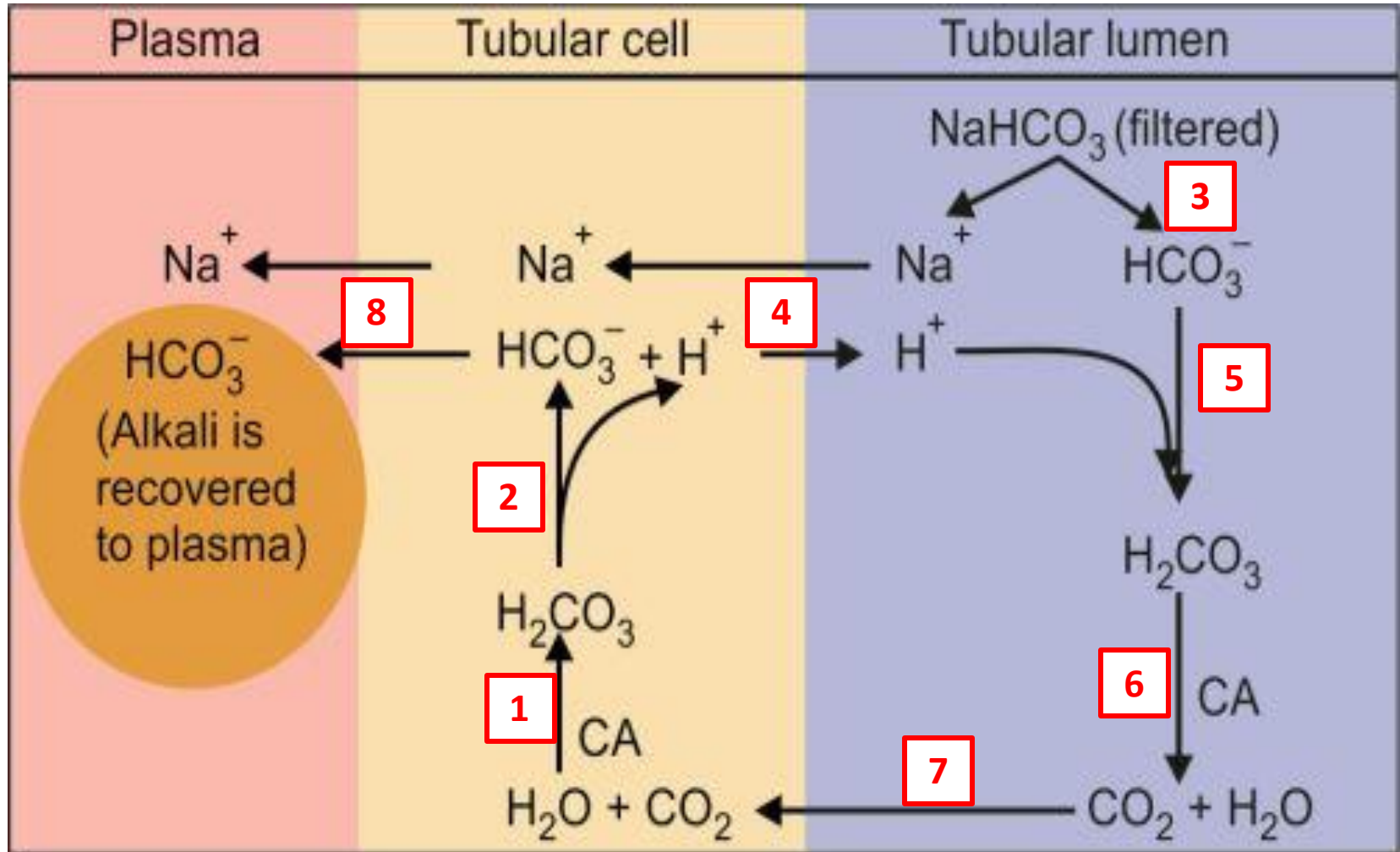
1. Excretion of H^+ ; generation of bicarbonate



- This occurs in the proximal convoluted tubules (PCT)
- It aims to excrete hydrogen and regenerate bicarbonate

Renal regulation of pH:

2. Reabsorption of bicarbonate (recovery of bicarbonate)



- It does not aim to excrete H^+ but to conserve base.
- Also, there is no net excretion of H^+ or generation of new HCO_3^-

Renal regulation of pH:

3. Excretion of titratable acid (net acid excretion)

Titratable acidity: It is the number of milliliters of N/10 NaOH required to titrate one liter of urine to pH 7.4.

- It is a measure of net acid excretion by the kidney.
- The major titratable acid in the urine is sodium acid phosphate (NaH_2PO_4).
- As the tubular fluid passes down the renal tubules more and more H^+ are secreted into the luminal fluid so that its pH steadily falls. The process starts in the PCT but continues up to the distal (DCT).
- Normally; about 70 mEq / d of acid is excreted daily and may reaches to 400 mEq / d during acidosis.

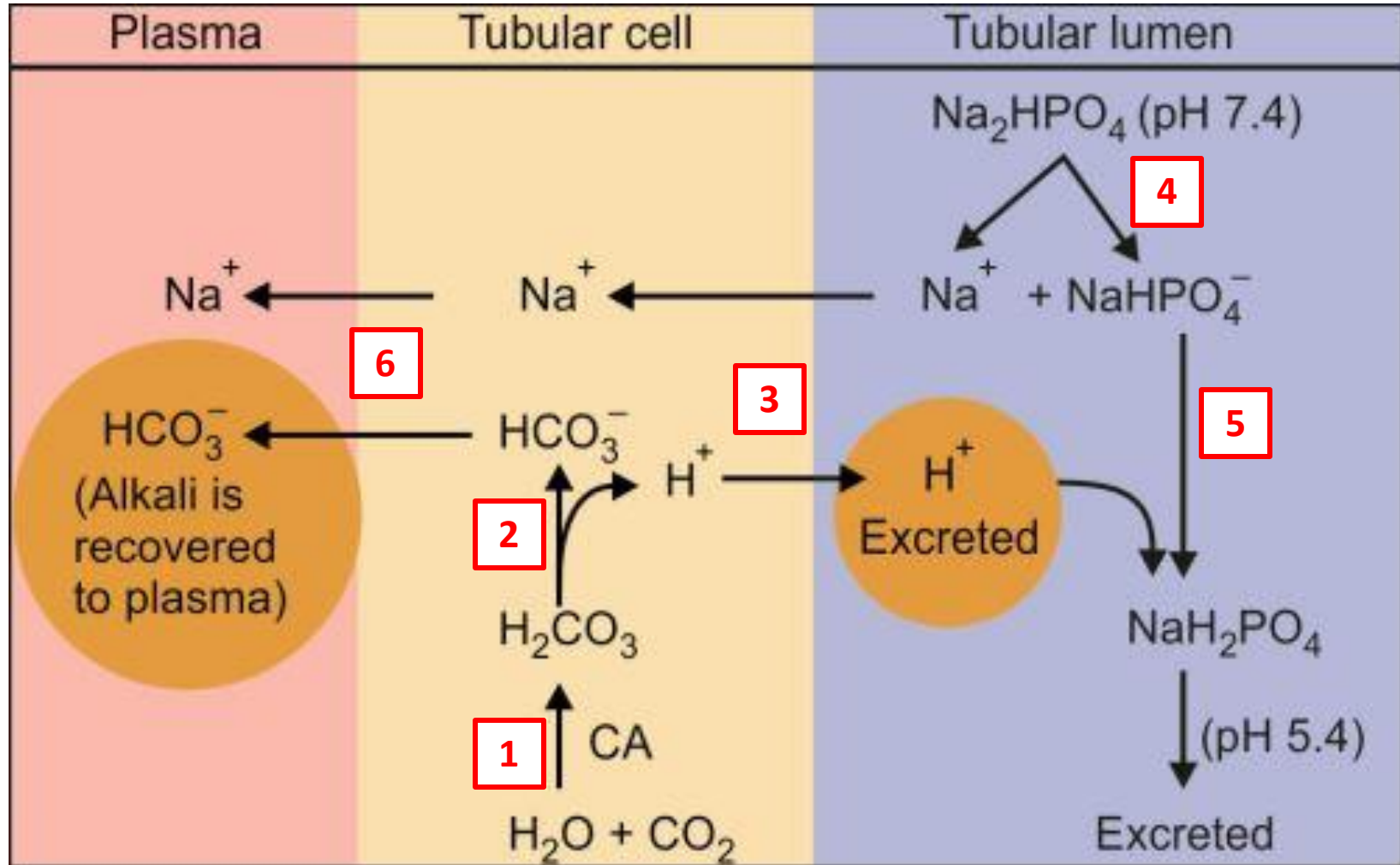
Renal regulation of pH:

3. Excretion of titratable acid (net acid excretion)

- The net acid excretion occurs in the DCT. H^+ is secreted by the distal and collecting ducts by H^+ ATPase located in the apical cell membrane.
- The acid and phosphate pair is considered as the urinary buffer. The maximum limit of acidification is pH 5.4.
- This process is inhibited by carbonic anhydrase inhibitors as acetazolamide.

Renal regulation of pH:

3. Excretion of titratable acid (net acid excretion)



Renal regulation of pH:

4. Excretion of ammonium ions (NH_4^+):

- Unlike excretion of H which occurs in PCT, ammonium ions (NH_4) excretion occurs in DCT. The excretion of ammonia helps in the elimination of H without appreciable change in urine pH.
- The activity of glutaminase is increased in acidosis.
- NH_4 is a positively charged and can accompany negatively charged acid anions so, Na^+ and K^+ are conserved.
- Ammonia content of urine plus titratable acidity of urine are used for measuring acidity of urine.

Renal regulation of pH:

4. Excretion of NH_4^+ (ammonium ions)

