

Regulating Kidney Function - HOMEOSTASIS

A) Homeostatic Functions:

1. Regulating pH
2. Regulating Salt balance
3. Regulating Blood volume

1. pH

- If pH is too low (blood is acidic) the kidneys take up and excrete the following:

ACIDIC → i) H^+ ii) $NH_3 \rightarrow NH_4^+$

- and reabsorb the following:

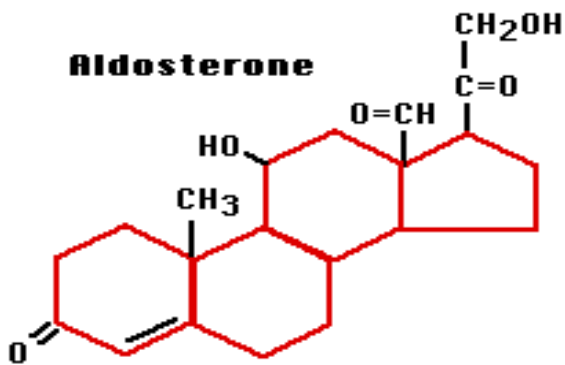
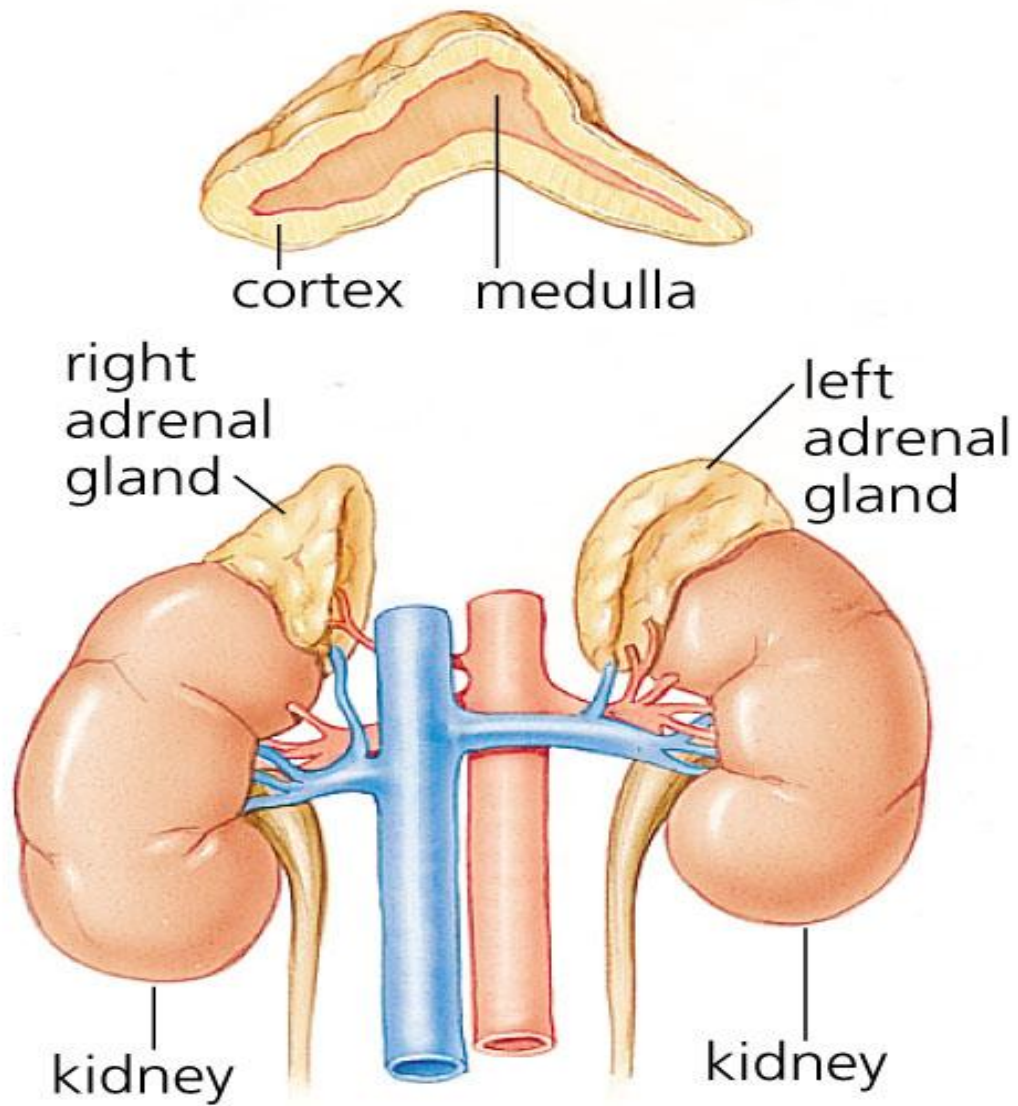
BASIC → iii) Na^+ iv) HCO_3^-

- If pH is too high (blood is too alkaline) the reverse of the above process takes place.

2. Salts/ions

- Various processes take place to maintain the proper balance of salts. Ions such as, sodium, bicarbonate, potassium, magnesium are kept perfectly in balance by either excretion or reabsorption.

- A Hormone (**Aldosterone**) is produced and secreted by the **Adrenal Cortex of the adrenal gland**, this hormone regulates the level of sodium (**Na+**) and potassium (**K+**) in the blood.



You should be able to recognize this as being a steroid hormone due to its backbone of four fused carbon rings

- If sodium is too low, Aldosterone causes more sodium to be reabsorbed into blood at the **distal convoluted tubule**. If sodium concentration is high, release of Aldosterone is inhibited.

3. Blood Volume

- The thickness/viscosity of blood is determined by the amount of H₂O in the blood. Two hormones, **ADH** and **Aldosterone** play important roles in regulating blood volume.

i) ADH – **Antidiuretic Hormone (ADH)** (Another good example of a Negative Feedback Loop) controls reabsorption of water.

- ADH is released into the bloodstream from the **posterior pituitary gland** (under the control of the Hypothalamus) when more water needs to be reabsorbed into the blood. ADH works by increasing the permeability of the **distal convoluted tubule and mostly the collecting duct** so that more water can be reabsorbed into the blood.

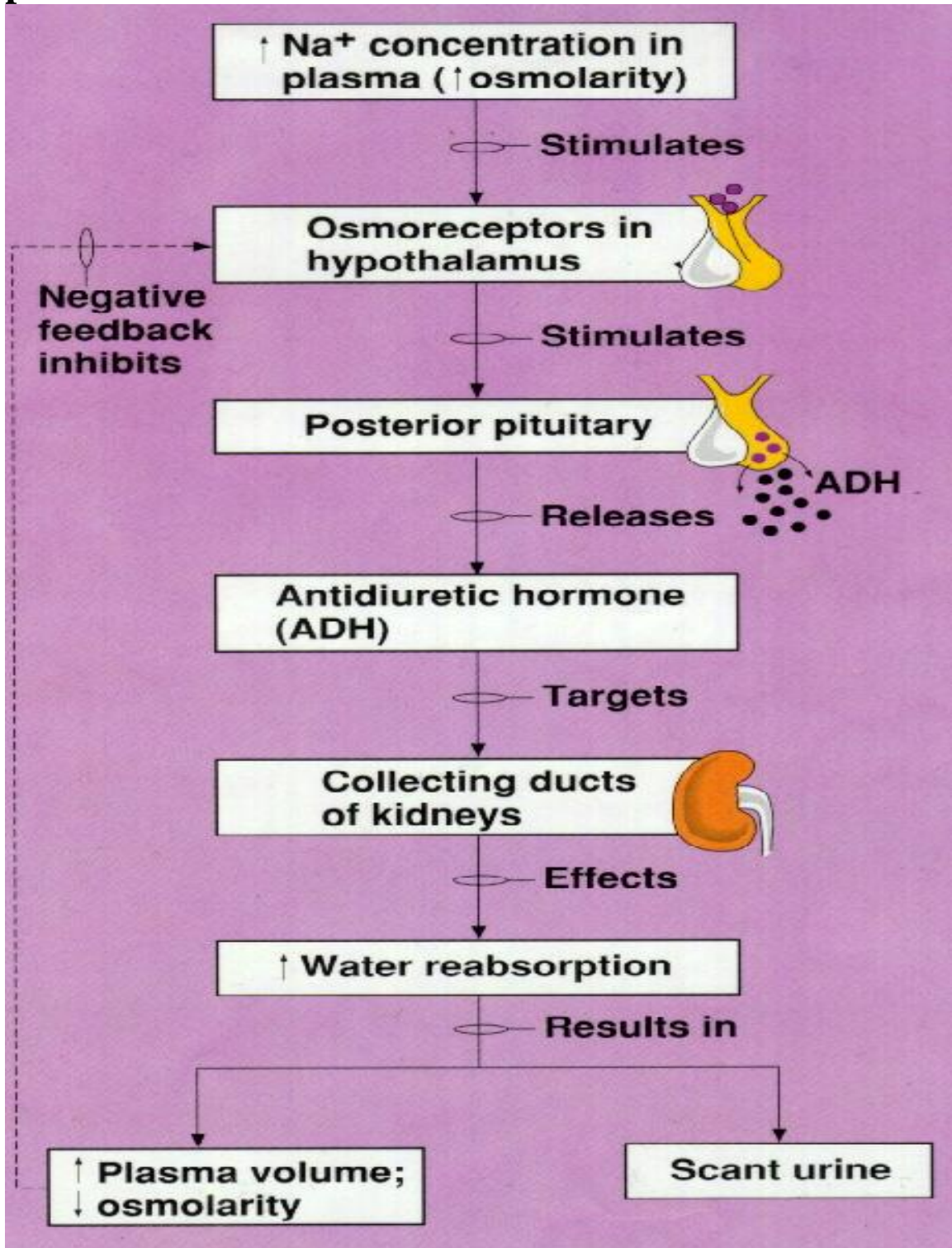
- ADH causes a decrease in the amount of urine produced (scant urination), but an increase in the concentration of that urine. Ex. Urine is dark after you have been working hard outside on a hot day without taking in adequate fluids.

- With more water being reabsorbed, blood volume tends to be increased (blood is less thick); proper blood volume is maintained.

- Alcohol has a negative effect on ADH. It sends a false message to the hypothalamus that there is too much water in the blood. ADH is not released in fact it is inhibited. Therefore water is not reabsorbed and more water is lost in the urine. That is why when someone drinks alcohol, they frequently urinate light-colored watery urine and are far more prone to become dehydrated.



The effect and regulation of ADH is illustrated in the picture that follows:



ii) The effect of another hormone, Aldosterone (mentioned in regulating salts) is the same as that of ADH.

- As Aldosterone causes the movement of Sodium to move back into the blood from the filtrate at the distal convoluted tubule, water soon follows due to osmosis.

- Aldosterone is sometimes referred to as the “*Salt and Water Retaining Hormone*”