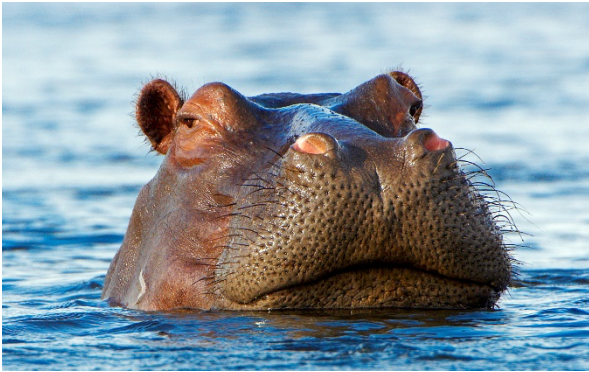


A. HYPOTONIC v HYPERTONIC

HYPOTONIC



HIGH WATER CONCENTRATION
LOW SOLUTE CONCENTRATION

HYPERTONIC



LOW WATER CONCENTRATION
HIGH SOLUTE CONCENTRATION

B. OSMOREGULATION (= CONTROL OF THE WATER CONCENTRATION OF BLOOD)

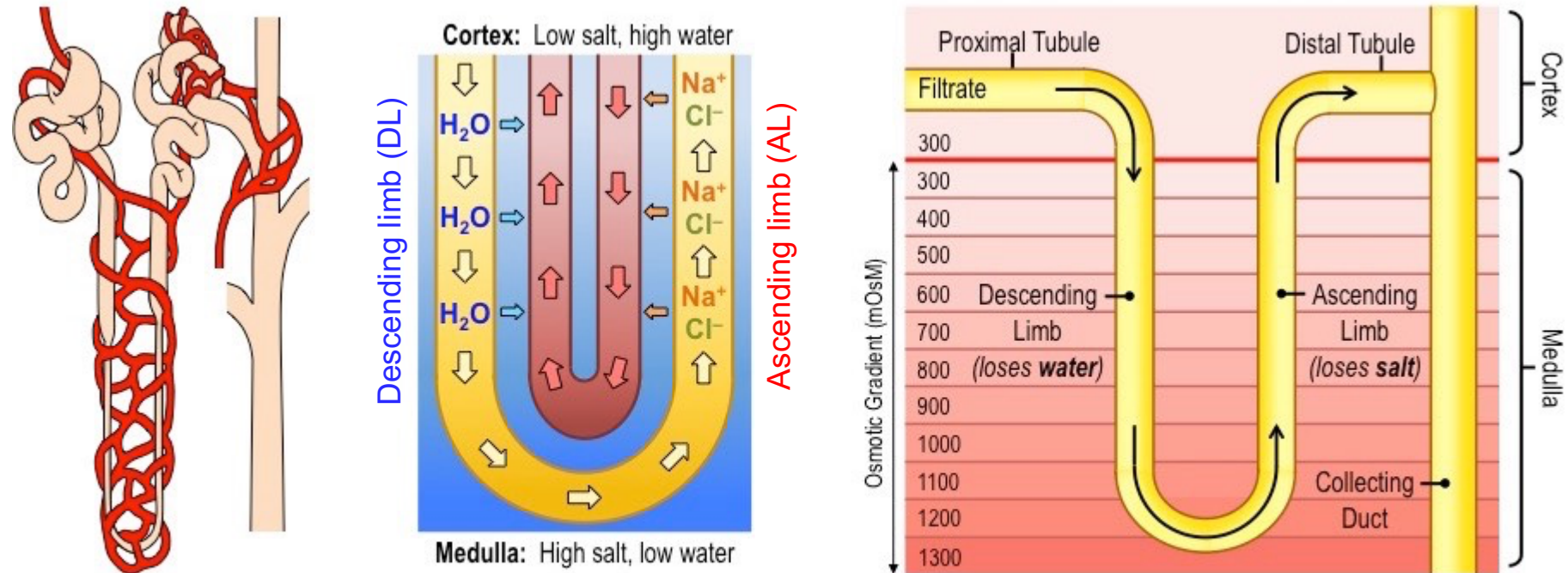
Osmoregulation occurs in the **medulla** of the kidney and involves **two key** events:

1. **The loop of Henle** creates a **salt concentration gradient** in the **medulla**.
 - This makes this area **hypertonic**, so **water** is drawn **towards** it from the **collecting duct**.
 - This **prevents** the body **losing** too much **water**.
2. **Anti-diuretic hormone (ADH)** controls the amount of **water reabsorption** from the **collecting duct** into the blood.

Both are involved in osmoregulation

C. HOW THE LOOP OF HENLE IS INVOLVED IN OSMOREGULATION

- The **loop of Henle** maintains an area of **high solute concentration** (hypertonic) in the **medulla**.
- This draws **water towards it** by **osmosis** from the **collecting duct**, **preventing** too much **water loss** from the body.



Loop of Henle and blood capillaries

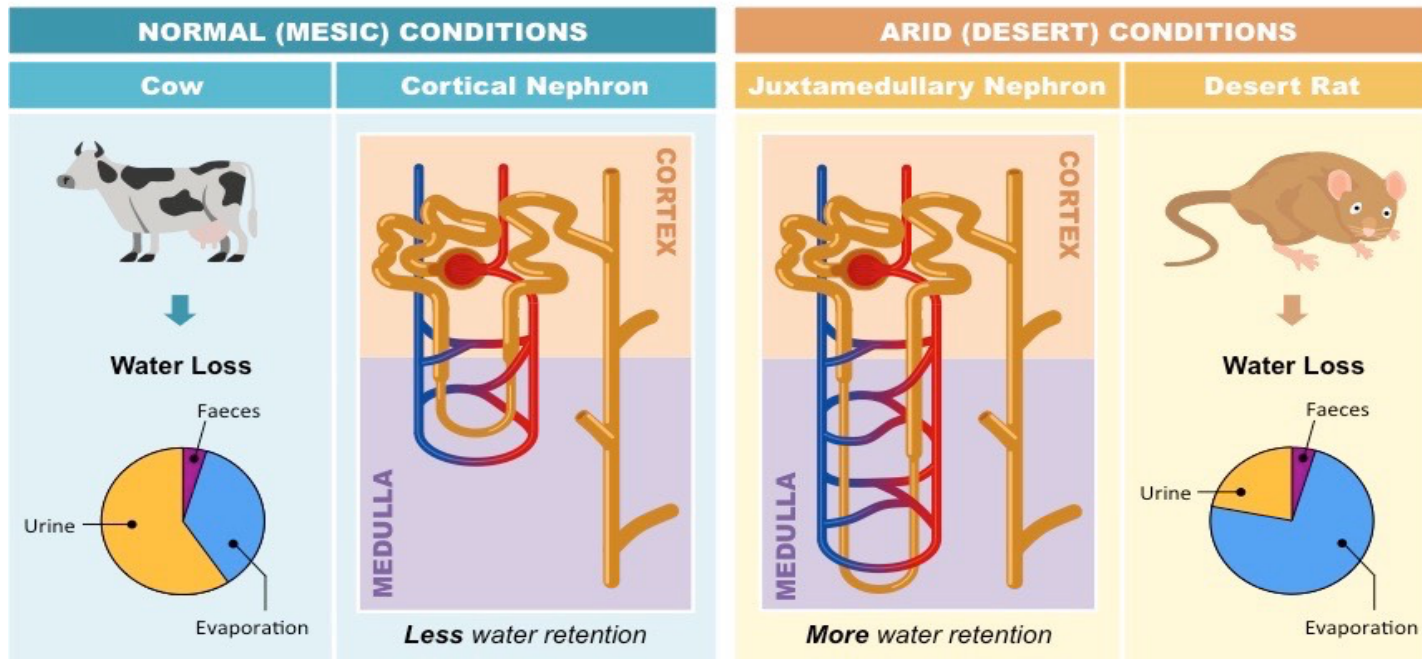
Maintaining a high solute concentration

Water will be drawn towards the loop of Henle by osmosis from the collecting duct

- **AL** is **permeable** to Na^+ but **impermeable** to H_2O .
- In the **AL**, Na^+ is **actively transported out** of the **filtrate** into the **medulla**.
- This creates a **high solute concentration** in the **medulla** (hypertonic).
- **DL** is **permeable** to H_2O but **impermeable** to Na^+
- As filtrate flows down **DL**, **water leaves** by **osmosis** (low \rightarrow high solute concentration)
- Also, **water** is **drawn towards** the **loop of Henle** from the **collecting duct** by **osmosis**
- This causes **more water** to be **conserved** and **less** to enter **urine**.

D. ANIMALS THAT LIVE IN HOT, DRY PLACES

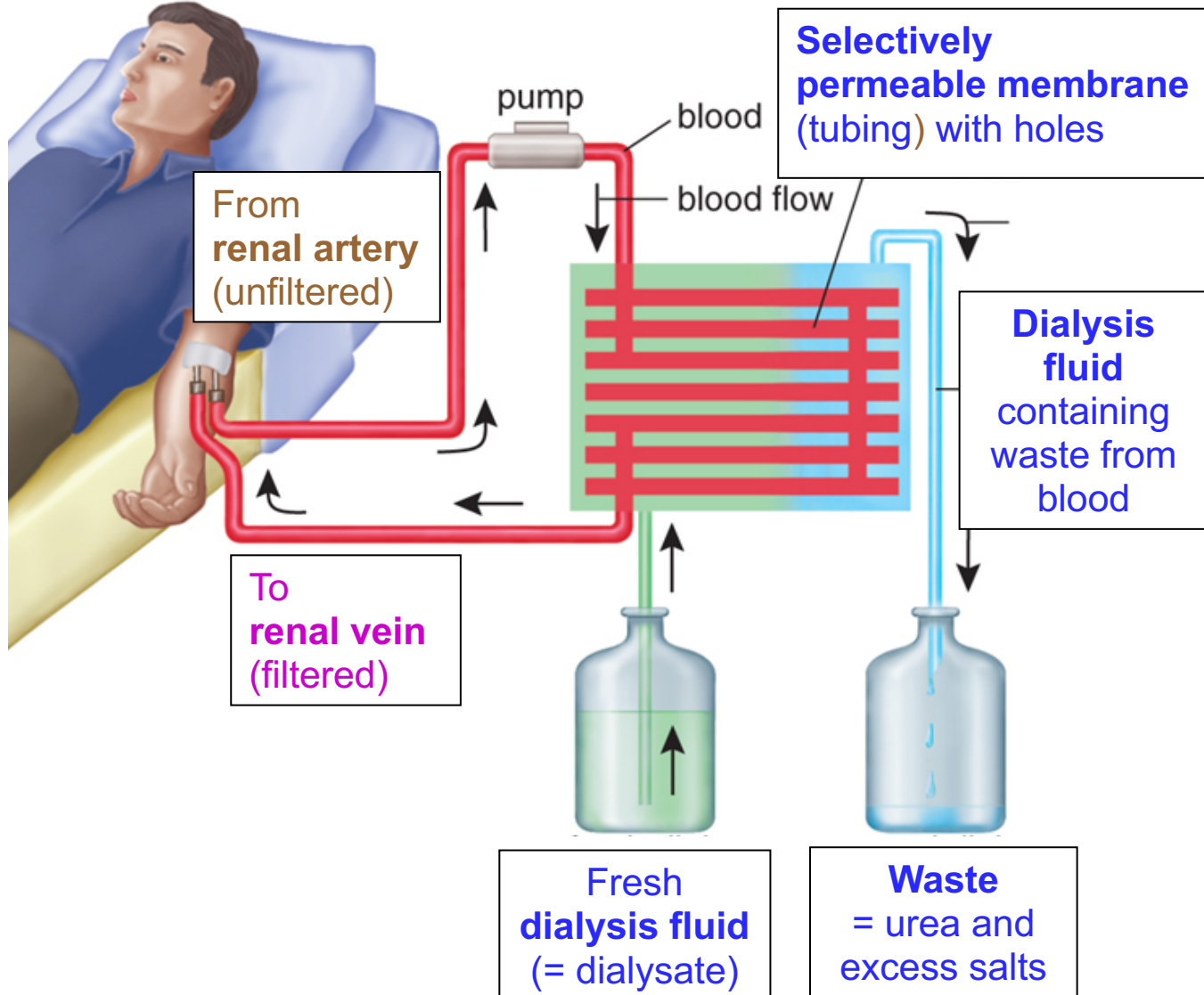
- Have adapted to living here by having a **longer loop of Henle**.
- This **increases** the **salt concentration gradient** in the **medulla**.
- (So) **more water** is **drawn** towards the **medulla** by **osmosis**, so even **less** leaves the **body**.



- Animals living in arid (dry) environments have a **thicker medulla** compared to the **overall size** of the **kidney**.
- This allows them to have **longer loops of Henle** that **descend deeply** into the **medulla**.
- This **increases** the **salt concentration** in the **medulla**.
- (So) **more water** **reabsorbed** from **collecting duct**.
- (So) **urine** is **more concentrated**.

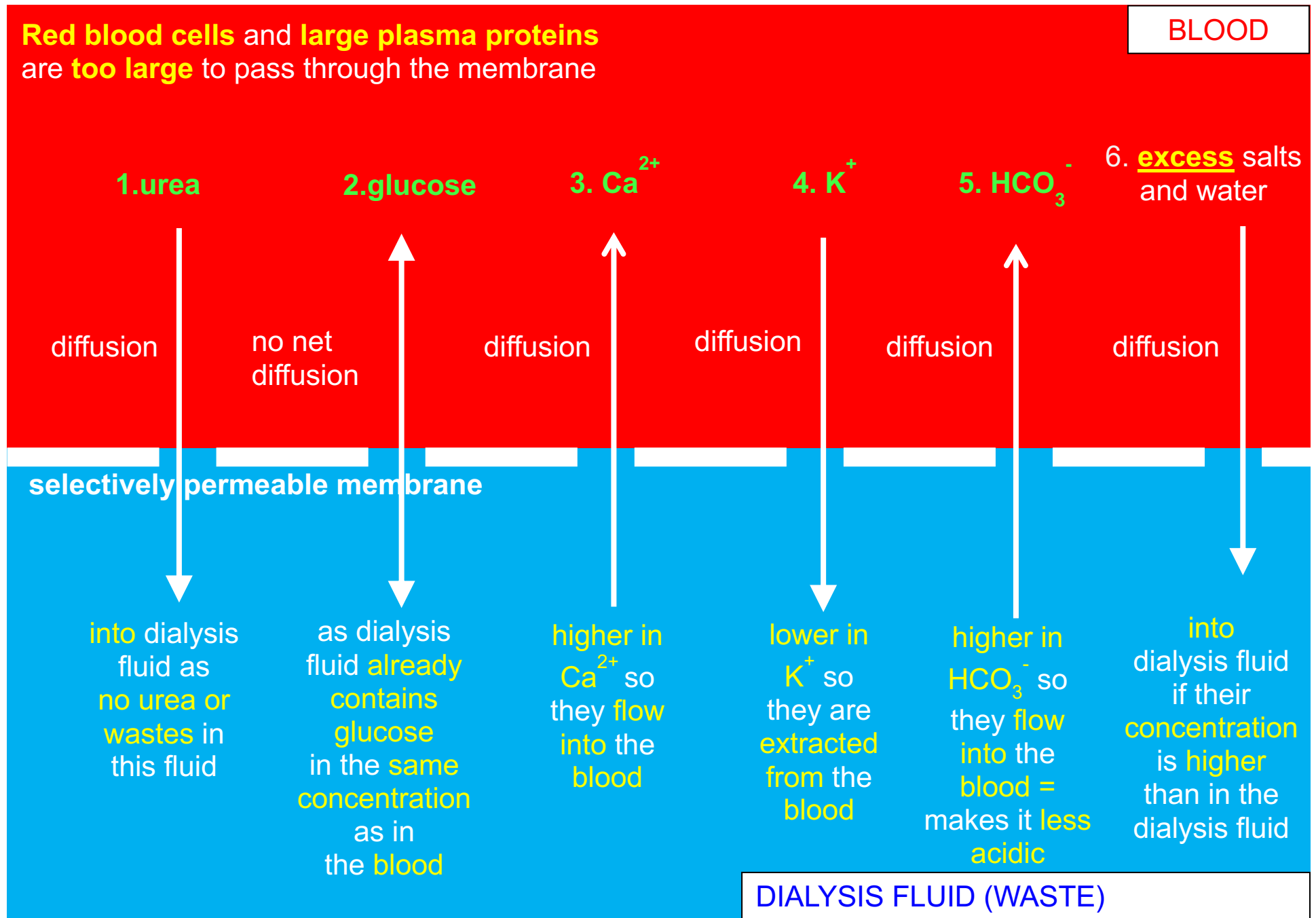
E. KIDNEY DIALYSIS

- A **kidney dialysis machine** can be used to **temporarily treat** a person whose **kidneys do not work** properly.



- The key to understanding how this machine filters the blood is to go back to **diffusion** and what a **selectively permeable membrane** does.
- We are now going to **magnify** and '**zoom in**' on the **selectively permeable membrane** used in a kidney dialysis machine.

F. SELECTIVELY PERMEABLE MEMBRANE AND DIFFUSION

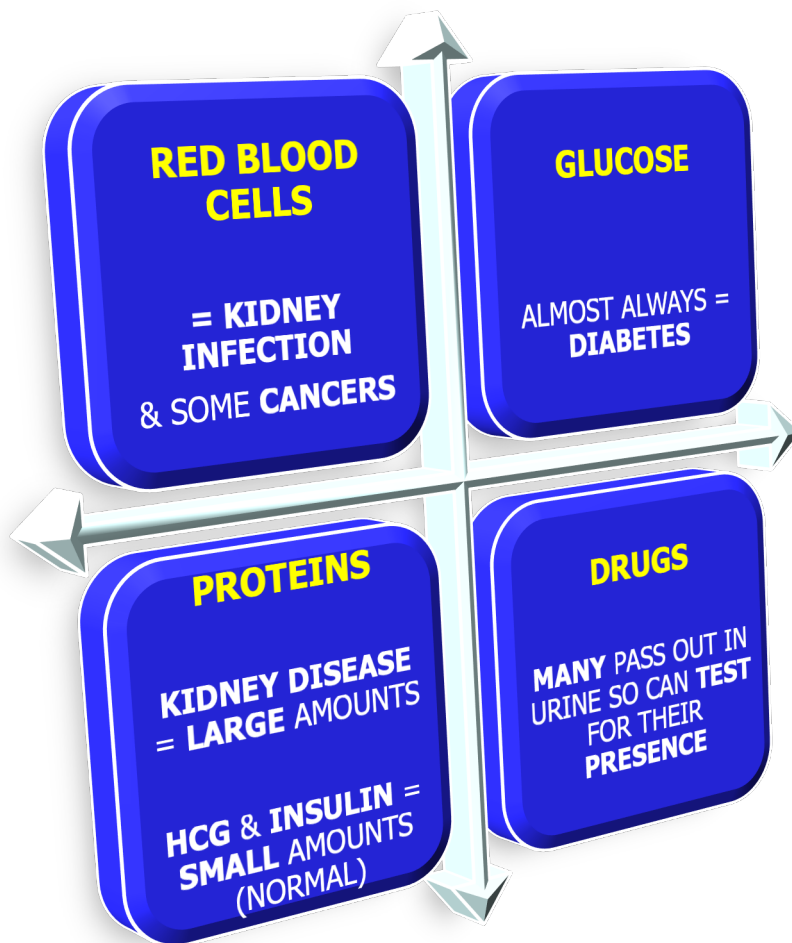


G. KIDNEY TRANSPLANTS

- A **more permanent** way of treating a person.
- You need to be able to weigh up the **advantages** and **disadvantages** of **dialysis**, versus a **kidney transplant**.

	DIALYSIS	KIDNEY TRANSPLANT
More expensive long term?	YES	NO
Very disruptive?	YES Three 6 to 8-hour sessions per week and must live near a dialysis machine	NO Only need to take medication but can go anywhere, anytime
Need to find a new kidney?	NO	YES Donor kidney must be "tissue typed" so it shares as many antigens as possible with the patient's tissues
Risk of rejection?	NO	YES
Harmless microbes can be dangerous?	NO	YES Immunosuppressive drugs are given to prevent rejection of the new kidney

H. REASONS FOR TESTING A PERSON'S URINE



I. COMPARING BLOOD IN THE RENAL ARTERY & RENAL VEIN

	RENAL ARTERY (TO KIDNEY)	RENAL VEIN (AWAY FROM KIDNEY)	REASON FOR DIFFERENCE
OXYGEN	Higher	Lower	Aerobic respiration provides ATP for kidney to function
CARBON DIOXIDE	Lower	Higher	
GLUCOSE	Slightly higher	Slightly lower	Used in aerobic respiration
UREA	Higher	Lower	Excreted in urine
PLASMA PROTEINS	Same		Not added or removed
Na ⁺ & Cl ⁻ IONS	Variable	Always at normal levels	Kidney raises or lowers concentrations to normal levels