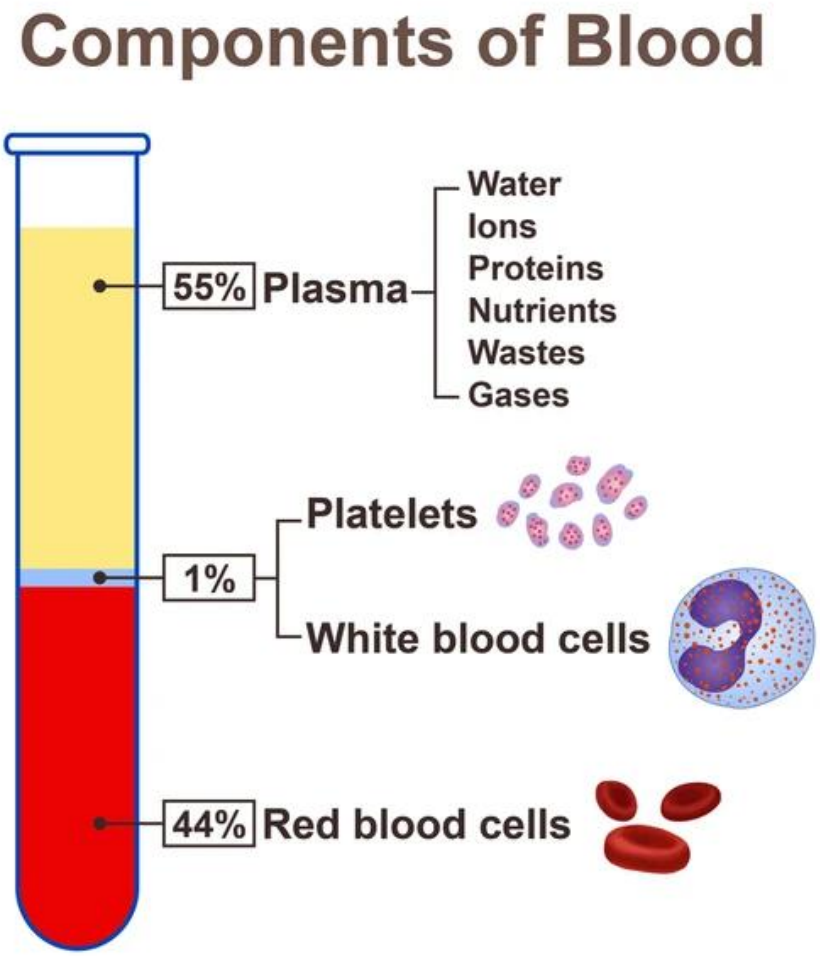
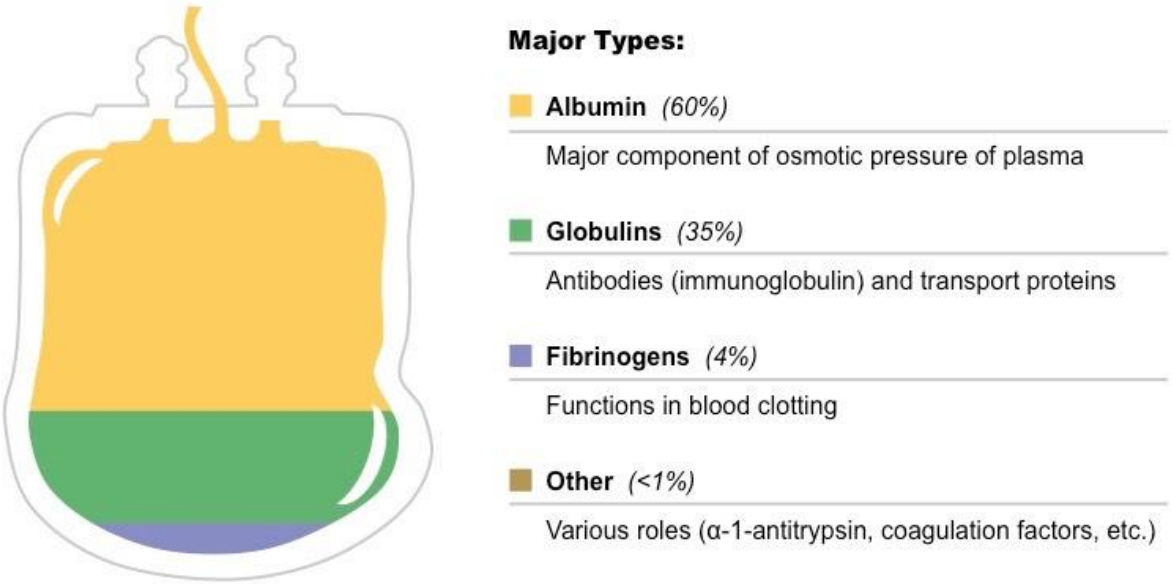
Card 1: Plasma (Overview)

1. **Definition**: Plasma is the **pale yellow, liquid component** of blood.
2. **Main Composition**: Approximately **90% water**, serving as a solvent for various substances.
3. **Appearance**: Translucent, **pale yellow** color visible when separated from blood cells.
4. **Transport Medium**: Dissolves and carries **nutrients** (e.g., glucose), **wastes** (e.g., urea), **hormones**, and **electrolytes**.
5. **Electrolytes** include **sodium**, **potassium**, **calcium**, and others, crucial for nerve impulses and muscle contraction.
6. **pH Regulation**: Plasma helps **buffer** blood pH, maintaining it around **7.4**.
7. **Heat Distribution**: High water content helps **distribute heat** throughout the body for temperature regulation.
8. **Volume Maintenance**: Plasma makes up about **55%** of total blood volume, supporting **circulatory pressure**.
9. **Co2 Transport**: A portion of carbon dioxide dissolves in plasma as **carbonic acid/bicarbonate**.
10. **Clotting Factors**: Plasma carries **fibrinogen**, **prothrombin**, and other clotting factors necessary for hemostasis.



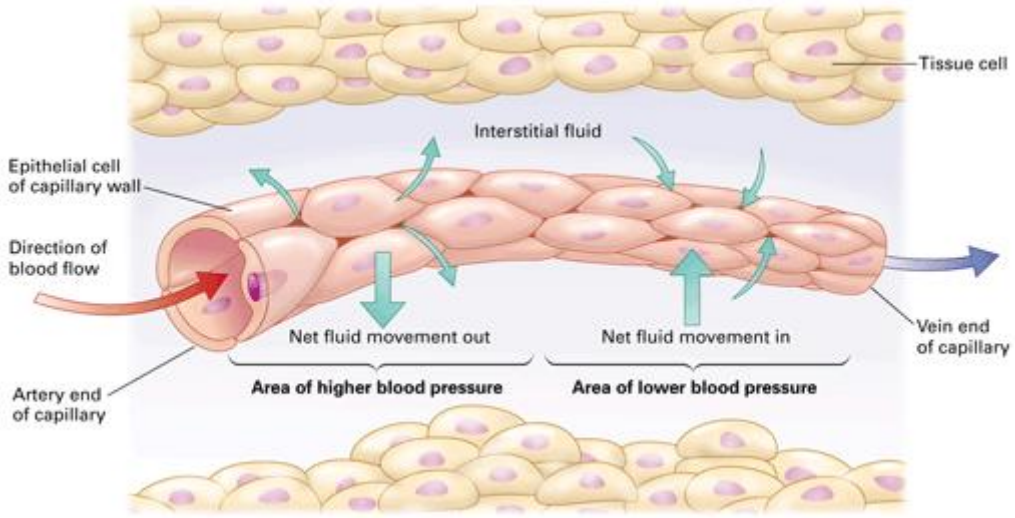
Card 2: Plasma Proteins

1. **Types**: **Albumin**, **globulins**, and **fibrinogen** are the primary plasma proteins.
2. **Albumin**: Maintains **osmotic pressure**; prevents excessive fluid loss into tissues.
3. **Globulins**: Include **immunoglobulins (antibodies)** crucial for immune defense.
4. **Fibrinogen**: Essential for **blood clotting**; converts to fibrin to form clots.
5. **Liver Production**: Most plasma proteins are **synthesized in the liver**.
6. **Transport Function**: Albumin carries **hormones**, **vitamins**, and **drugs** through the bloodstream.
7. **Immunity**: Globulins (especially gamma globulins) help fight **pathogens** and infections.
8. **Blood Volume**: Plasma proteins contribute to **colloid osmotic pressure**, affecting fluid distribution.
9. **Buffering Role**: Some plasma proteins help **maintain blood pH** by binding or releasing H^+ ions.
10. **Diagnostic Significance**: Changes in plasma protein levels can indicate **liver disease**, **kidney dysfunction**, or **malnutrition**.



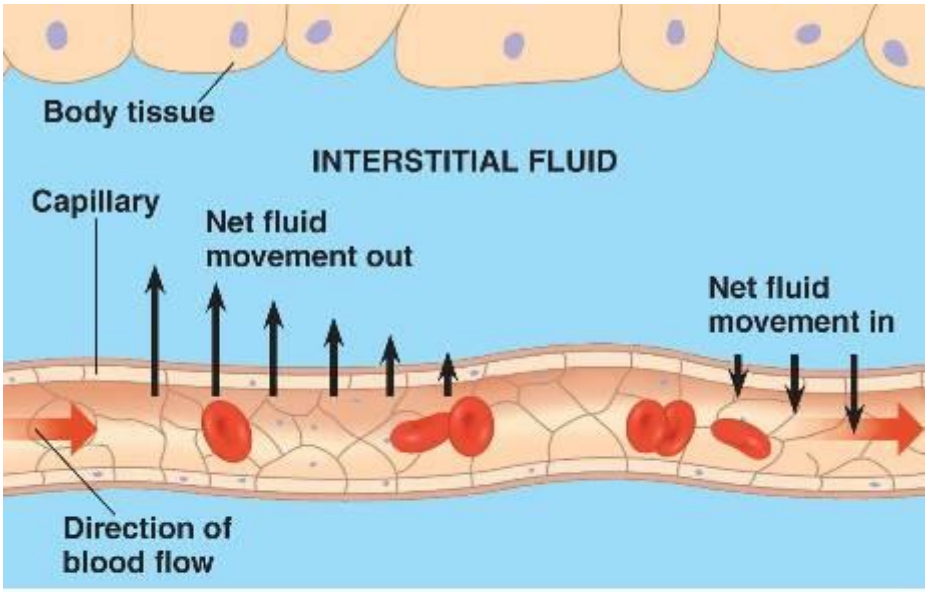
Card 3: Tissue Fluid (Definition & Composition)

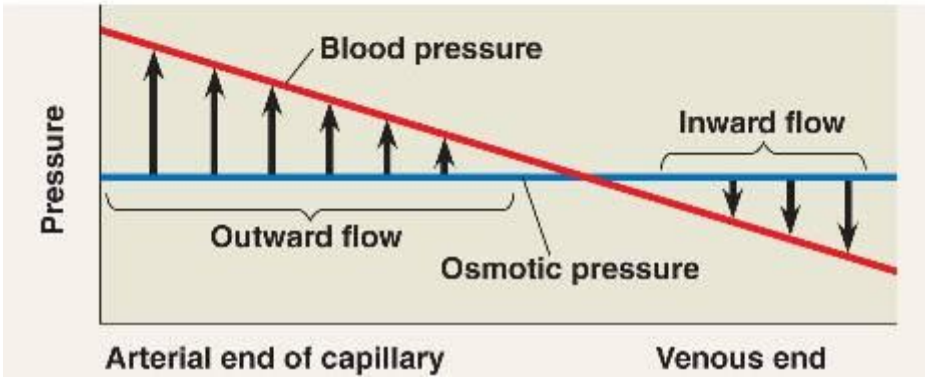
1. **Definition**: Tissue fluid is fluid that **escapes from capillaries** into the spaces between cells.
2. **Composition**: Contains **water**, **ions**, **nutrients**, and **dissolved gases**, similar to plasma but without significant protein content.
3. **No RBCs**: **Red blood cells** do **not** normally leave capillaries.
4. **Low Protein Content**: **Large proteins** (e.g., albumin) remain mostly in the blood due to size.
5. **WBC Passage**: **White blood cells** can move into tissue fluid to fight infection.
6. **Interstitial Spaces**: Tissue fluid bathes cells, allowing **exchange of nutrients** (e.g., glucose) and **waste** (e.g., CO_2).
7. **Nutrient Diffusion**: Cells take in **oxygen** and nutrients from tissue fluid, then release waste back into it.
8. **Lymph Formation**: Some excess tissue fluid drains into **lymphatic vessels**, becoming lymph.
9. **Volume Control**: Balanced fluid exchange prevents excessive **tissue swelling** or fluid depletion.
10. **Tissue Fluid vs. Plasma**: Similar solutes, but far fewer **proteins** and **formed elements** in tissue fluid.



Card 4: Formation of Tissue Fluid (Arterial End)

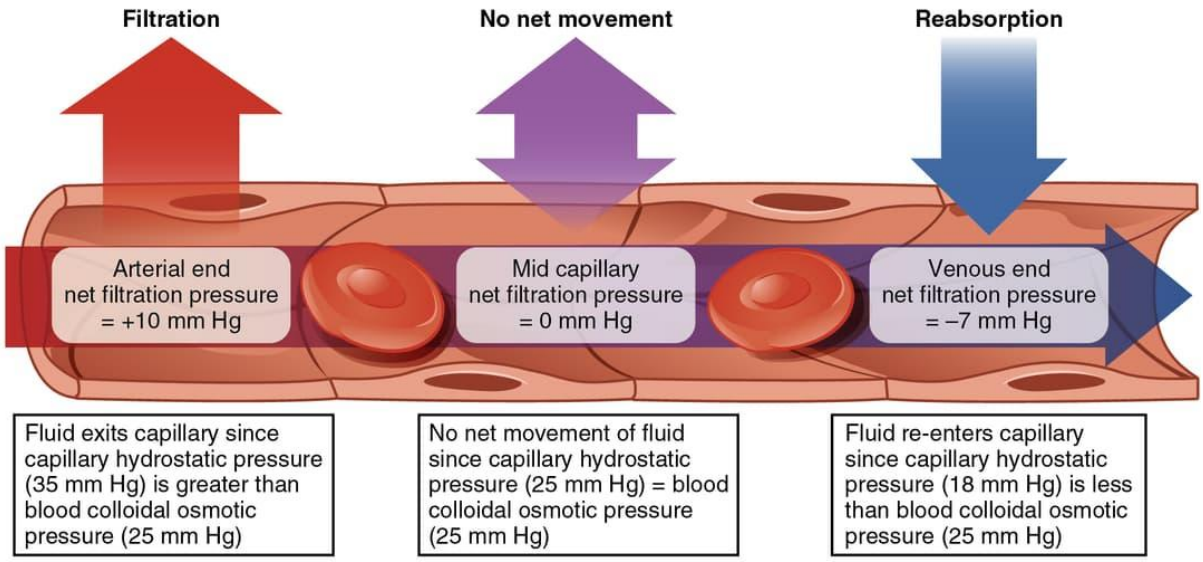
1. **Capillary Beds**: Site where **hydrostatic pressure** pushes fluid out at the arterial end.
2. **High Blood Pressure**: At the arterial end, blood pressure is **relatively high** (hydrostatic force).
3. **Filtration**: Fluid containing **water, ions, glucose** is filtered into the interstitial space.
4. **Capillary Walls**: Selectively permeable, allowing small molecules to pass through.
5. **Albumin Retention**: Large plasma proteins like **albumin** remain in capillaries, maintaining osmotic pull.
6. **Oncotic Pressure**: Created by plasma proteins; opposes hydrostatic pressure but not enough to fully counter it at the arterial end.
7. **Net Flow**: **Outward** flow dominates, forming tissue fluid around cells.
8. **Nutrient Delivery**: The fluid delivers **oxygen** and soluble nutrients to tissue cells.
9. **Balance of Forces**: Starling's law describes the **balance** between capillary hydrostatic pressure and oncotic pressure.
10. **Arteriole Regulation**: **Arterioles** can constrict or dilate, affecting capillary hydrostatic pressure and fluid formation.





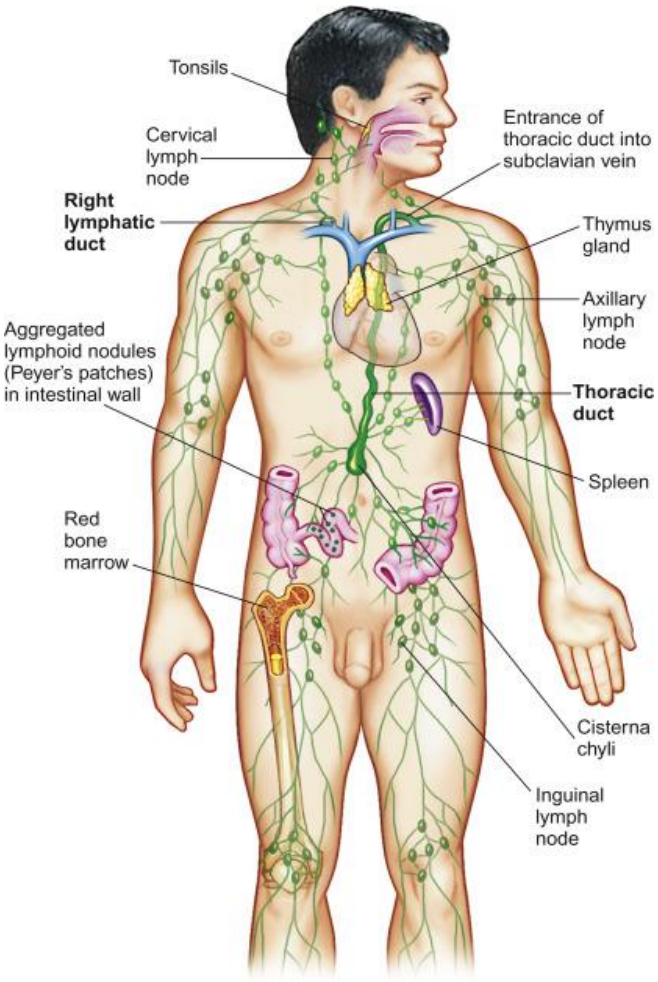
Card 5: Movement of Fluid in Capillaries (Venule End)

1. **Lower Hydrostatic Pressure**: By the time blood reaches the venule end, capillary pressure has **dropped**.
2. **Oncotic Pressure Dominates**: Plasma proteins (especially **albumin**) create a **higher osmotic pull** inward.
3. **Reabsorption**: Fluid moves **back** into the capillaries, returning some water and solutes.
4. **Waste Removal**: Carbon dioxide and metabolic wastes diffuse from tissues into capillaries at this end.
5. **Net Flow In**: Overall, more fluid is reabsorbed than pushed out at the venule end (but not 100%).
6. **Blood Volume Maintenance**: Reabsorption prevents excessive fluid loss, sustaining adequate blood volume.
7. **Venous Return**: The remaining fluid enters **venules** and moves towards veins.
8. **Pressure Gradient**: Venous pressure is **much lower** than arterial pressure, driving slow but steady flow.
9. **Preventing Edema**: Proper reabsorption is key to **preventing fluid accumulation** in tissues.
10. **Balance**: Any excess fluid left in tissues is drained by the **lymphatic system**, preventing swelling.



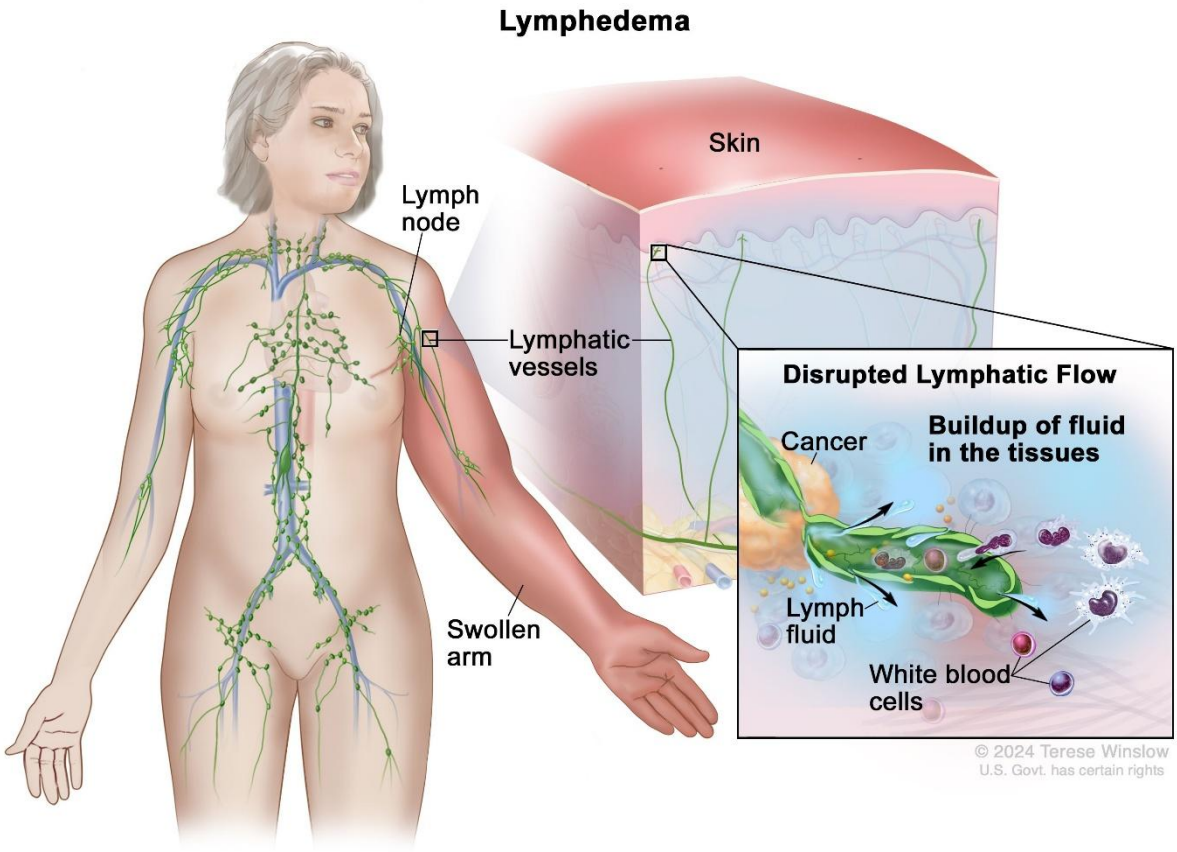
Card 6: Overall Fluid Balance & Lymphatic System

1. **Net Capillary Loss**: A small amount of fluid remains in tissues after the arterial/venous exchange.
2. **Lymphatic Vessels**: Collect **excess tissue fluid** (now called **lymph**).
3. **Lymph Return**: Lymphatic system eventually returns this fluid to the **venous bloodstream**.
4. **Lymph Nodes**: Along the lymphatic vessels, they filter lymph and house **immune cells**.
5. **Preventing Edema**: By removing surplus fluid, the lymphatic system helps **prevent swelling**.
6. **One-Way Flow**: Lymph vessels have **valves** ensuring flow toward the subclavian veins.
7. **Role in Immunity**: Lymph nodes trap pathogens and present them to **lymphocytes** for an immune response.
8. **Thoracic Duct**: The main lymphatic duct that empties into the **left subclavian vein**.
9. **Right Lymphatic Duct**: Drains lymph from the upper right quadrant of the body into the **right subclavian vein**.
10. **Homeostatic Balance**: Lymphatic drainage is crucial for **fluid homeostasis** and avoiding fluid overload in tissues.



Card 7: Oedema (Edema) and Its Prevention

1. **Definition**: Oedema is the **excess accumulation of fluid** in the interstitial spaces.
2. **Swelling**: Tissues become **swollen**, often noticeable in the extremities (ankles, feet).
3. **Causes**: High blood pressure in capillaries, low albumin (reducing oncotic pressure), or capillary damage.
4. **Inflammation**: Inflammatory mediators increase **capillary permeability**, causing more fluid leakage.
5. **Pitting Edema**: A finger press leaves an **indent** (pit) in the swollen tissue.
6. **Arterioles' Role**: **Arteriole constriction** can limit excess fluid entry into capillary beds, helping prevent edema.
7. **Lymphatic Insufficiency**: If lymphatic drainage is impaired, fluid accumulates in the tissues.
8. **Low Plasma Proteins**: Malnutrition (especially protein deficiency) can lead to **reduced oncotic pressure** and edema.
9. **Heart Failure**: Poor venous return increases **venous/capillary pressure**, often causing edema in the legs.
10. **Management**: Address underlying cause; elevate limbs, compression stockings, diuretics, and improving nutrition.



Card 8: Homeostasis & Tissue Fluid

1. **Definition**: Homeostasis is the maintenance of a **stable internal environment**.
2. **Role of Tissue Fluid**: Ensures cells have **consistent levels** of oxygen, nutrients, and waste removal.
3. **pH Balance**: Tissue fluid pH must be kept within narrow limits; buffers in blood and plasma help maintain this.
4. **Temperature Regulation**: Blood flow adjustments manage **heat delivery** or dispersal to tissues.
5. **Blood-Brain Barrier**: Special capillary structure in the CNS, more selective to protect neural tissue.
6. **Kidney Function**: Filters blood to regulate **ion balance**, fluid levels, and waste excretion.
7. **Hormonal Control**: Hormones (e.g., ADH, aldosterone) influence fluid retention and electrolyte balance.
8. **Osmoregulation**: The balance of electrolytes and water is critical; disruptions can cause swelling or dehydration.
9. **Respiratory System**: Maintains CO_2/O_2 balance, affecting tissue fluid composition.
10. **Feedback Mechanisms**: Negative feedback loops (e.g., baroreceptors, chemoreceptors) adjust cardiac output and vessel diameter to maintain stable pressure.

Card 9: Capillary Wall Permeability

1. **Selective Barrier**: Capillary walls are **one cell thick** (endothelium) for efficient exchange.
2. **Size Matters**: Small molecules (e.g., water, ions, glucose) pass freely; large proteins generally remain inside.
3. **Relative Molecular Mass (RMM)**: The lower the RMM, the more easily a molecule traverses capillary walls.
4. **Albumin RMM** (~69,000) is too large to exit most capillaries under normal conditions.
5. **Water RMM** (18) moves across capillaries easily, permitting fluid exchange.
6. **Types of Capillaries**: Continuous (most common), fenestrated (kidneys, intestines), sinusoidal (liver, bone marrow).
7. **Fenestrations (pores)**: Increase permeability to certain molecules (e.g., smaller proteins, rapid fluid transfer).
8. **Tight Junctions**: Found in the blood-brain barrier, restricting passage of most substances.
9. **Infection/Inflammation**: Can increase capillary permeability (e.g., histamine widens gaps between cells).
10. **Clinical Relevance**: Changes in capillary permeability affect fluid balance, drug delivery, and immune cell access.

Card 10: Clinical Relevance – Albumin & Kwashiorkor

1. **Albumin's Role**: Maintains **colloid osmotic pressure** to keep fluid in capillaries.
2. **Hypoalbuminemia**: Low albumin in blood reduces **oncotic pressure**, causing edema.
3. **Kwashiorkor**: Severe malnutrition (protein deficiency) leading to **marked hypoalbuminemia**.
4. **Symptoms**: Edema (particularly **swollen belly**), muscle wasting, lethargy.
5. **Mechanism**: Without sufficient dietary protein, liver cannot produce enough **plasma proteins** like albumin.
6. **Fluid Shift**: Low oncotic pressure → **excess fluid** leaking into tissue spaces → visible swelling.
7. **Treatment**: Nutritional rehabilitation with **adequate protein** intake; addressing underlying causes (e.g., poverty).
8. **Other Causes** of Low Albumin: Liver disease, kidney disease (protein loss in urine).
9. **Diagnostic Indicator**: Serum albumin levels are often measured to gauge **nutritional status**.
10. **Prevention**: Balanced diet, ensuring **sufficient protein** intake, is crucial for maintaining normal plasma protein levels.

How to Use the Cards

1. **Distribute** these 10 cards among 10 students.
2. Each student **studies** the fact-rich points on their assigned card.
3. They then **create or select** a relevant image (based on the **Suggested Image** tips).
4. Each student **teaches** the class using both **verbal explanation** and **visual aids**, reinforcing A-Level Biology concepts on blood composition, tissue fluid, and clinical relevance.