Capillary – Tissue Fluid Exchange

I. Exchange of Gases

A. Oxygen

1. 95% is carried by oxyhaemoglobin (HbO_2)
    a. 200 million hemoglobin molecules per RBC
    b. Each hemoglobin carries four oxygen molecules

2. 5% dissolved in plasma

ANIMATION

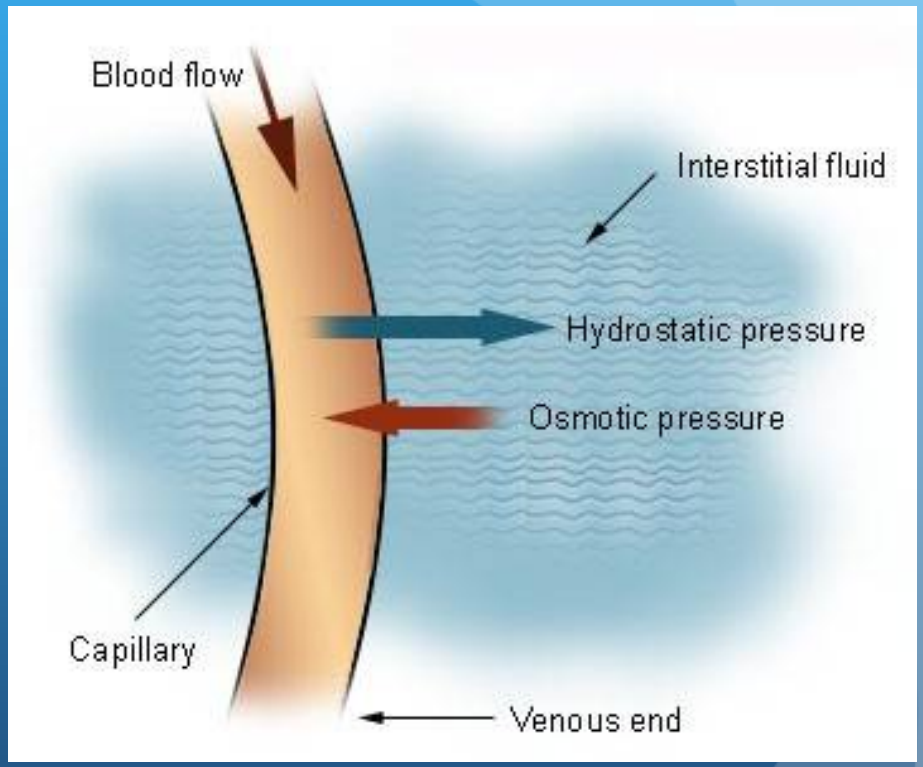
B. Carbon dioxide (CO_2)
   1. 9% dissolved in plasma
   2. 27% picks up CO_2 to form carbaminohemoglobin ($HbCO_2$).
   3. 64% of CO_2 is transported as bicarbonate ion (HCO_3^-)
      a. It is formed after CO_2 combines with water, forming carbonic acid which then dissociates.
      b. Note the following reaction:
         $CO_2 + H_2O \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^-$
      c. The enzyme CARBONIC ANHYDRASE speeds up this reaction.
      d. The H^+ released by reaction changes the blood pH.
      e. To prevent this H^+ is picked up by the globin portion of hemoglobin (to become HHb) so that pH is maintained.

II. Mechanism of Gas Exchange

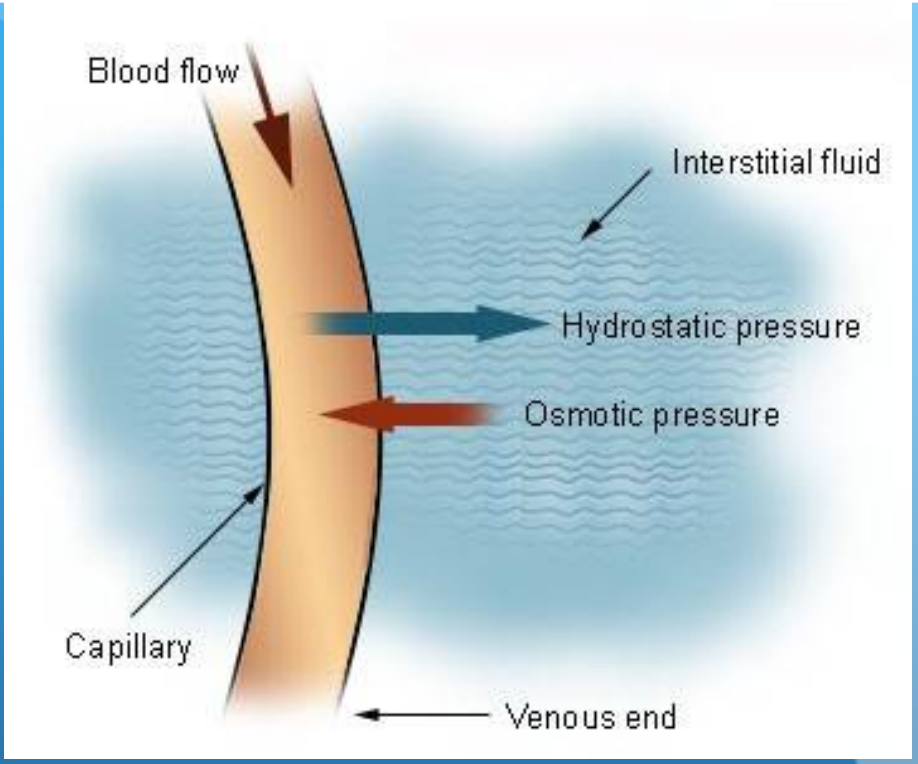
Intro Animation

A. Due to a pressure differential between blood pressure and osmotic pressure.

B. Blood pressure is the pressure of blood in blood vessel would tend to push molecules out of the blood.



1. At arterial side of a capillary bed, blood pressure is (40 mm Hg) HIGHER than blood osmotic pressure (25 mm Hg).
2. Thus plasma constantly "leaks" out through the walls of the capillaries, forming INTERSTITAL FLUID that bathes tissues.
    a. The interstitial fluid contains water, nutrients, hormones, gases, wastes.
    b. Plasma proteins and blood cells are too big so they are left behind in the capillaries.



C. Oxygen, sugars and amino acids in the fresh plasma diffuse into/taken up by local cells.

D. CO_2 and waste molecules produced in the tissue cells diffuse out of the tissues and into the interstitial fluid.

E. Osmotic pressure is the opposing force trying to force molecules into the blood.
   1. At the venule side of the capillary beds, blood pressure is now reduced (10 mm Hg) whereas osmotic pressure is about the same (25mm Hg).
   2. Therefore, water, ammonia, and carbon dioxide laden interstitial fluid is now pulled by osmotic pressure back into the blood vessels tend to enter the bloodstream.
   3. Osmotic pressure is basically constant, but blood pressure varies considerable around a capillary bed. This causes some natural movement of molecules.