Osmosis

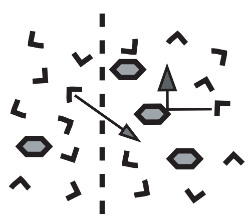
An Introduction to

Mechanisms of Osmosis

and its effect on

Water Movement

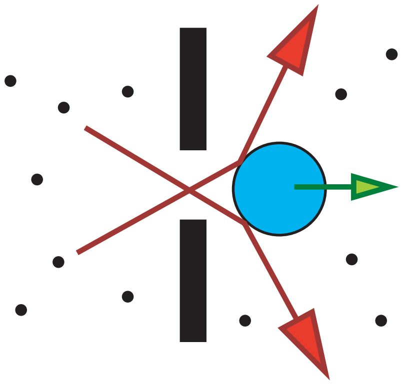
through a capillary



By Noel Ways

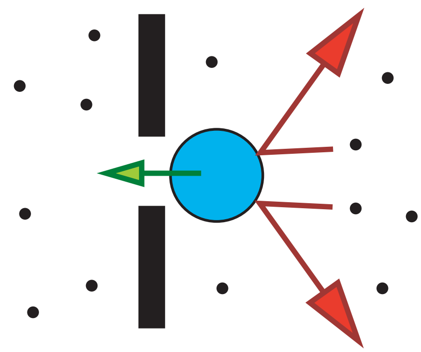
Osmosis

Osmosis is the movement of water through a semi-permeable membrane into a region of higher solute concentration. In the case of the blood and a capillary, the water may pass through the capillary wall, but the protein albumin can not. To understand this process, it must be first understood that any such system is in constant motion. Water molecules as well as the solute are in constant movement and this random movement increases when temperature increases.

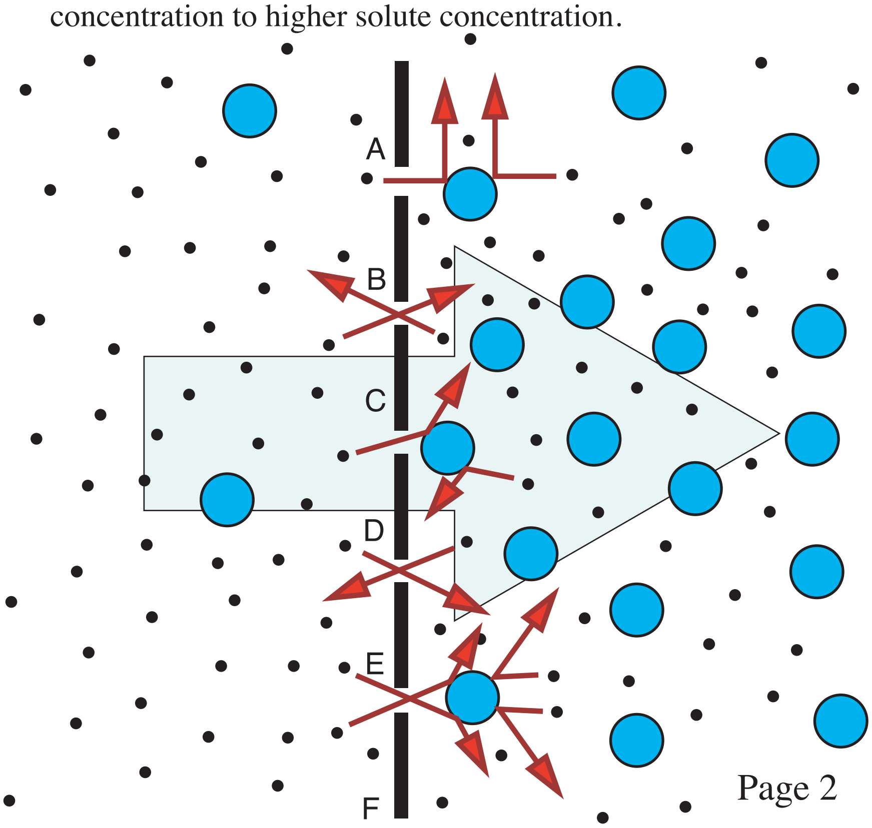


Consider the diagram at left. Albumin in close proximity to a pore permits water to pass through the pore into the other side of the membrane. The solute will also move in such manor so as to allow additional water to pass to the right.

In the diagram to the right, water molecules heading for the same pore hit an albumin protein and bounce off of it, and are not permitted to pass through. Furthermore, the albumin moves toward the pore and will make more difficult the passage of any other water molecules from right to left.



In short, the pore-albumin system is acting like a system of ***one-way valves.*** It is important to realize that all movement is random, and indeed some water will slip in the other way. But for certain, the net movement of water (the solvent) will always be from lower solute concentration to higher solute concentration.

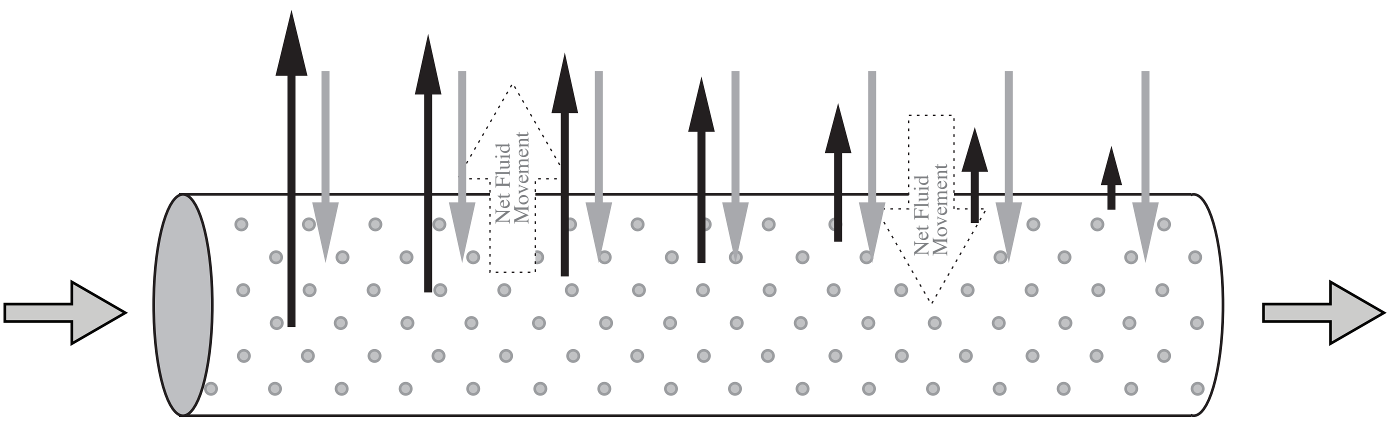


In the diagram at left, the higher solute concentration is clearly on the right side and the many "one-way valves" cause a net movement of water from the left to the right. And although there may be "one-way valves" on both sides of the semi-permeable membrane, the side with the greater concentration will see a greater movement of water to that side.

Fluid Movement at the Capillary

Note in the capillary below that albumin concentration ( ) stays relatively the same throughout the capillary. Therefore the osmotic pressure stays the same through out, shown by the gray arrow ( ). The size of the arrow is the same throughout, indicating that the osmotic pressure is the same throughout the vessel.

However, as the blood enters the capillary, one notes that the blood pressure ( ) is much higher than the osmotic pressure. Therefore there will be a movement of water out of the capillary. Because the blood is thick, it encounters resistance as it goes through the capillary. This results in a decrease in the blood pressure. Note that at the center of the capillary that the blood pressure and the osmotic pressure is the same, and there would therefore be no net movement of water into or out of the capillary.



As the thick blood continues through the capillary, resistance lowers the blood pressure more and at the right side, one now notes that osmotic pressure is greater than the blood pressure. Now water returns back into the vessel.

We noted in lecture that albumin is made by the liver, and if ones diet is deficient in protein, there will not be enough albumin to draw fluid back into the vessels. This may result in severe swelling so characteristics where protein deficiency is observed.