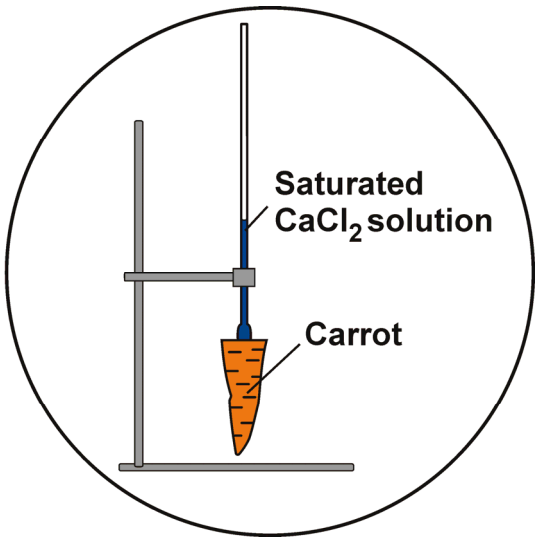
Experimental Demonstration of Osmotic Pressure



Equipment:

riser pipe with a funnel shaped end
possibly ground-in glass stopper
cork borer with adequate diameter
beaker
support stand, clamp holder, extension clamp
strip of white cardboard

"Chemicals":

carrot
saturated calcium chloride solution
methylene blue solution

Safety:

calcium chloride ($CaCl_2$):

H319
P305 + P351 + P338

methylene blue solution ($C_{16}H_{18}ClN_3S$) (in ethanol):

H302, H315, H319, H335
P261, P305 + P351 + P338

It is highly recommended to wear safety glasses and protective gloves.

Procedure:

The inside of the carrot is hollowed out in a cylindrical form with the aid of a cork borer. Alternatively, one can drill totally through a thick slice of the carrot and close the bore hole on one side with the ground-in glass stopper. Subsequently, the calcium chloride solution colored with methylene blue is filled into the cavity. Then the funnel shaped end of the riser pipe is pressed into the hole without causing air bubbles. The meniscus of the solution should be just visible at the lower end of the riser pipe. The osmotic cell is then held on the stand by a clamp.

Observation:

After a short time, one observes a continuous rise of the solution in the riser pipe. With the white cardboard placed behind the pipe, the phenomenon is made more easily visible.

Explanation:

The solution in the cavity is more strongly concentrated and the solvent therefore more diluted than in the cells of the carrot. Because of the corresponding potential drop solvent

flows through the semipermeable cell mebrane into the salt solution. As result the liquid begins to rise in the riser pipe, but the hydrostatic pressure of the column of solution opposes the flow of solvent into the solution. Equilibrium is established when the hydrostatic pressure is equal to the *osmotic pressure* of the solution.

Disposal:

The solution can be flushed down the drain and the carrot can be disposed of with the regular household garbage.