# Why Does Adding Solute Decrease Water Potential?

The equation for water potential, $\Psi = \Psi_P + \Psi_S$, combines the effect of pressure and solute concentration on water potential. Your textbook states, "A solution's solute potential ($\Psi_S$) is always a negative number, and the greater the solute concentration the more negative the value of $\Psi_S$ and therefore $\Psi$. Why should this be so?

The explanation involves entropy. The arrangement of water molecules in pure water is orderly, in that every molecular location is occupied by a water molecule, and each water molecule is bonded to four others, and each of these to four others, etc., forming an orderly lattice. Whenever an osmotically active solute is added, the arrangement in the solution becomes more disorderly, in the sense that any given molecular location may be occupied by either a water molecule or a solute molecule. The water has lost free energy. The more solute that is added, the more the disorderly three-dimensional array of the water molecules becomes. Since an orderly system possesses more free energy than a disorderly one, a fluid loses free energy when solute is added to it. A solution of pure water is arbitrarily assigned an osmotic potential ($\Psi_S$) of zero. The more solute that is added, the more disorderly the fluid becomes, and the lower the osmotic potential ($\Psi_S$).

To sum it up:

- The osmotic potential of a solution is always decreased if osmotically active substances (dissolved or colloidally-suspended particles) are present, because such particles disturb the orderliness of the water molecules and decrease the free energy of water.

- The decrease in the osmotic potential is proportional to the total number of solute particles that are present: the more solute, the more disorderly the arrangement, and the lower the osmotic potential.