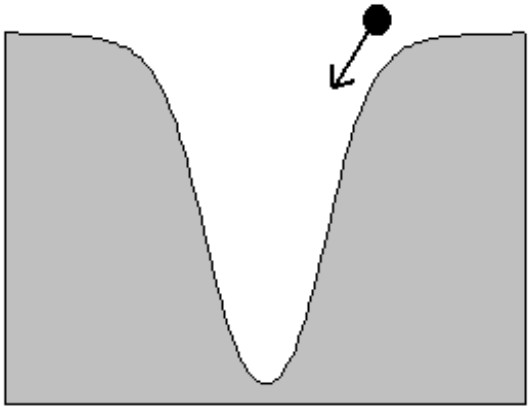
A bluffer's guide to Thermodynamic Equilibrium… entropy, enthalpy, free energy and compensation effects:

There is a natural tendency for all things (even atoms & molecules) to roll downhill - to fall to lower energy.

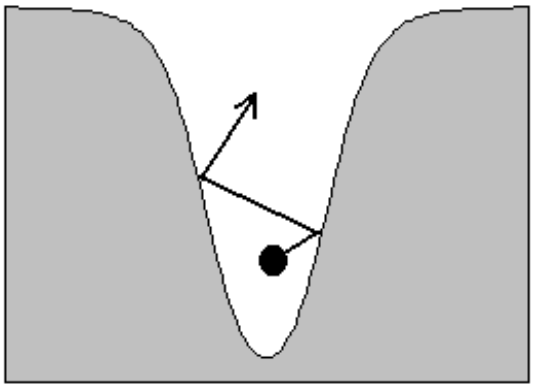
ΔH tends to want to be negative



This is opposed (at the molecular level) by the equally natural tendency for thermal/Brownian motion (otherwise known as "entropy") to make things go the other way…

…and this effect gets bigger as the temperature increases.

T.ΔS tends to want to be positive



Thermodynamic Equilibrium, expressed in terms of the Gibbs Free Energy change, reflects just the balance between these opposing tendencies…

$$\Delta G = \Delta H - T.\Delta S$$

Equilibrium is reached when these two forces just balance ($\Delta G = 0$).

The standard free energy change, ΔG°, is just another way of expressing the equilibrium constant, or affinity (K) for any process, on a logarithmic scale…

$$\Delta G^\circ = -RT.\ln K$$

Entropy-Enthalpy compensation is a natural consequence of this: systems with higher enthalpy tend also to have higher entropy, but these tend to compensate to give relatively much smaller changes in free energy.

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