Tutorial on electrostatic interactions in soft and biological matter: electrolytes, membranes and polyelectrolytes

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In this tutorial I will review some of the basic physical concepts related to the behavior of charged objects, such as membranes and polyelectrolytes when they are immersed in an electrolyte solution. Examples are abundant in biology: DNA, RNA, proteins, bio-polymers and bio-membranes; in electro-chemistry: batteries and fuel cells; and in soft matter: colloids, micelles, emulsions and gels.

I will cover the follwoing topics:

1. The diffusive double layer and ionic profiles close to charged interfaces
2. Simple solutions of the Poisson-Boltzmann equation in planar geometries
3. The origin of the Debye-Huckel screening in electrolyte solutions
4. The Manning-Oosawa condensation of counter-ions close to charged rods
5. The DLVO theory for colloidal stabilization