Assignment One, Due Wednesday, April 12, 5:00 pm.

[1.] In class we discussed the electric field strength in an atom, at the surface of the earth in solar radiation, and in a laser one of you used as an undergraduate. Perform a similar estimate of the electric field one centimeter away from a cell phone. One approach is to get a number for the power employed by your cell phone in broadcasting to a satellite. You could do that by looking up the energy stored in a typical cell phone battery, assuming all the energy a cell phone uses is involved in transmitting (is that right?), and then asking how long you can talk before your battery is drained.

[2.] We decided the electric field in solar radiation is "small" (in the sense that it was much, much less than the field acting on an electron due to a proton inside an atom. Does this "smallness" mean there are very few photons? Estimate the flux of visible photons a distance one meter away from a one hundred Watt light bulb. What about the number of photons per cubic wavelength 100 km away from an isotropic FM antenna with a power of 100 Watts at 10^8 Hz? Discuss the relevance of your answers to the fact that in this course we are speaking of electric and magnetic fields, and ignoring the discrete photon aspect.

[3.] A conducting metal sphere of radius a carries a free charge Q and is surrounded by a dielectric sphere of radius $b > a$. What is the potential at the center of the sphere?

[4.] Consider a point charge in a spherical tank of water. What are $\vec{E}, \vec{D}, \vec{P}$ inside the sphere? What are the induced volume and surface charge densities?

[5.] Redo problem [4] for a dipole at the center of the sphere.