

21. Shielding: Comparing Atoms

When there are multiple electrons in a single atom, the electron waves overlap and result in shielding. This effect changes the energy levels of each of these electron waves and the effective nuclear charge (Z_{eff}). When comparing different elements, the effect of shielding may be different because of the electron configuration and effective nuclear charge. This activity will help you look at some of these the differences.

1) The ground state cloud energy ($n = 1$) of hydrogen and helium are $E_1 = -13.6 \text{ eV}$ and $E_1 = -54.4 \text{ eV}$ respectively. First, draw an energy diagram for each of these atoms.

2) Explain the difference between the two ground state cloud energies for hydrogen and helium described above. What does this mean for the interactions between the electron cloud and the nucleus?

3) If the electron in hydrogen (single-electron atom) were to be excited to $n = 2$, the energy of the electron cloud would increase. If one of the electrons in helium (multi-electron atom) were excited to $n = 2$, the energy of the electron cloud would also increase. Draw an energy diagram showing this transition and describe the difference of this energy change between these two atoms.

4) Using what you now know about shielding, answer the following question: How would the electron energy of a 2s electron cloud in hydrogen (single electron atom) be different than the energy of a 2s electron cloud in lithium (multi-electron atom)? Draw an energy diagram of the electron configuration for each atom to help support your answer.