ATOMIC SIZE

While the "size" of an atom is a bit of a soft target — atoms are "fuzzy" and difficult to measure, say in diameter or radius, it's also fair to say that atoms have *relative* size. That is, some atoms are larger than others.

Atomic size depends on three things:

1. The number of electrons bound to the atom,
2. The number of protons in the nucleus— More protons means a larger ball of positive charge at the center of an atom, resulting in more net attractive force on any of the electrons that surround it, and
3. The electron configuration of the atom, mainly how close it is to having a stable octet of outer-shell electrons.

While electrons don't take up much space (the radius of an electron is far smaller than the radius of a proton, which is also pretty small, though neither has been very accurately measured), they don't crowd together very well because their like negative charges keep them apart. More electrons mean a bigger atom.

The number of protons and electrons in a neutral atom is equal, but because of the odd shapes of electron orbitals, that increasing the number of protons in the nucleus effectively holds electrons more closely and more tightly to the nucleus. This effect is somewhat diminished in larger atoms, where outer electrons can be *shielded* from the nucleus by a screen of inner electrons.

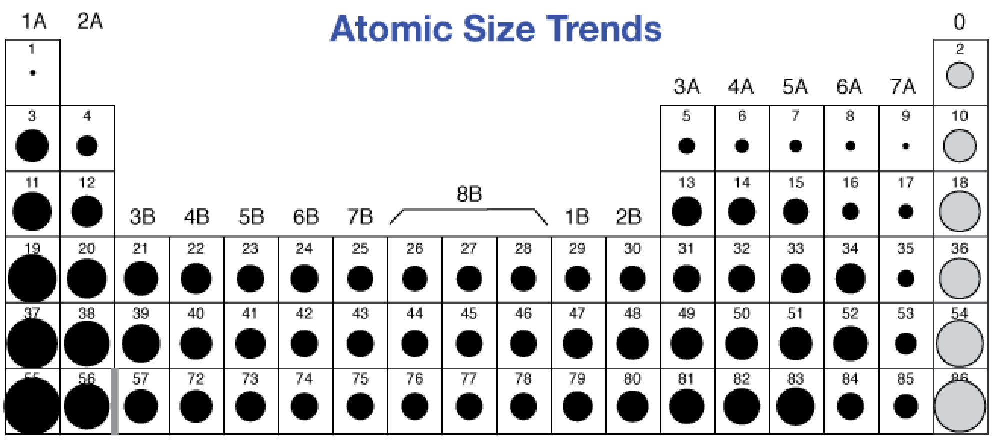
Finally, a full outer shell imparts a lot of energetic stability to an atom, which tends to allow its electron cloud to contract a bit, so as a shell is filled across a period of the periodic table, it tends to contract a little.

Atomic size (usually we refer to atomic radius) increases with atomic number as we move down the periodic table and decreases across a period from left to right as electron shells approach the filled state. There are exceptions, but they are logical if we keep the basic physics in mind.

A periodic table of relative atomic sizes

In this periodic table, the relative sizes (not absolute - there are no measurements) are shown. The sizes of the noble gas atoms (gray) can't really be compared to the other atoms because atomic sizes are generally averaged over many measurements of atoms bound in compounds with other kinds of atoms.

The noble gases (with the exception of Xe) don't bind to other atoms, so their radii have to be measured another way.

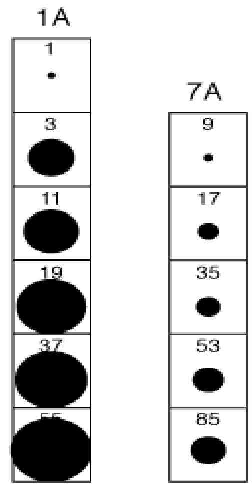


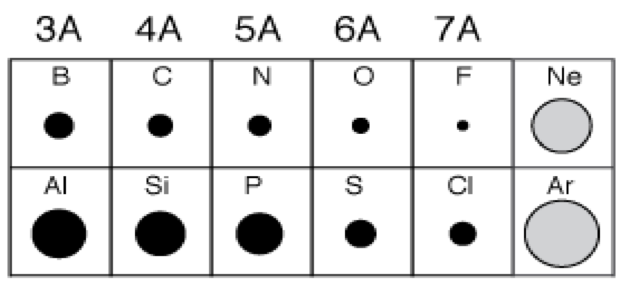
Group trends

Here are closeups of the size trends in the group 1A (alkaline earth) elements and the group 7A (halogens) elements.

These are very easy to understand. As we move down the periodic table within a group (same number of electrons in the outer shell), each row represents addition of a new shell of electrons. Those electrons take up space (mostly because they repel one-another), so more shells means a larger atom.

The exception to this rule can be seen in the middle of the periodic table, where d-subshells are being filled in metallic elements. D-orbitals are different in many respects in the chemistry of elements.





Period trends

← Here are parts of the second and third periods of the table. Notice that as we move from left to right across the period, atomic sizes diminish because of increased nuclear positive charge and completion of an octet. Remember that we have to throw out the noble gas sizes in this comparison; they can only be compared within their group, in which case they show the same group pattern as the figure above.

Source: http://www.drcruzan.com/PeriodicTrends.html