

Chapter 6 : The Periodic Table and Periodic Law

Section 3 Notes

Atomic Radius

Section 6-3

Atomic size is a periodic trend influenced by electron configuration.

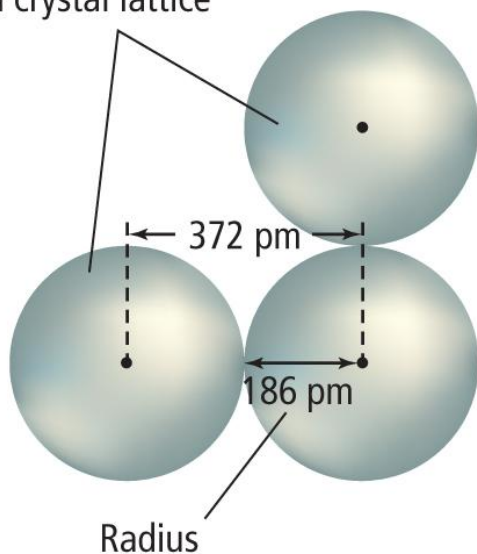
For metals, atomic radius is half the distance between adjacent nuclei in a crystal of the element.

Atomic Radius (cont.)

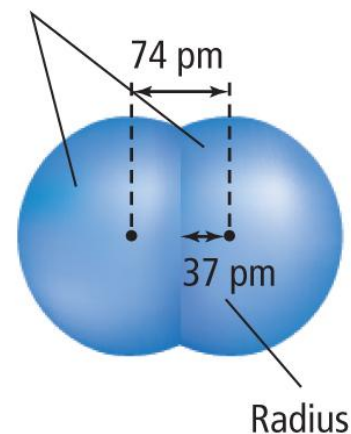
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For elements that occur as molecules, the atomic radius is half the distance between nuclei of identical atoms.

Bonded metallic sodium atoms in a crystal lattice



Bonded nonmetal hydrogen atoms in a molecule



Atomic Radius (cont.)

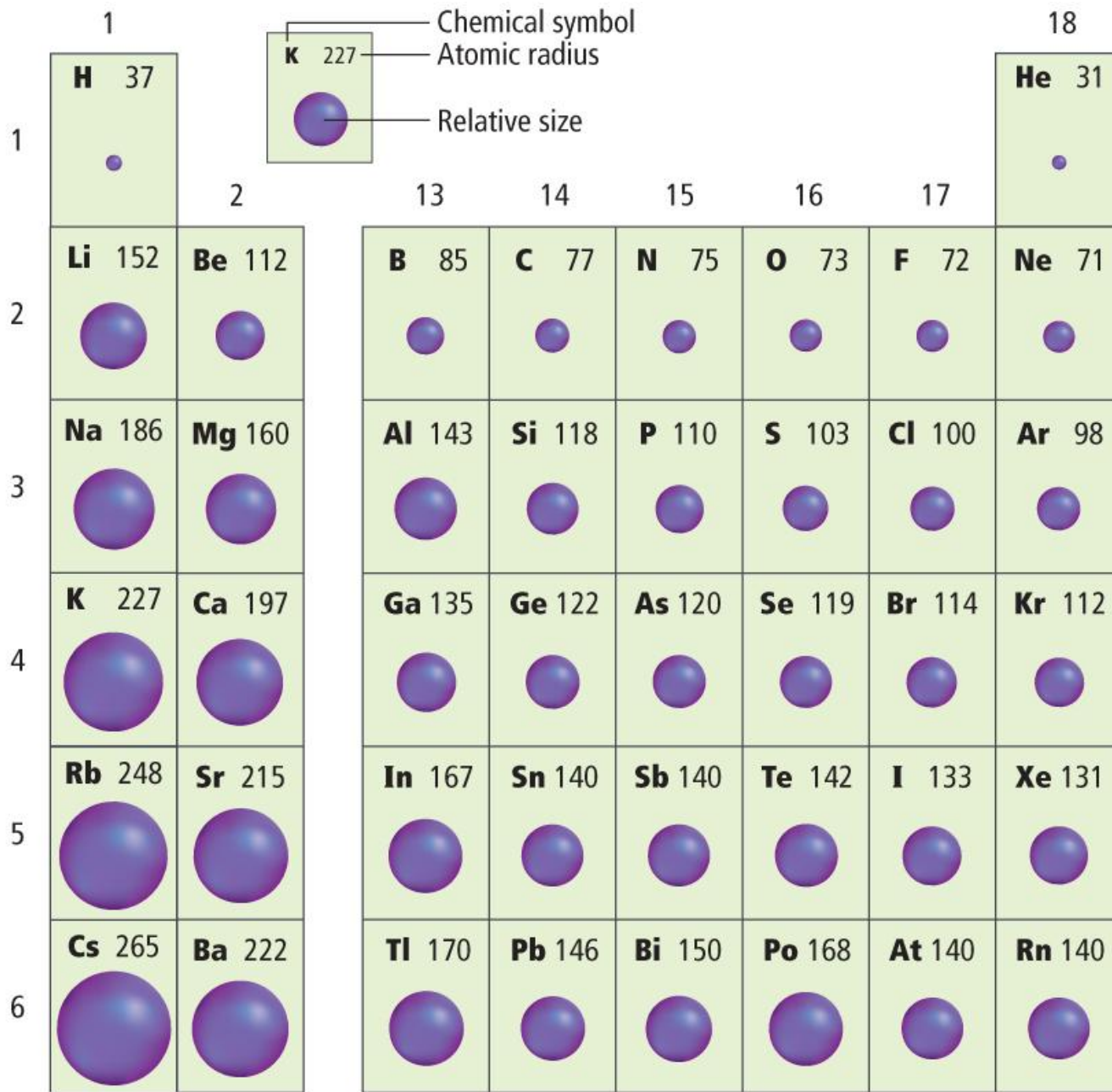
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There is a general decrease in atomic radius from left to right, caused by increasing positive charge in the nucleus.

Valence electrons are not shielded from the increasing nuclear charge because no additional electrons come between the nucleus and the valence electrons.

Atomic Radius (cont.)

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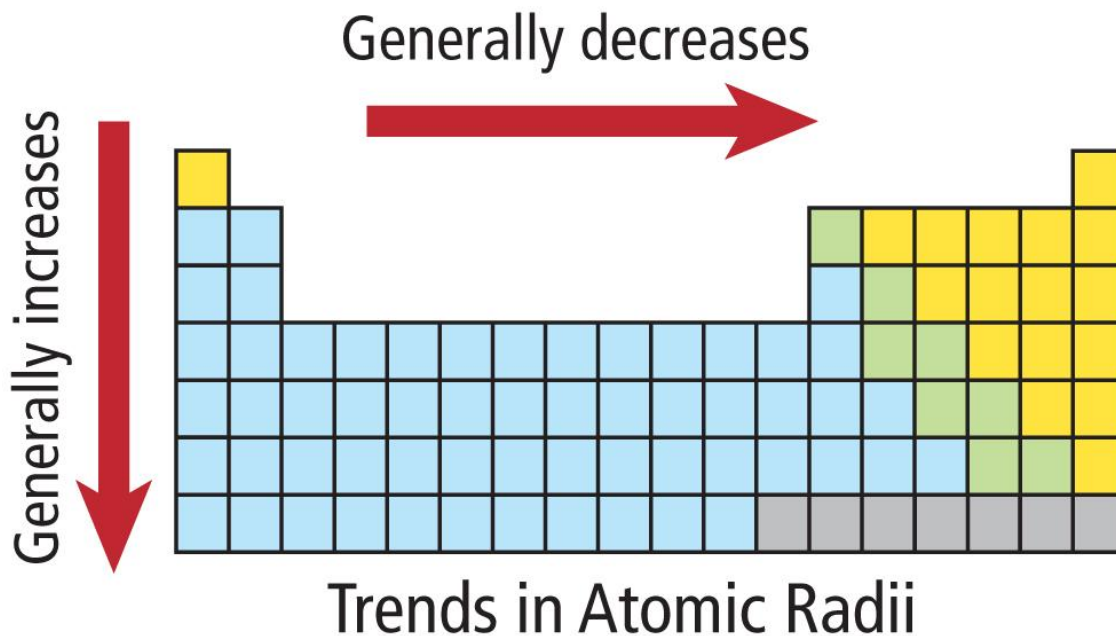


Atomic Radius (cont.)

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Atomic radius generally increases as you move down a group.

The outermost orbital size increases down a group, making the atom larger.



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An ion is an atom or bonded group of atoms with a positive or negative charge.

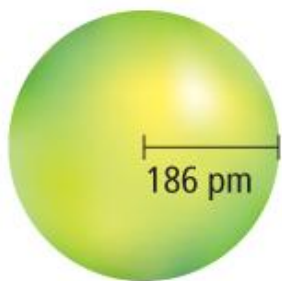
When atoms lose electrons and form positively charged ions, they always become smaller for two reasons:

- 1. The loss of a valence electron can leave an empty outer orbital resulting in a small radius.**
- 2. Electrostatic repulsion decreases allowing the electrons to be pulled closer to the nucleus.**

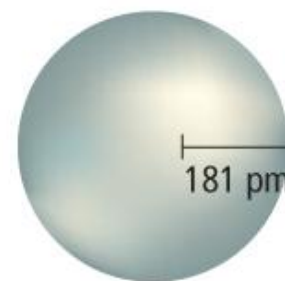
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When atoms gain electrons, they can become larger, because the addition of an electron increases electrostatic repulsion.

a



b



Sodium atom (Na)
[Ne]3s¹

Sodium ion (Na⁺)
[Ne]

Chlorine atom (Cl)
[Ne]3s²3p⁵

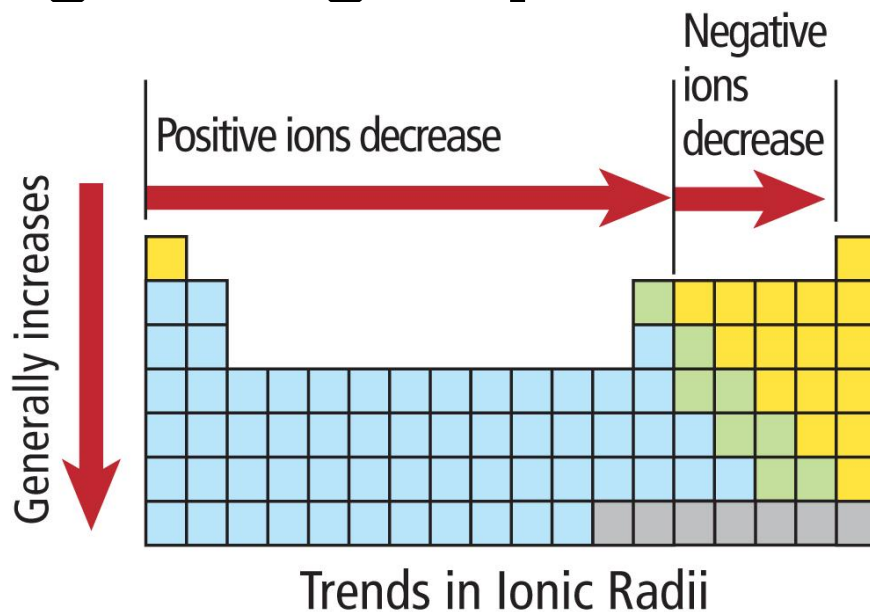
Chlorine ion (Cl⁻)
[Ne]3s²3p⁶ or [Ar]

Ionic Radius (cont.)

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The ionic radii of positive ions generally decrease from left to right.


































The ionic radii of negative ions generally decrease from left to right, beginning with group 15 or 16.

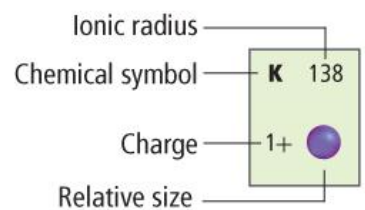


Ionic Radius (cont.)

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Both positive and negative ions increase in size moving down a group.

	1	2	13	14	15	16	17
2	Li 76 1+ 	Be 31 2+ 	B 20 3+ 	C 15 4+ 	N 146 3- 	O 140 2- 	F 133 1- 
3	Na 102 1+ 	Mg 72 2+ 	Al 54 3+ 	Si 41 4+ 	P 212 3- 	S 184 2- 	Cl 181 1- 
4	K 138 1+ 	Ca 100 2+ 	Ga 62 3+ 	Ge 53 4+ 	As 222 3- 	Se 198 2- 	Br 195 1- 
5	Rb 152 1+ 	Sr 118 2+ 	In 81 3+ 	Sn 71 4+ 	Sb 62 5+ 	Te 221 2- 	I 220 1- 
6	Cs 167 1+ 	Ba 135 2+ 	Tl 95 3+ 	Pb 84 4+ 	Bi 74 5+ 		



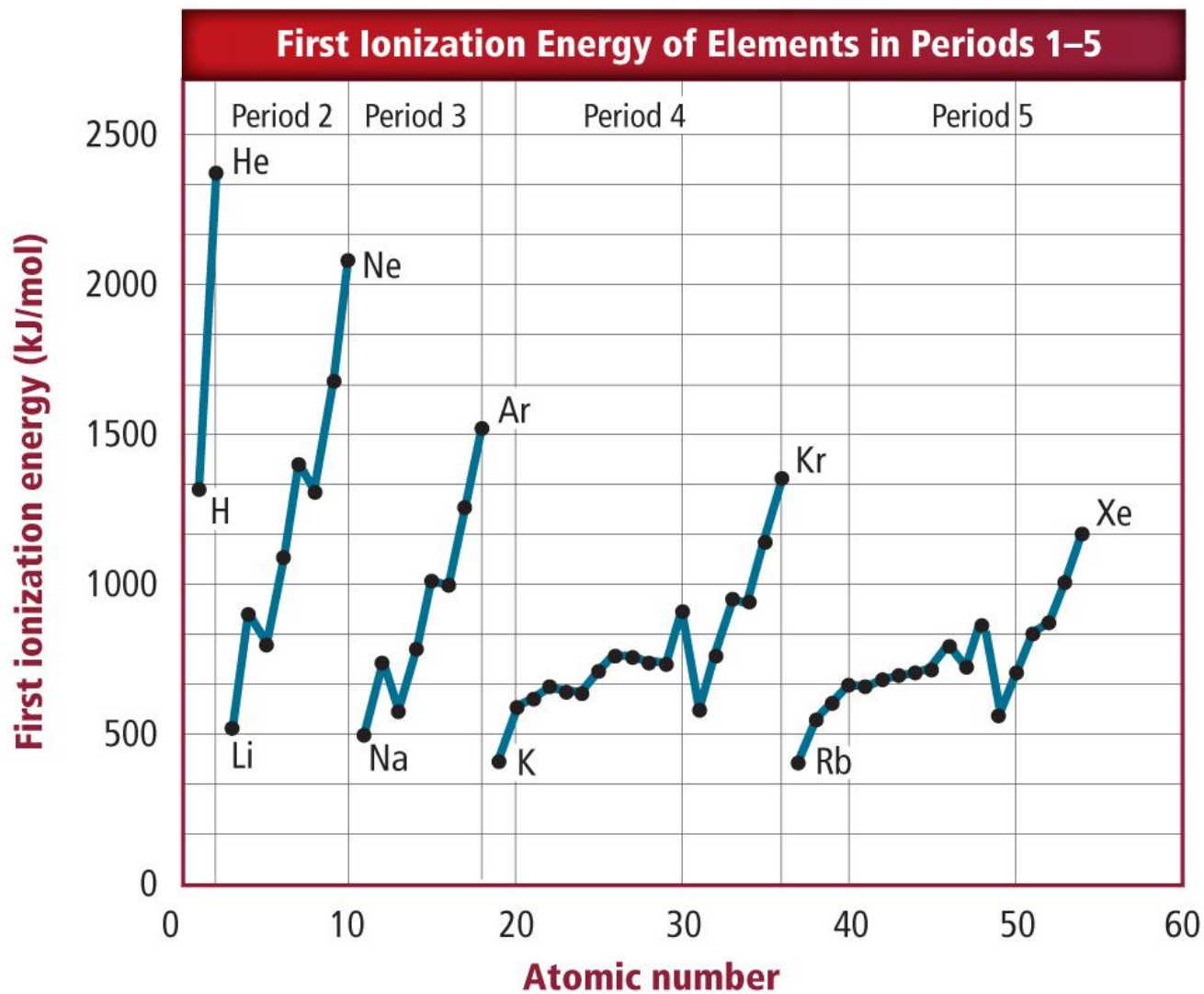
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Ionization energy is defined as the energy required to remove an electron from a gaseous atom.

The energy required to remove the first electron is called the first ionization energy.

Ionization Energy (cont.)

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Ionization Energy (cont.)

Section 6-3

Removing the second electron requires more energy, and is called the second ionization energy.

Each successive ionization requires more energy, but it is not a steady increase.

Ionization Energy (cont.)

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Table 6.5

**Successive Ionization Energies
for the Period 2 Elements**

Element	Valence Electrons	Ionization Energy (kJ/mol)*								
		1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th
Li	1	520	7300							
Be	2	900	1760	14,850						
B	3	800	2430	3660	25,020					
C	4	1090	2350	4620	6220	37,830				
N	5	1400	2860	4580	7480	9440	53,270			
O	6	1310	3390	5300	7470	10,980	13,330	71,330		
F	7	1680	3370	6050	8410	11,020	15,160	17,870	92,040	
Ne	8	2080	3950	6120	9370	12,180	15,240	20,000	23,070	115,380

* mol is an abbreviation for mole, a quantity of matter.

Ionization Energy (cont.)

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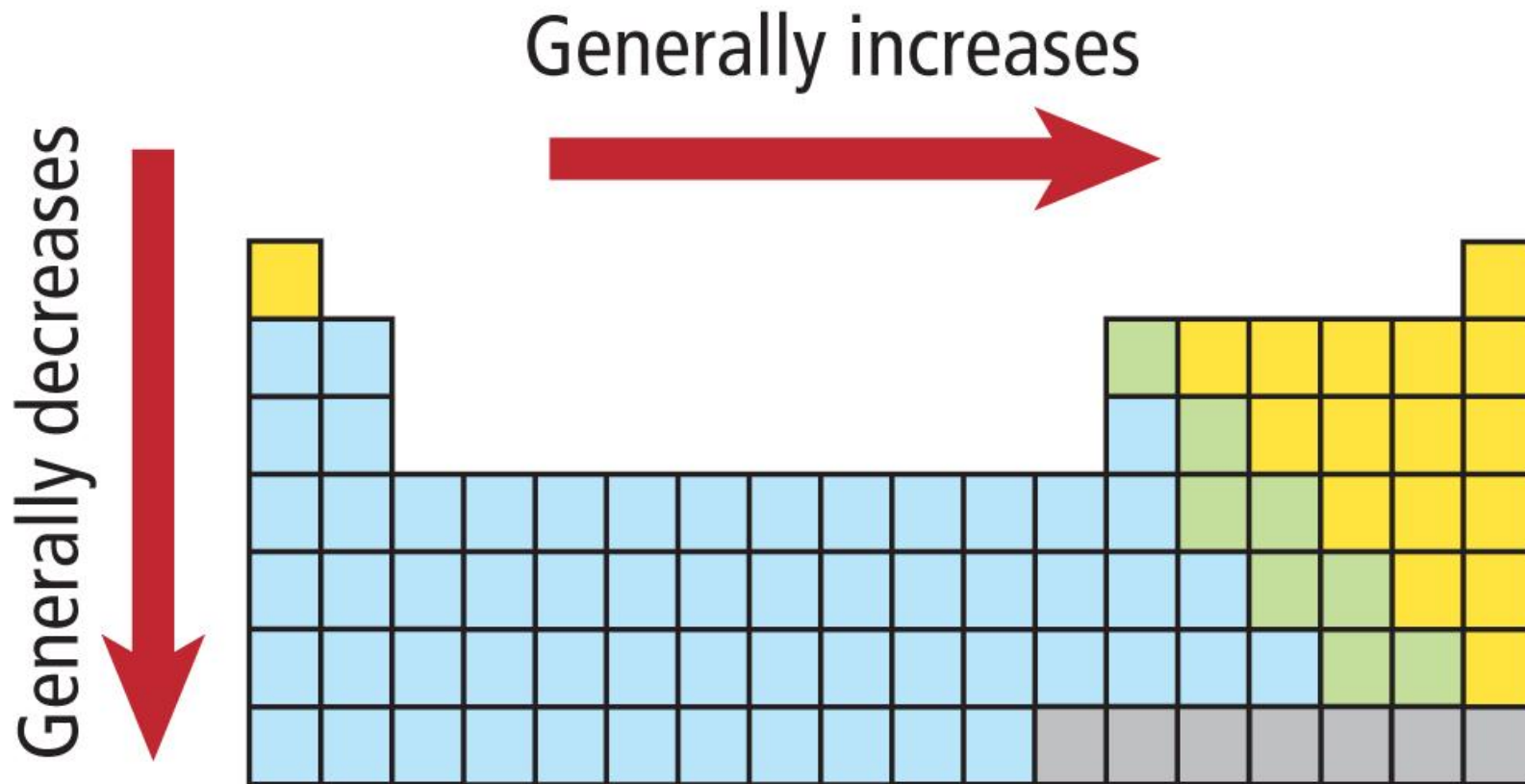
The ionization at which the large increase in energy occurs is related to the number of valence electrons.

First ionization energy increases from left to right across a period.

First ionization energy decreases down a group because atomic size increases and less energy is required to remove an electron farther from the nucleus.

Ionization Energy (cont.)

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Trends in First Ionization
Energies

Ionization Energy (cont.)

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The octet rule states that atoms tend to gain, lose or share electrons in order to acquire a full set of eight valence electrons.

The octet rule is useful for predicting what types of ions an element is likely to form.

Ionization Energy (cont.)

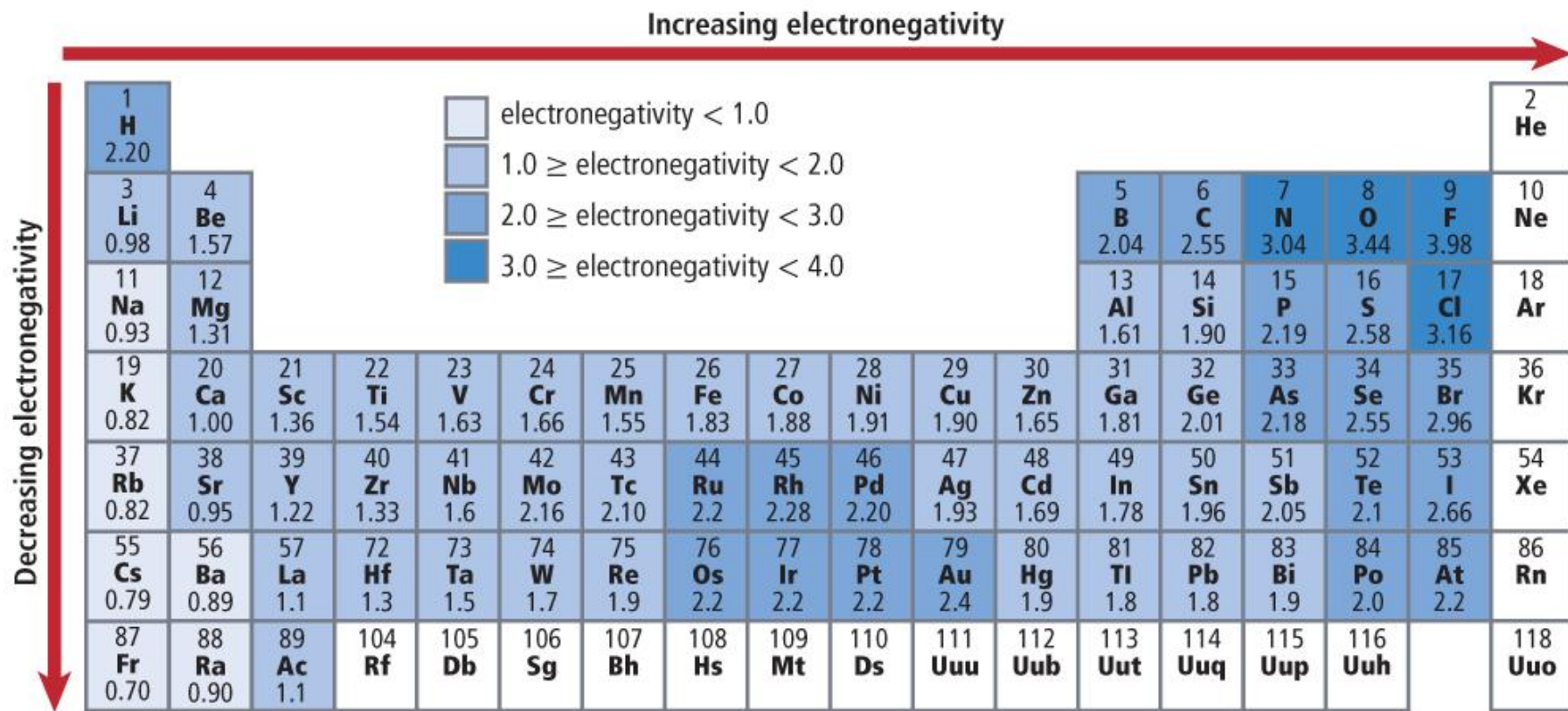
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The electronegativity of an element indicates its relative ability to attract electrons in a chemical bond.

Electronegativity decreases down a group and increases left to right across a period.

Ionization Energy (cont.)

Section 6-3



Electronegativity Values in Paulings



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The lowest ionization energy is the _____.

- A. first
- B. second
- C. third
- D. fourth

Section 6-3

The ionic radius of a negative ion becomes larger when:

- A. moving up a group
- B. moving right to left across period
- C. moving down a group
- D. the ion loses electrons