Chapter 14

Chemical Periodicity

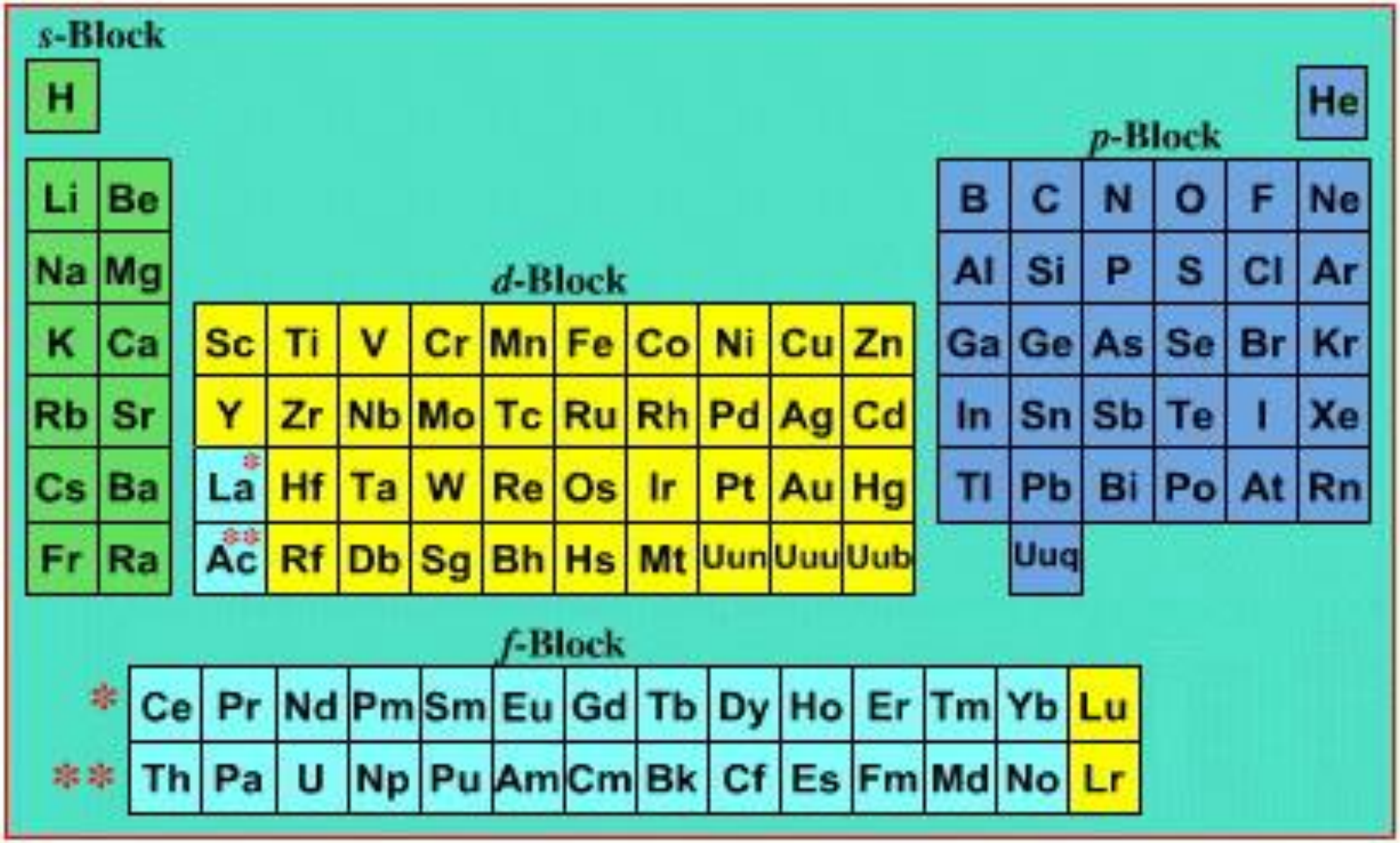
Periodic Trends

- An element's placement in the periodic table determines characteristics like the size of the atom, its ability to attract electrons and the stability of its electron configuration.

Periodic Trends

- Highest occupied principal energy level is equal to the period number of the element.
- i.e. for Calcium (in the 4th period), the highest occupied energy level is n=4

Block Diagram



"S" block

Groups 1A & 2A

- Electron Configuration ends in an **S** Sub-level.
- Highest occupied energy level is equal to the period number of the element.
  - i.e. Calcium's electron configuration ends in 4s.

"P" block

Groups 3A through 8A

- Electron Configuration ends in a **P** Sub-level.
- Highest occupied energy level is equal to the period number of the element.
  - i.e. Silicon electron configuration ends in 3p.

"D" block

Group B elements

- Electron Configuration ends in a **D** Sub-level.
- The occupied d sublevel has a principle energy level that is one less than the period number of the element.
  - i.e. Silver's electron configuration ends in 4d.

"F" block

"Inner Transition Metals"

- Electron Configuration ends in an **F** Sub-level.
- The occupied f sublevel has a principle energy level that is two less than the period number of the element
- i.e. Uranium's electron configuration ends in 5f.

Periodic Trends

Important Trends found on the Periodic Table

- Atomic Radius
- Ionization Energy
- Electronegativity
- Metallic Character

Atomic Radius

- Size of atoms of each element.
- How will the size of atoms change as we proceed down a group

Atomic Radius

Compare the sizes of Li and Na.

- From Li to Na, we add an entire energy level, therefore the size increases.

Atomic Radius

How will the size of atoms change as we proceed across a period?

- Compare C, N and O.

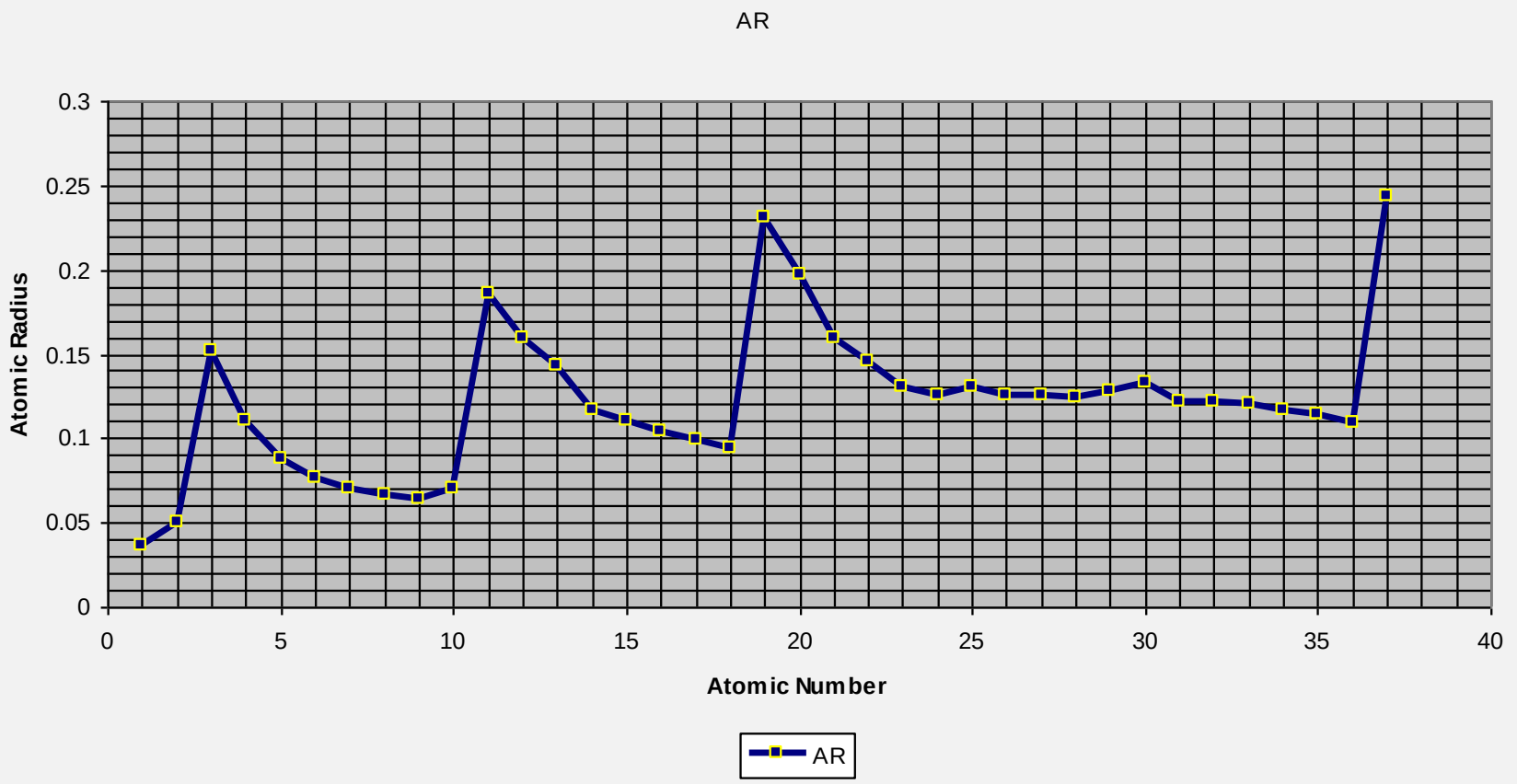
Atomic Radius

- Oxygen's greater nuclear charge attracts the electrons, causing the atom to contract
- Oxygen is the smallest of the three, Carbon is the largest.

Atomic Radius

Atomic Radius decreases as we go across a period from left to right and increases from top to bottom down a group.

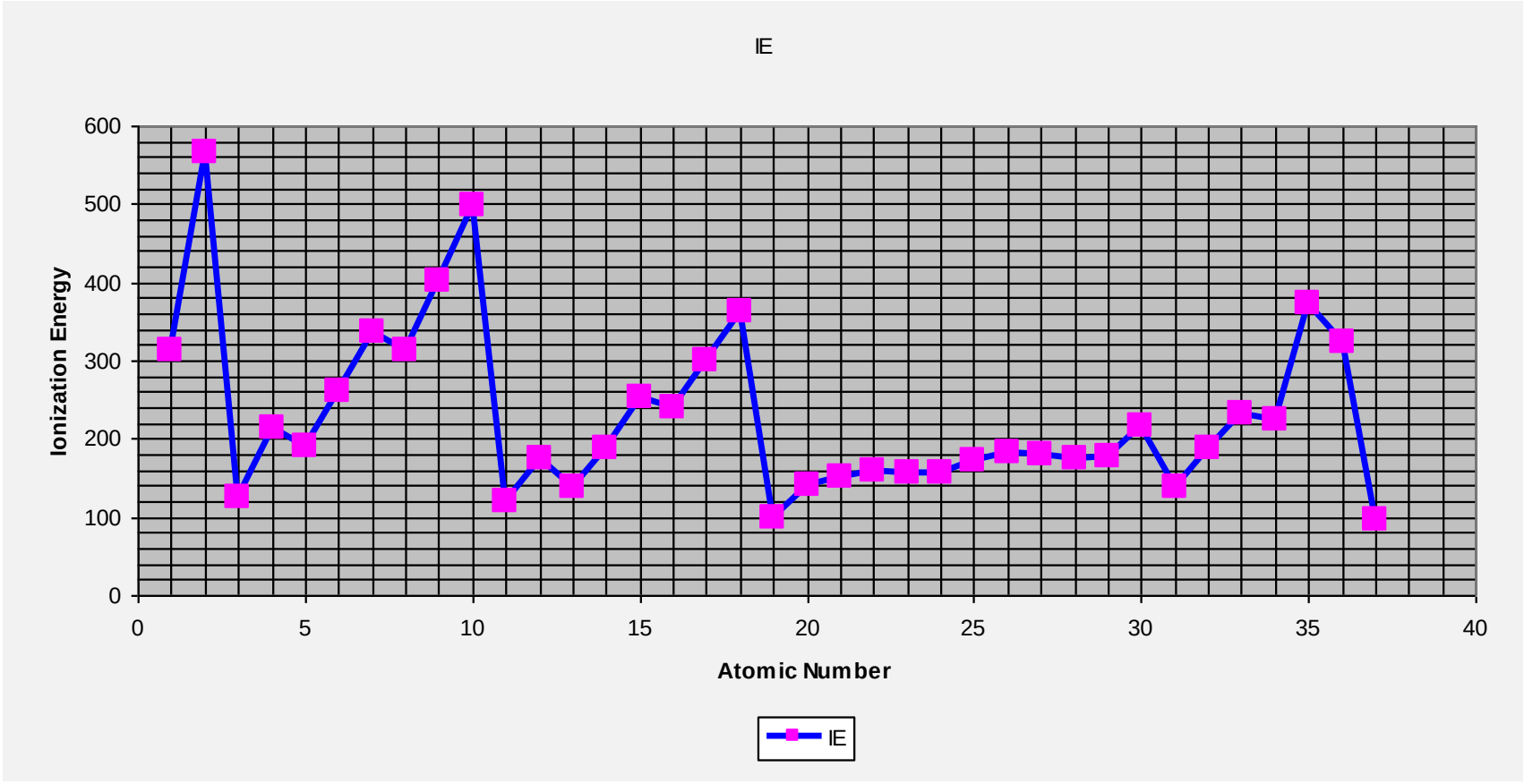
Graph of Atomic Radius



Ionization Energy

- Amount of energy required to remove a valence electron from an atom.
- The more stable an element is, the harder it will be (more energy is required) to remove an electron.

Graph of Ionization Energy



Ionization Energy

- Some elements become more stable by losing an electron so they lose electrons easily (less energy needed).

Ionization Energy

Ionization energy increases across a period (left to right) and decreases from top to bottom within a group.

Electronegativity

Tendency for an atom to attract electrons to itself when it is chemically combined with another element

Electronegativity

Elements that need electrons to complete an energy-level will have a high electronegativity.

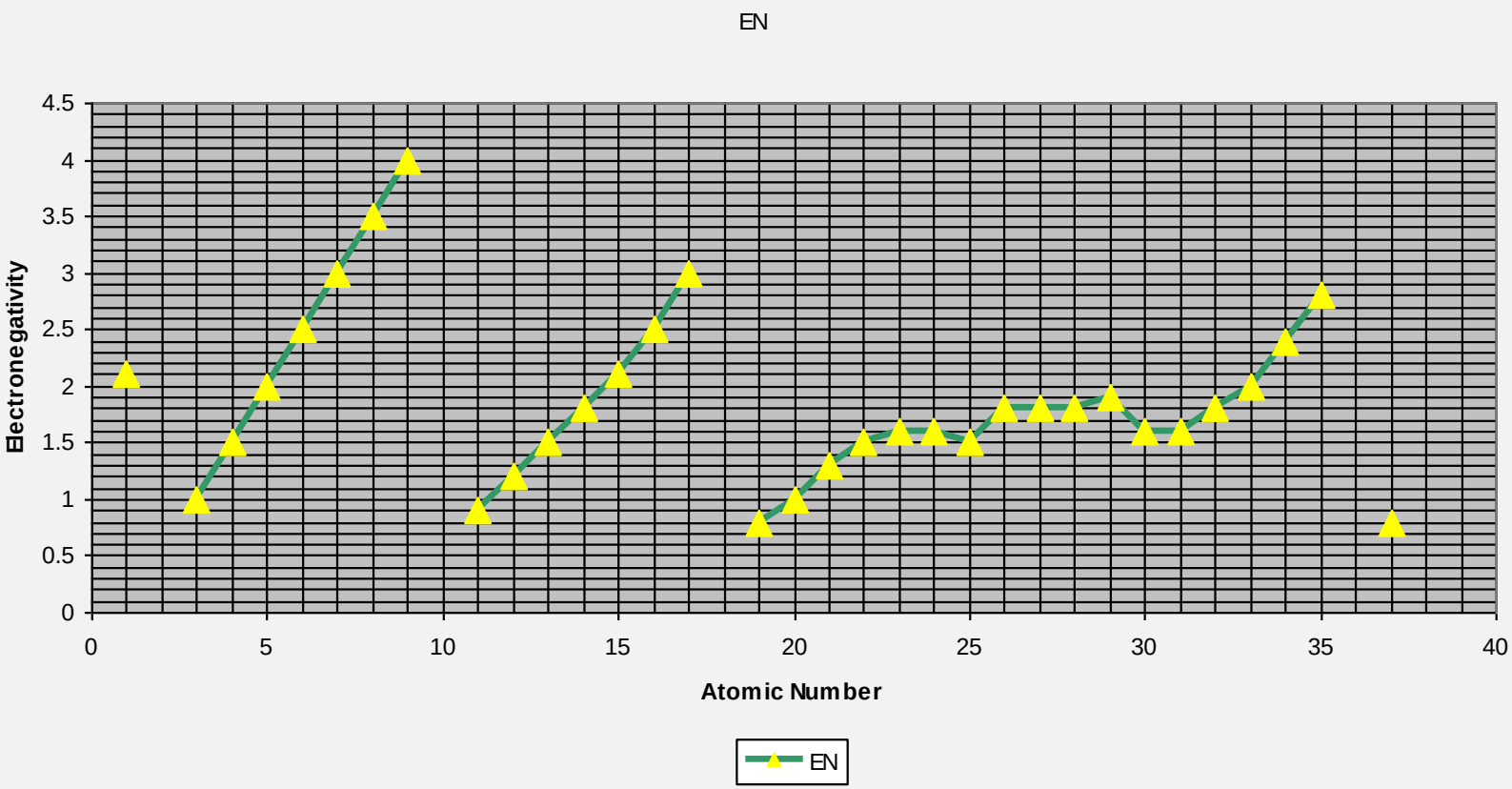
Electronegativity

Elements that will be more stable by losing electrons have low electronegativities.

Electronegativity

- Electronegativity increases across a period and decreases from top to bottom within a group (Noble Gases omitted).
- Noble Gases do not have electronegativity.

Graph of Electronegativity



Metallic Character

Tendency to exhibit metallic properties

- Decreases left to right across period
- Result of other trends
- Increases Down a group

Periodic Trends Review

Important Trends found on the Periodic Table

- Atomic Radius
- Ionization Energy
- Electronegativity
- Metallic Character

Atomic Radius

Size of the Atom

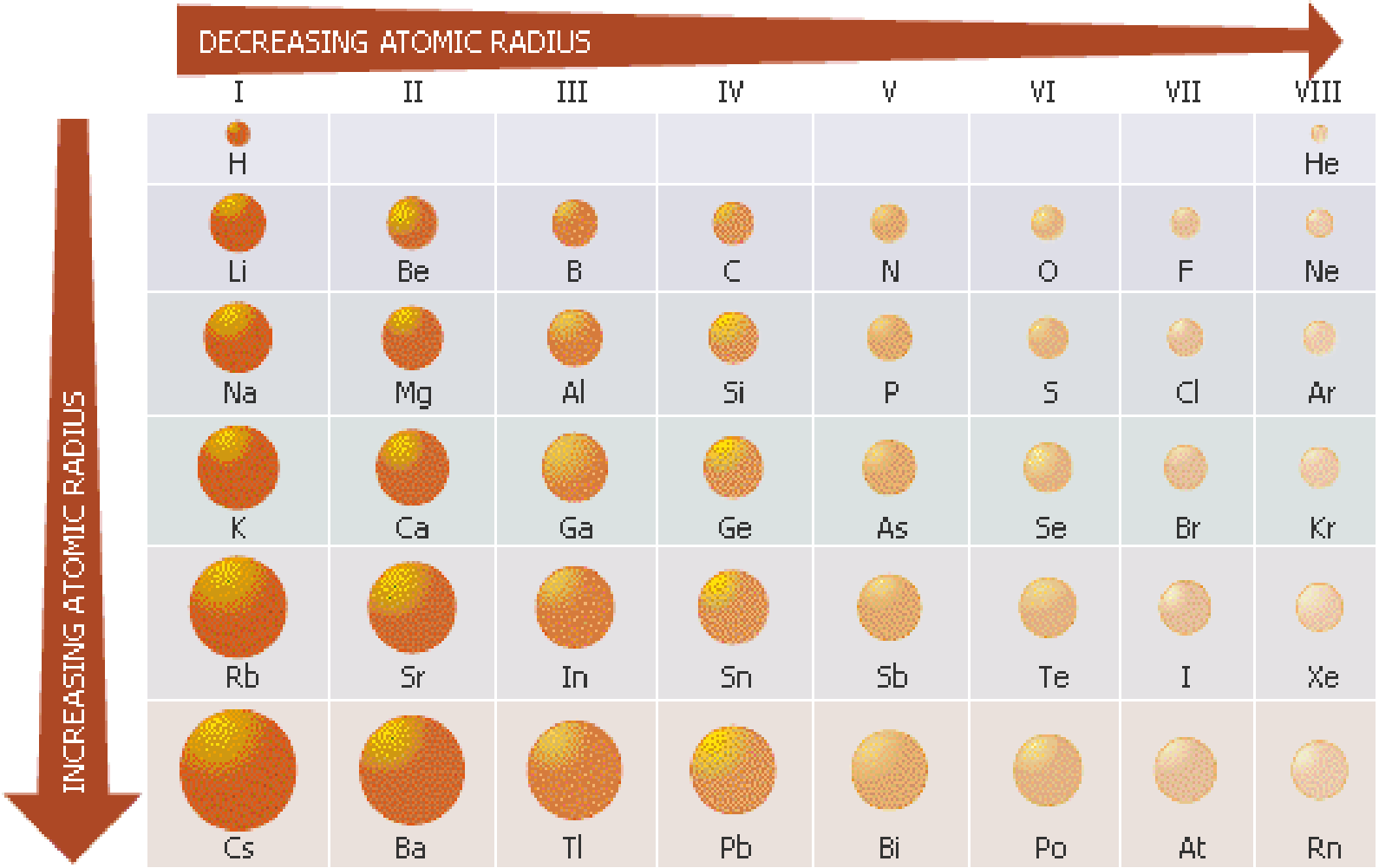
Decreases left to right across period

- Caused by increased nuclear charge

Increases Down a group

- Caused by shielding effect

Atomic Radius



Ionization Energy

Energy needed to remove one electron

Increases left to right across period

- Caused by increased nuclear charge

Decreases Down a group

- Caused by shielding effect

Electronegativity

Tendency to attract electrons when bonded

Increases left to right across period

- Caused by increased nuclear charge

Decreases Down a group

- Caused by shielding effect

Metallic Character

Tendency to exhibit metallic properties

Decreases left to right across period

- Result of other trends

Increases Down a group

- Result of other trends

The Periodic Table-Review

- An element's position in the Periodic Table dictates its electron configuration.
- The periodic table is broken down into "Blocks"

Your Turn:

Put these elements in order of decreasing atomic radius

- C N Li F O
- What is the trend?
- Answer: Li > C > N > O > F

Your Turn:

Put these elements in order of decreasing ionization energy

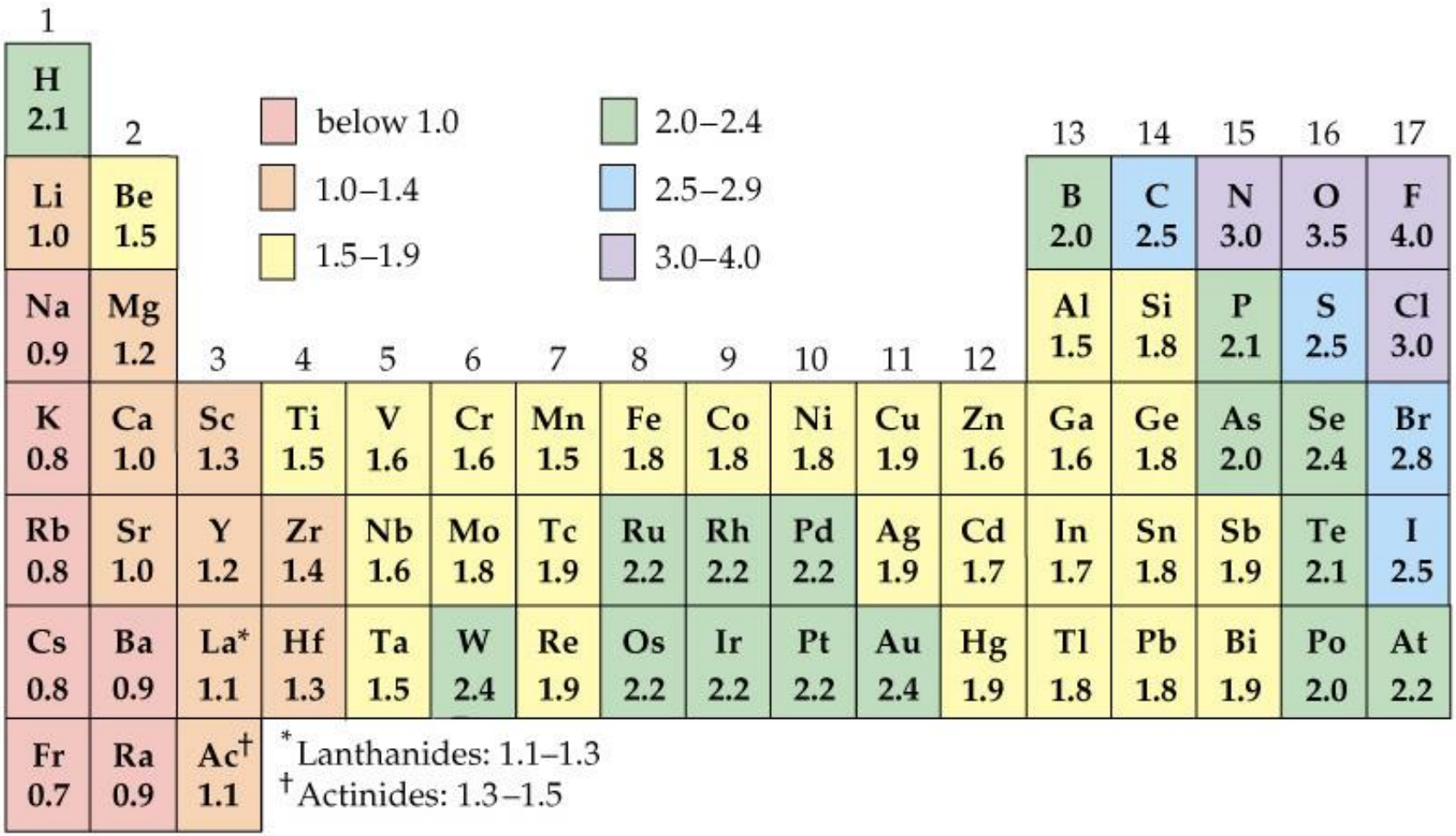
- C N Li F O
- What is the trend?
- Answer: F > O > N > C > Li

Your Turn:

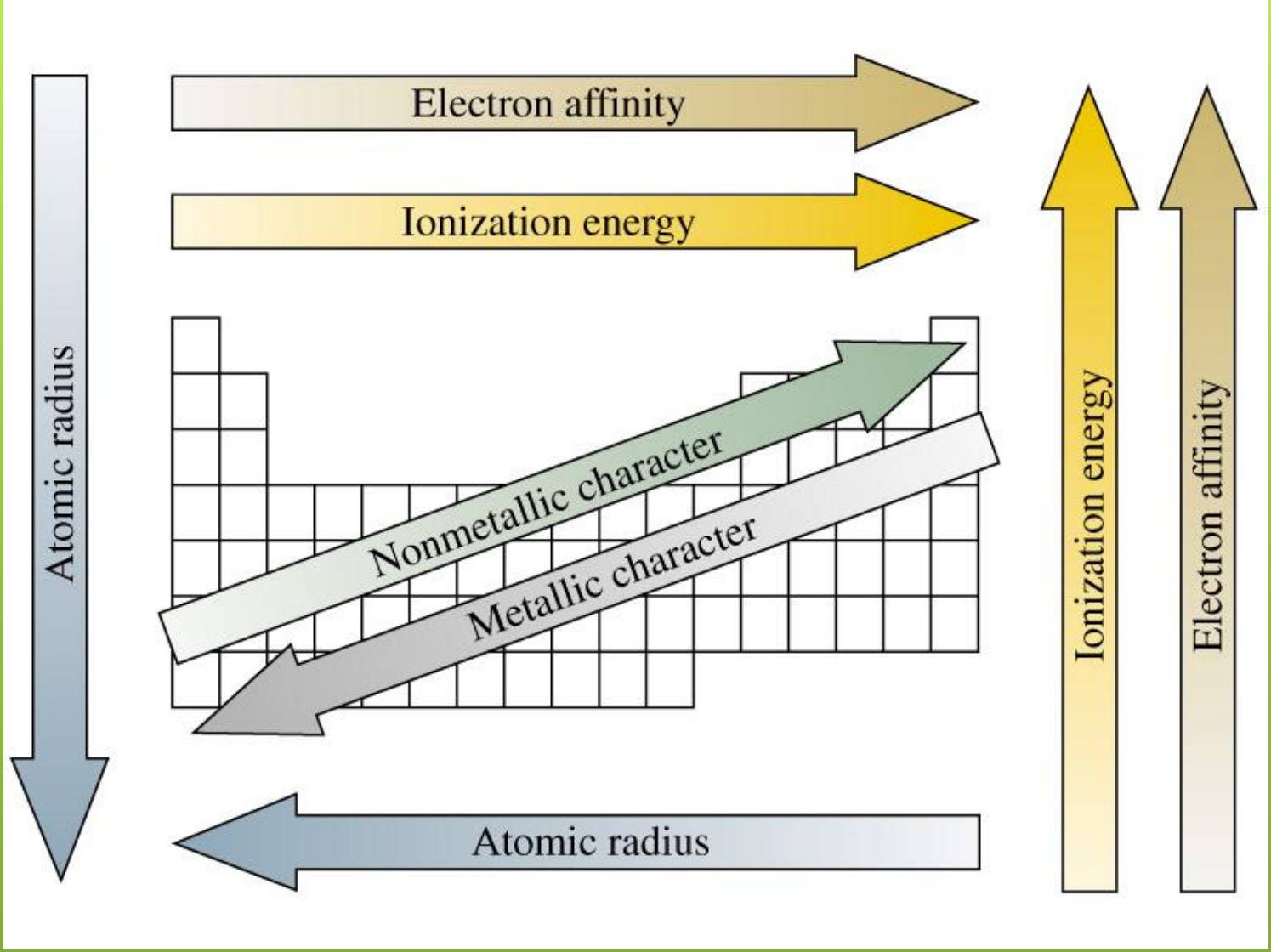
Put these elements in order of increasing electronegativity

- C N Li F O
- What is the trend?
- Answer: Li < C < N < O < F

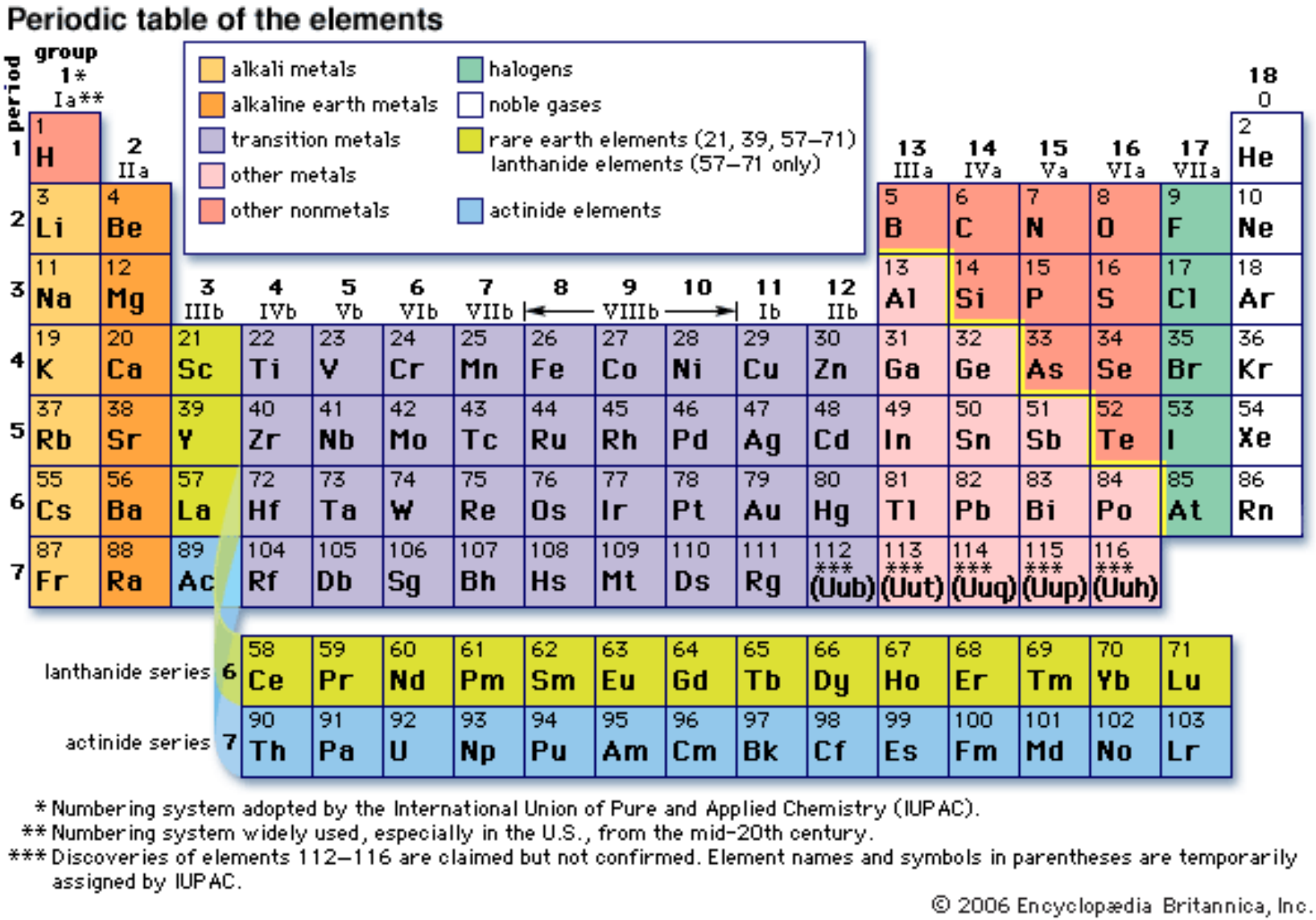
Periodic Table of Electronegativities



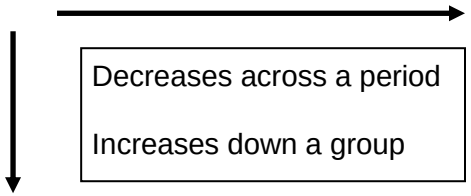
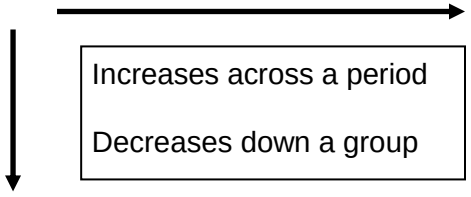
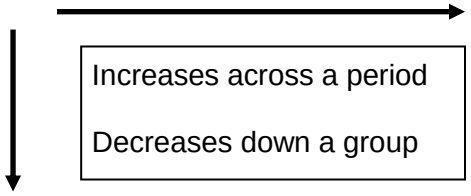
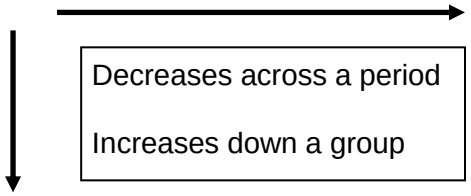
Summary of Periodic Trends



The Modern Periodic Table



* Numbering system adopted by the International Union of Pure and Applied Chemistry (IUPAC).
** Numbering system widely used, especially in the U.S., from the mid-20th century.
*** Discoveries of elements 112–116 are claimed but not confirmed. Element names and symbols in parentheses are temporarily assigned by IUPAC.

Term	Definition	Trend on the Periodic Table	Why?
Atomic Radius	The radius of an atom (half the distance between the nuclei of two atoms of the same element)		Across: Electrons added to the same energy level experience increasing attraction to the nucleus due to the successive addition of protons. Down: Each period on the table adds a new energy level to the electron cloud.
Ionization Energy	The energy required to remove a valence electron from an atom		Across: Electrons are harder to remove from small atoms because they are closer to the nucleus. Down: Electrons are easier to remove from large atoms because they are farther from the nucleus.
Electronegativity	A measure of the ability of an atom to attract electrons when it combines chemically with another atom		Across: Caused by the increase in nuclear charge across a period. Down: Caused by the increased distance from the nucleus
Metallic character	The tendency to exhibit metallic properties		Across: The result of the other trends. Down: The result of the other trends.