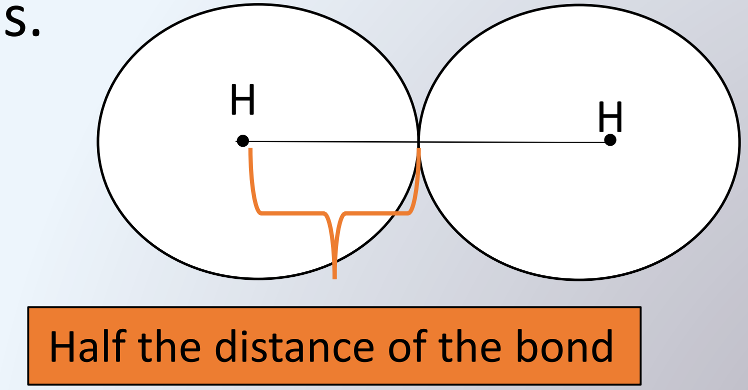
Trends in the Periodic Table

Atomic Radius

- Atomic Radius is defined as half the distance between the nuclei of 2 atoms of the same element that are joined together by a single covalent bond.

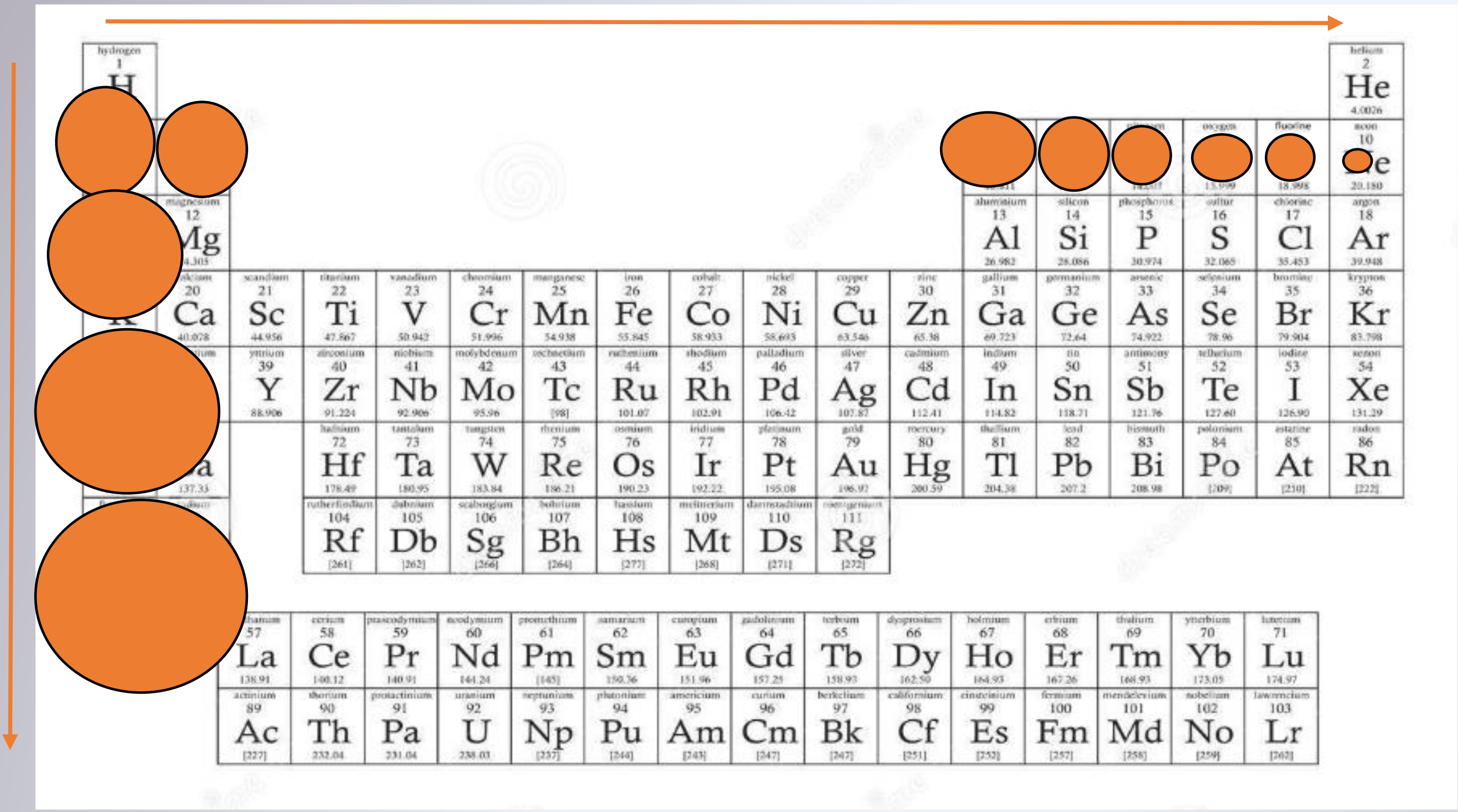
- Another name for atomic radius is covalent radius.



Trends in Atomic Radius

Atomic radius decreases across period

Atomic radius increases down the group



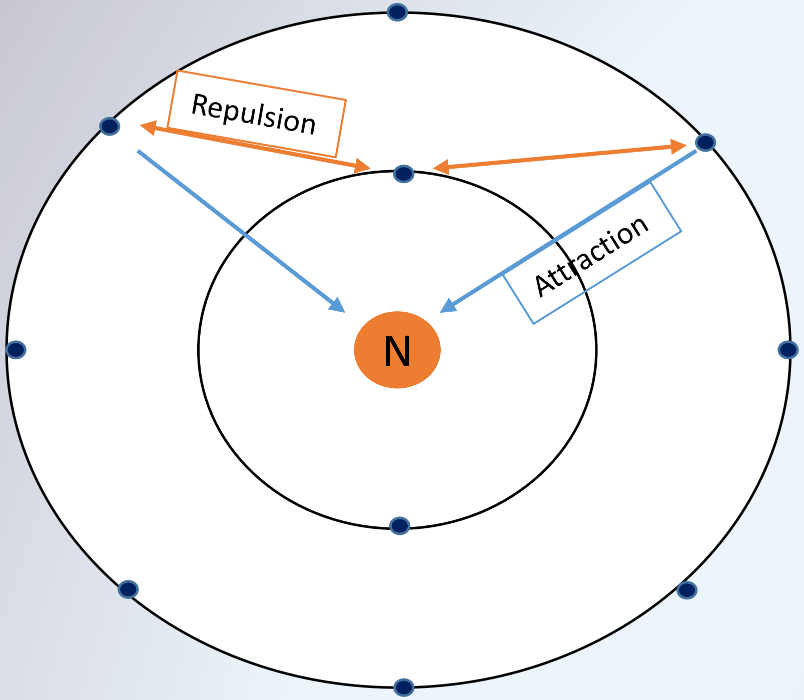
classroomchemistry

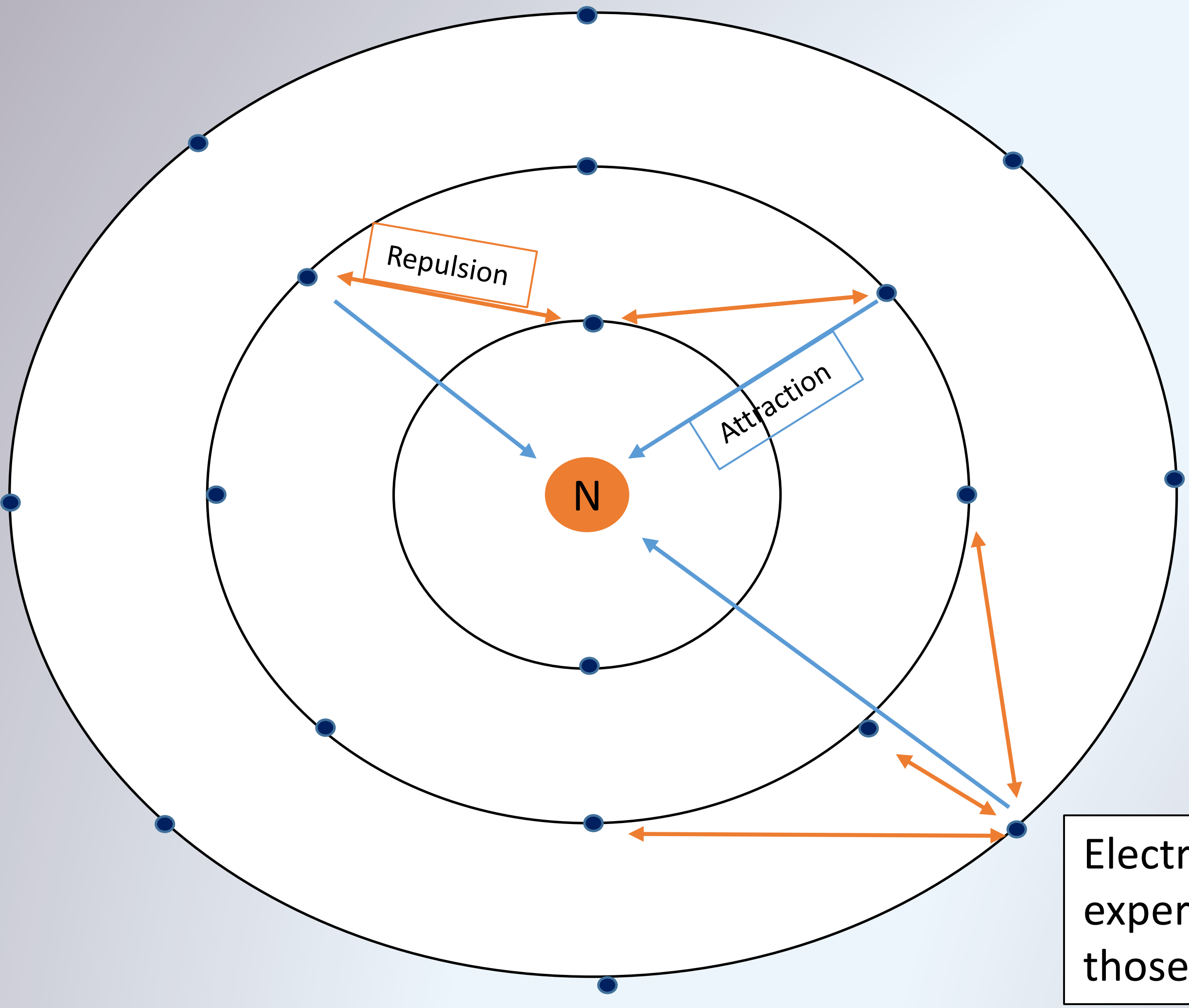
Atomic Radius increases down the group due to:

1. **A new shell of electrons** which is further away from the nucleus.

2. **The increase of the screening effect** of inner shells of electrons.

The Shielding (Screening) Effect





Electrons in the outer shells experience more repulsion than those in the inner shells

Atomic Radius decreases across a period due to:

1. Increase in nuclear charge

- The more protons that are in the nucleus, then the stronger the attraction between the nucleus and the outer electrons

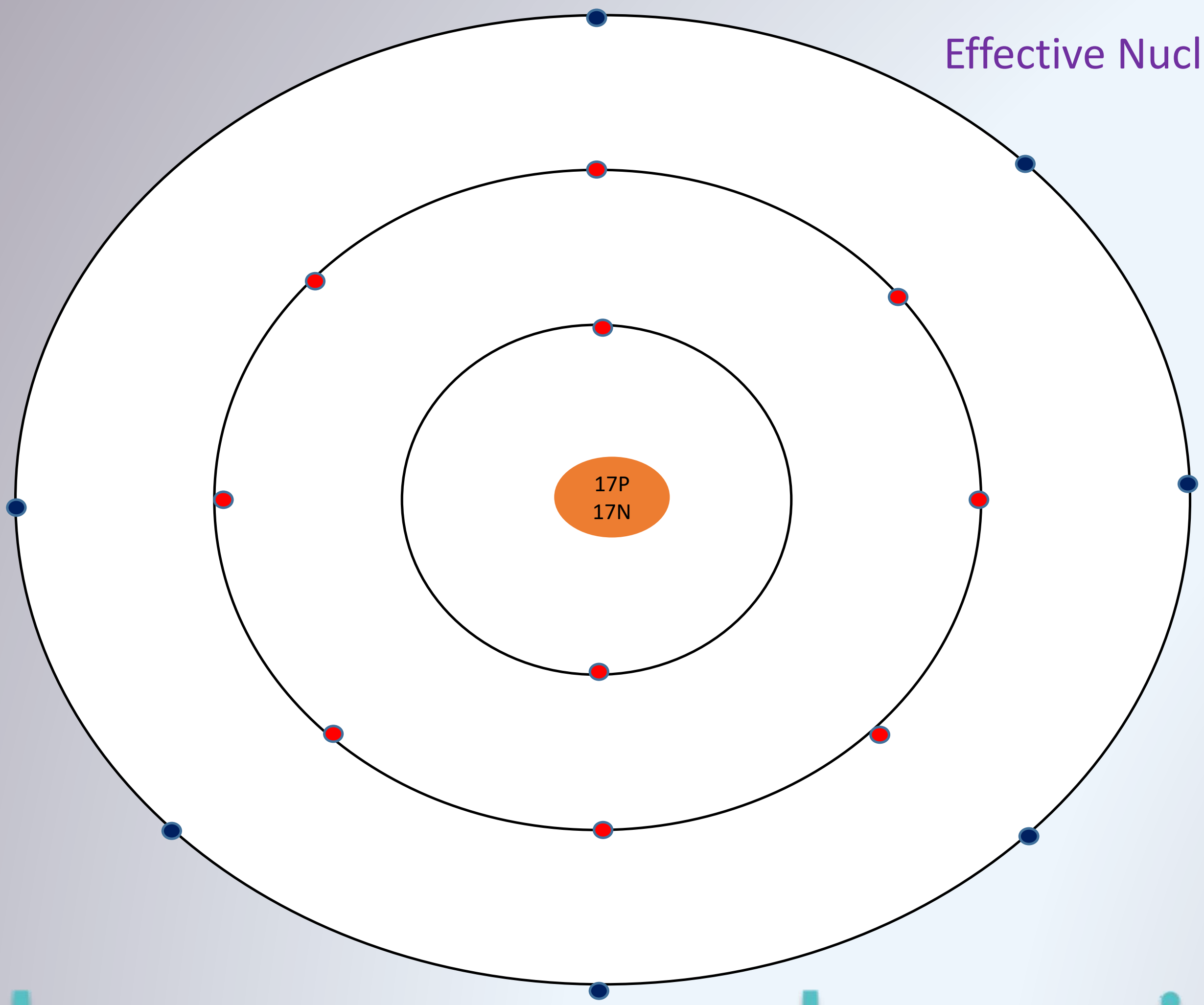
2. No increase in the screening effect

- The extra electron is being added to the same outer shell.

Decreasing Atomic Size (Across a Period)

- As the attraction between the (+) nucleus and the (-) valance electrons increases, the atomic size decreases.
- From left to right, size decreases because there is an increase in nuclear charge and Effective Nuclear Charge (# protons - # core electrons).
- Each valance electron is pulled by the full Effective Nuclear Charge

Effective Nuclear Charge



Effective Nuclear Charge = total electrons – inner electrons

Chlorine = 17 total electrons
10 inner electrons

E.N.C. = 17 – 10 = +7 charge

D-Block elements

- As the difference in electron structure in the d-block elements occur in the 2nd last energy level, there is very little change in the size of their atoms across any period.

- The increased nuclear charge is effectively cancelled by the increase in the screening effect.

Why does little change occur in the size of D-block atoms?

First Ionization Energy

- The first ionisation energy is the energy required to remove the most loosely bound electron from a neutral atom in the gaseous ground state.

$$X - e^{-} = X^{+}$$

Second Ionization Energy

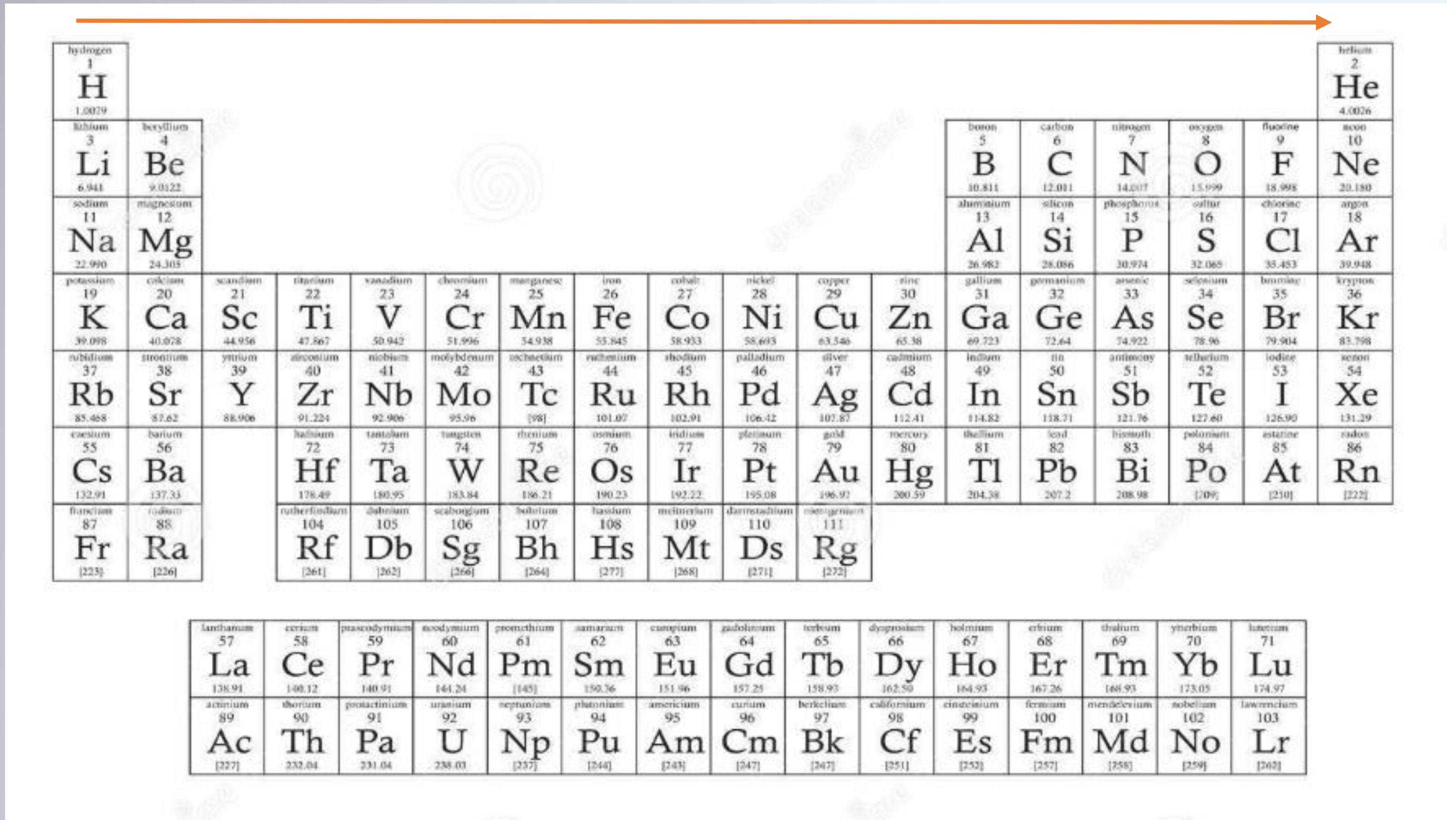
- Is the energy required to remove the most loosely bound electron from the ion, the first electron already having been removed.

$$X^{+} - e^{-} = X^{2+}$$

Trends in Ionisation Energy

Ionisation energy increases across period

Ionisation energy decreases down the group



Trends in Ionization Energy

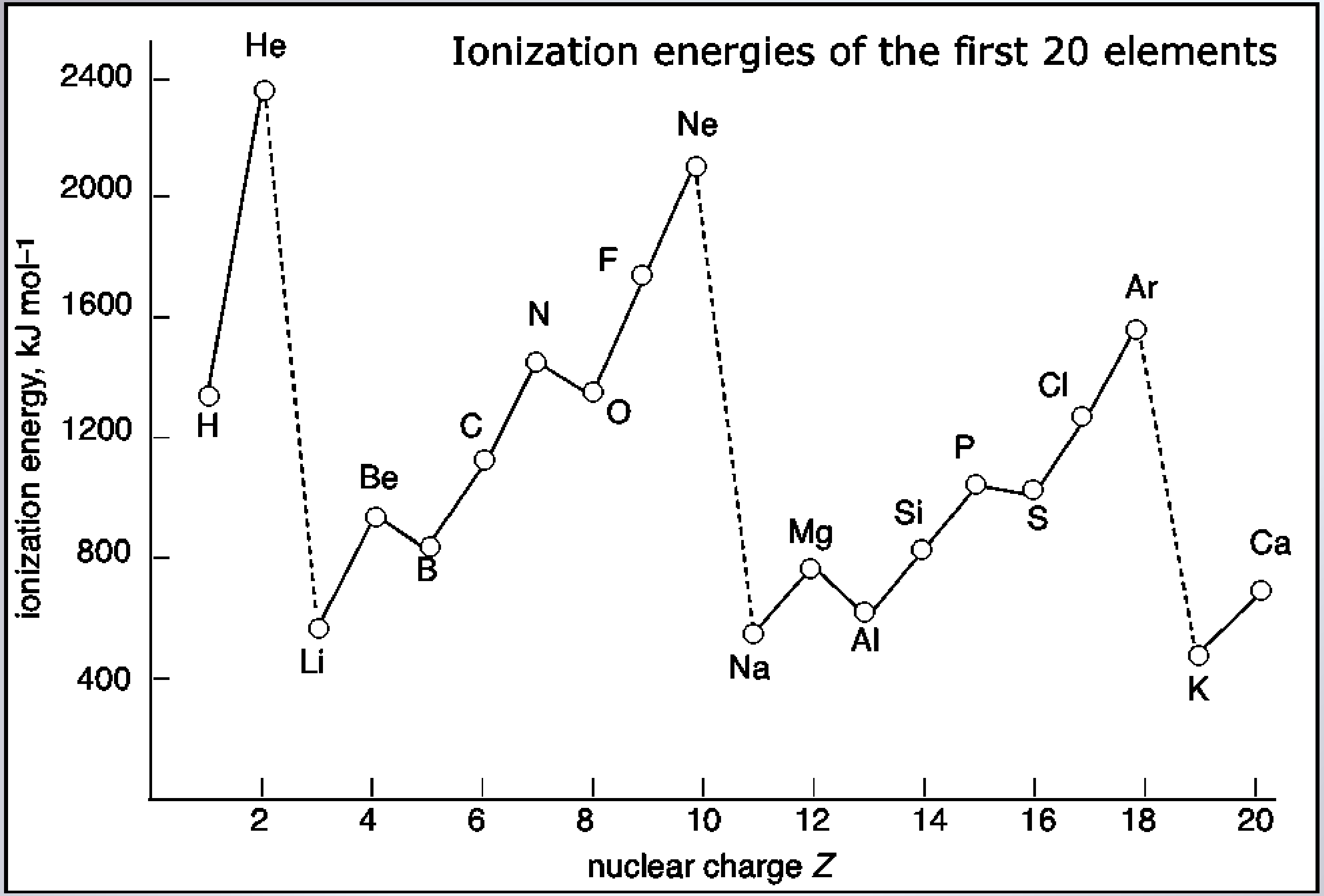
- **Increase across a period due to:**

- Increase in the nuclear charge
- Decrease in atomic radius

- **Decrease down a group due to:**

- Increase in 'screening effect'
- Increase in atomic radius

Ionization Energies (*be able to explain)



classroomchemistry

Exceptions to Ionisation Trends

- Write out the electron configuration (s, p, etc.) for the following atoms:

  Be and B

Exceptions to Ionisation Trends

- Write out the electron configuration (s, p, etc.) for the following atoms:

  Mg and Al

Exceptions to Ionisation Trends

- Write out the electron configuration (s, p, etc.) for the following atoms:

  N and O

Exceptions to Ionisation Trends

- Write out the electron configuration (s, p, etc.) for the following atoms:

  P and S

Why are these exceptions?

- Where is the outer electron being removed from in each atom?
- Which atom is more stable?

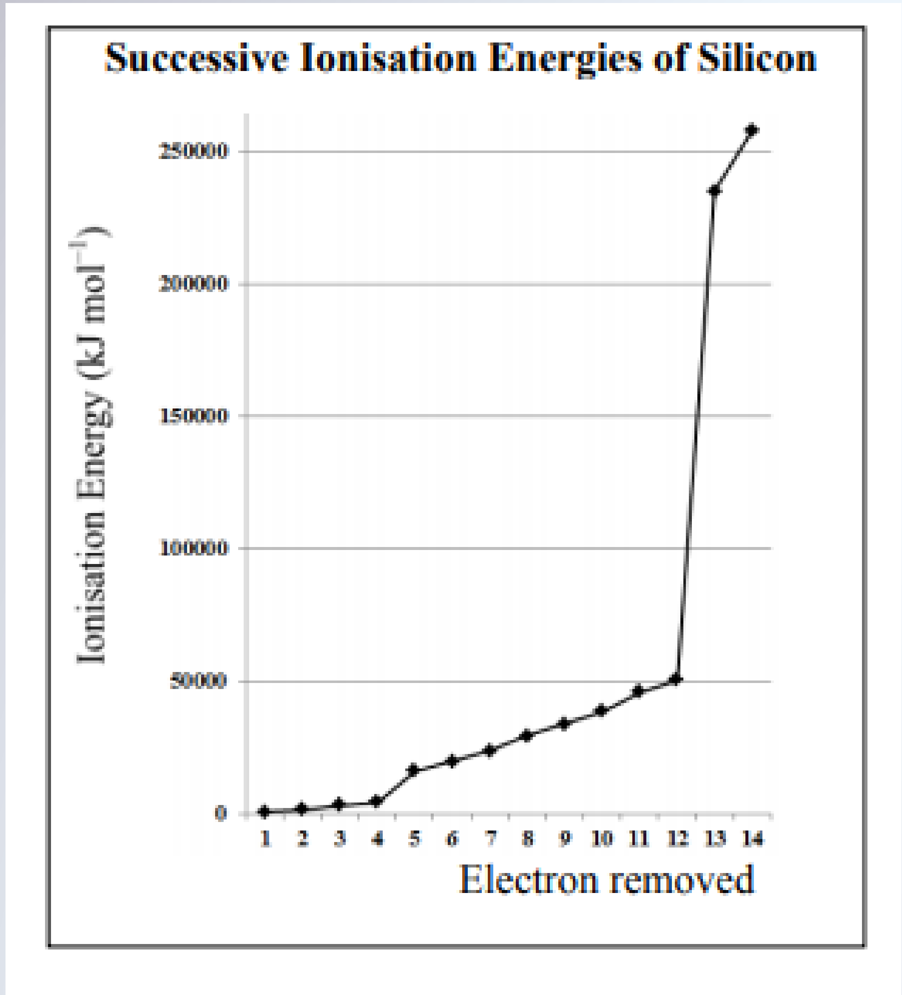
Evidence for the existence of energy levels

1. There is a steady increase in I.E. values as electrons are removed from the same shell.
2. There is a large increase in I.E. values when an electron is removed from a full shell.

This is because the new shell is:

- Closer to the nucleus
- There is less screening effect
- Shell is full, so has extra stability

Trends in I.E. for Silicon… Can you explain the trends?



Electronegativity (E.N)

- Is the relative force of attraction atoms have for a shared pair of electrons in a covalent bond.

- Electronegativity values lay between 0.7 to 4.

Table of E.N values

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 2.20																	2 He --
3 Li 0.98	4 Be 1.57											5 B 2.04	6 C 2.55	7 N 3.04	8 O 3.44	9 F 3.98	10 Ne --
11 Na 0.93	12 Mg 1.31											13 Al 1.61	14 Si 1.90	15 P 2.19	16 S 2.58	17 Cl 3.16	18 Ar --
19 K 0.82	20 Ca 1.00	21 Sc 1.36	22 Ti 1.54	23 V 1.63	24 Cr 1.66	25 Mn 1.55	26 Fe 1.83	27 Co 1.88	28 Ni 1.91	29 Cu 1.90	30 Zn 1.65	31 Ga 1.81	32 Ge 2.01	33 As 2.18	34 Se 2.55	35 Br 2.96	36 Kr --
37 Rb 0.82	38 Sr 0.95	39 Y 1.22	40 Zr 1.33	41 Nb 1.60	42 Mo 2.16	43 Tc 2.10	44 Ru 2.20	45 Rh 2.28	46 Pd 2.20	47 Ag 1.93	48 Cd 1.69	49 In 1.78	50 Sn 1.96	51 Sb 2.05	52 Te 2.10	53 I 2.66	54 Xe 2.60
55 Cs 0.79	56 Ba 0.89	57 La 1.10	72 Hf 1.30	73 Ta 1.50	74 W 1.70	75 Re 1.90	76 Os 2.20	77 Ir 2.20	78 Pt 2.20	79 Au 2.40	80 Hg 1.90	81 Tl 1.80	82 Pb 1.80	83 Bi 1.90	84 Po 2.00	85 At 2.20	86 Rn --
87 Fr 0.70	88 Ra 0.90	89 Ac 1.10	104 Rf --	105 Db --	106 Sg --	107 Bh --	108 Hs --	109 Mt --	110 Ds --	111 Rg --	112 Uub --	113 Uut*	114 Uuq --	115 Uup*	116 Uuh --	117 Uus*	118 Uuo --

Trends in E.N

- **Increase across a period due to:**

- Increase in nuclear charge (# protons).
- Decrease in atomic radius.

- **Decrease down a group due to:**

- Increase in the number of shells of electrons (shielding effect).
- Increase in atomic radius

Uses of E.N values

- Help determine the type of bond within a molecule (intramolecular)… ionic or covalent bonds.
- Helps determine the type of force between molecules (intermolecular)…Van der Waals, Dipole-Dipole, or Hydrogen bonding.
- Helps determine the solubility in polar/non-polar solvents. "

  "Like dissolves like"