14 • The Periodic Table
Terms about the Periodic Table
People of the Periodic Table
(1 of 8)

period	a horizontal **row** of the table
group / family	a vertical **column** of the table
periodic law	properties repeat if you arrange elements by **atomic mass**. The **modern periodic law** arranges elements by **atomic number**
Döbereiner	**triads** of similar elements
Newlands	**Law of Octaves** for similar elements
Meyer	**close** to a modern periodic table
Dimitri Mendeleev	first to publish, predicted missing elements, his table was very detailed

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Families (Groups) of the Periodic Table
(2 of 8)

hydrogen	a family by itself because it acts like both group I and group VII
alkali metals	Family I… forms 1+ ions
alkaline earth metals	Family II… forms 2+ ions
halogens	Family VII (salt formers)… forms 1– ions
noble gases	Family VIII… He, Ne, Ar are **inert**
representative elements	Families I – VIII s-block (I & II) and p-block (III – VIII)
main transition elements	elements with unfilled inner shells d-block (often form colored compounds)
inner transition	f-block (lanthanoids and actinoids)

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Terms used in the Trends
(3 of 8)

ionization energy

energy needed to **remove** an electron from an atom

ex: Li + **energy** → $Li^+ + e^-$

atomic radius	size of an atom
ionic radius	size of an ion

negative ions get **larger**; positive ions get **smaller**

metallic character (compared to nonmetals)

- **low** ionization energies… form **positive** ions
- **low** electronegativities — **high** luster
- **easily** deformed (malleable and ductile)
- **good** conductors of heat and electricity

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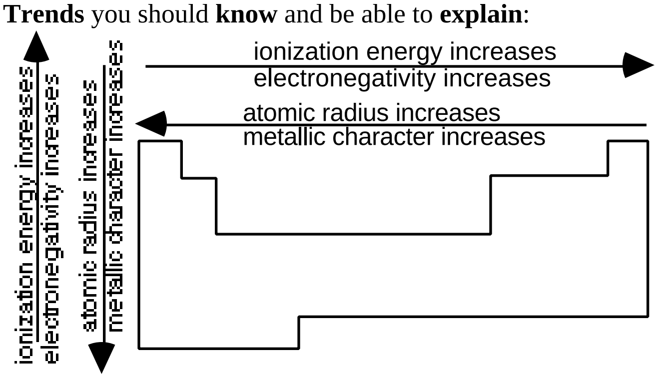
Trends of the Periodic Table
(4 of 8)

Trends you should **know** and be able to **explain**:



14 • The Periodic Table
Explaining The Size of Atoms and Ions
(5 of 8)

The **<u>size of an atom</u>** depends on the **electron cloud**… the **average distance** of the **valence e^-'s** from the **nucleus**.

Three important factors:

the e^- - e^- **repulsion** … making the atom **larger**
the p^+ - e^- **attractions**… making the atom **smaller**
the *principal quantum number,* **n**…
as **n** increases, the average distance of the valence e^-'s from the nucleus increases… making the atom **larger**

- **across** a **period**… **more** p^+'s… **more** attraction… **smaller**
- **down** a **family**… **n increases**… e^-'s **farther**… **larger**
- **+ ion**… **lose** e^-'s… **less** repulsion… **smaller**

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Explaining Ionization Energy
(6 of 8)

Ionization energy trends follow the **size** trends:
As atoms or ions get **larger**, the electron being removed is **farther** from the nucleus… the **attractions** are **less**… the **energy needed** is **less**… the **ionization energy** is **less**.

Ionization energy **greatly increases** when you start removing electrons from an **inner shell** (**n** decreases).

Moving **across** a period, **two** other **factors** come into play:
- "p" e^-'s are **higher energy**… require **less** energy to remove than "s" e^-'s with the same quantum number, n
- e^-'s in **filled** orbitals are **easier** to remove than e^-'s in singly occupied orbitals because of e^- - e^- **repulsions**.

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Isoelectronic Species
(7 of 8)

The elements **before** and **after** a noble gas form ions by **gaining** or **losing** electrons until they have the same electron configuration as the **noble gas.**

N^{3-} O^{2-} F^- Ne Na^+ Mg^{2+} Al^{3+}
all have the electron configuration: $1s^2\ 2s^2\ 2p^6$
We say these ions and atoms are **isoelectronic**
iso means "same" and *electronic* means "electrons"

Using ideas from Study Card #5, we see that if the **electrons** are the **same** but there are **increasing** numbers of **protons**, the **increased attractions** cause the **sizes** to **decrease**.

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Clues from the Periodic Table
(8 of 8)

The **group** or **family number** (I through VIII) tells you…
- the number of **valence electrons** of the elements in each family (except He which only has 2 valence electrons)
- the **ion** that commonly forms
- the **bonding capacity** (the number of bonds it will form)

	I	II	III	IV	V	VI	VII	VIII
# of valence e–	1	2	3	4	5	6	7	8
ion formed	1+	2+	3+	*	3–	2–	1–	none
bonding capacity	1	2	3	4	3	2	1	0
IUPAC family #	1	2	13	14	15	16	17	18

* Family IV usually **shares** e^-'s rather than forming **ions**