CHEM103
General Chemistry

Chapter 2: Atoms, Molecules, and Ions

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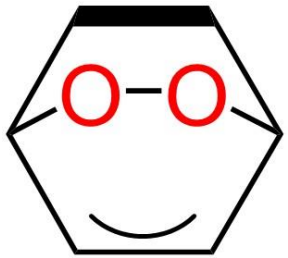


Assignment 1

Please either **print** the Answer Sheet or **use** your paper; **write down** your answers on your sheet/paper.

Please submit your assignments to me during the classes. Or you can submit your assignment to the folder **outside room 520**, **research building 1** (anytime you like).

Homework 1

Due date: **14 Sep. (Wed)**

Review on Chapter 1

Chemistry: matter, its properties and changes

Classifications of Matter:
Atoms, Elements, Compounds, Mixture; State of Matter

Properties of Matter:
Physical & Chemical; Intensive & Extensive;
Separation of Mixtures

Measurement of Matter:
Units (SI, Prefix); Uncertainty (Exact vs. Inexact number; Precision and Accuracy; Significant Figures); Dimensional Analysis

Outline of Chapter 2

Atoms:

Atomic Theory; Atomic Structure (nucleus, electron, proton & neutron); Atomic Weight (atomic number; isotopes); Periodic Table (periods & groups)

Molecules:

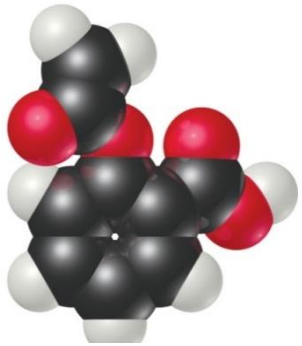
Compounds; Chemical formula and empirical formula

Ions:

Cations, anions, ionic bonds

Naming of Inorganic & Organic Compounds



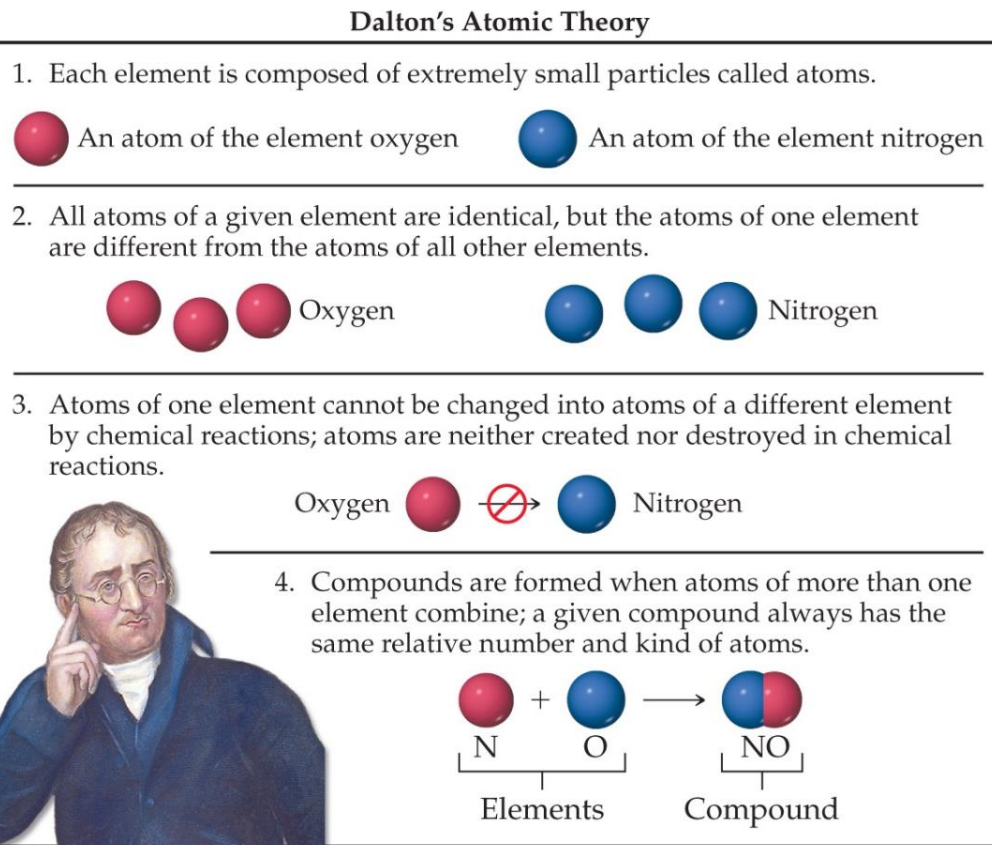
All matter/material: composed of > 100 elements (>100 chemically different kinds of atoms).

Structure & behavior of atoms are keys to understand both physical & chemical properties of matter.

Any rules to combine different atoms? How do properties of a substance relate to the types of atoms?

Atomic Theory of Matter

Atomic Theory of Matter

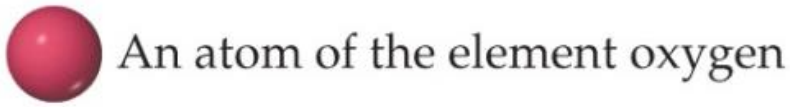


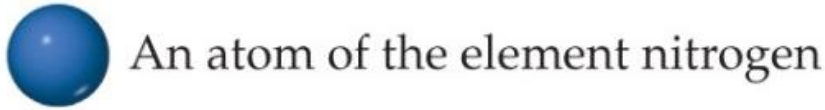
Atomos: Greek meaning of "indivisible or uncuttable (不能分割的)"

Atoms: fundamental building blocks of matter reemerged in the early 19th century, championed by John Dalton.

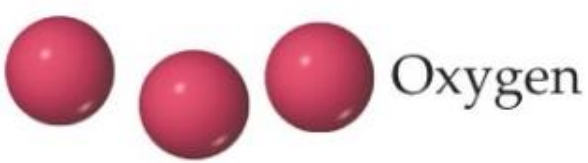
Dalton's Postulates (道尔顿的假说)

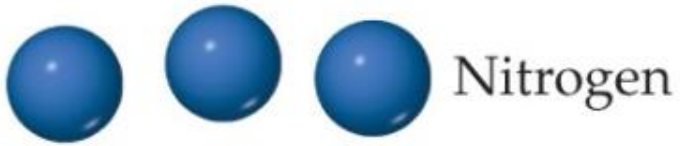
1. **Each element** is composed of an extremely small particle (粒子), so-called **atom**.





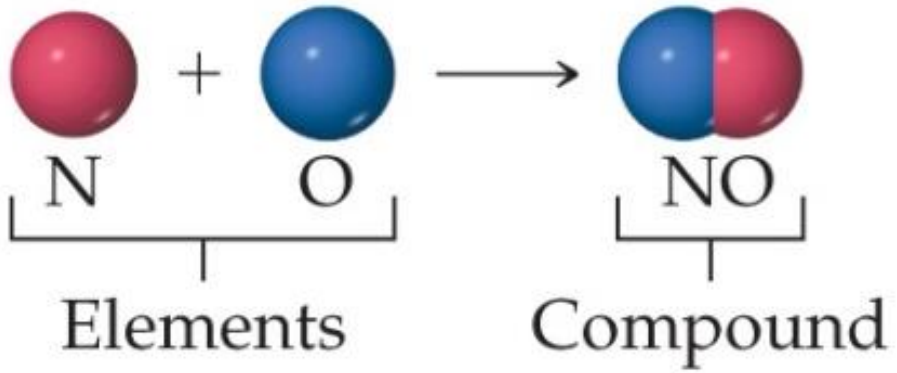
2. **All atoms of the same element** are **same** to one another in terms of **mass and other properties**. The atoms of one element are **different** from the **atoms of all other elements**.





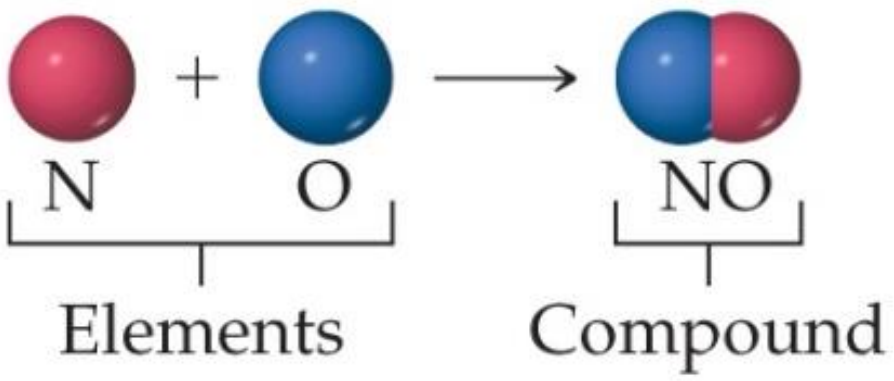
3. Atoms of **an element** are **NOT changed** into atoms of a **different element** by chemical reactions. **Atoms are neither created nor destroyed in chemical reactions**.

4. **Compounds** are **formed** when **atoms of more than one element combine**. A **same** compound always has the **same relative number and same kind of atoms**.



Law of Conservation of Mass (质量守恒定律)

The **total mass** of substances present **after** a chemical reaction is the **same** as the total mass of substances present **before** the reaction.

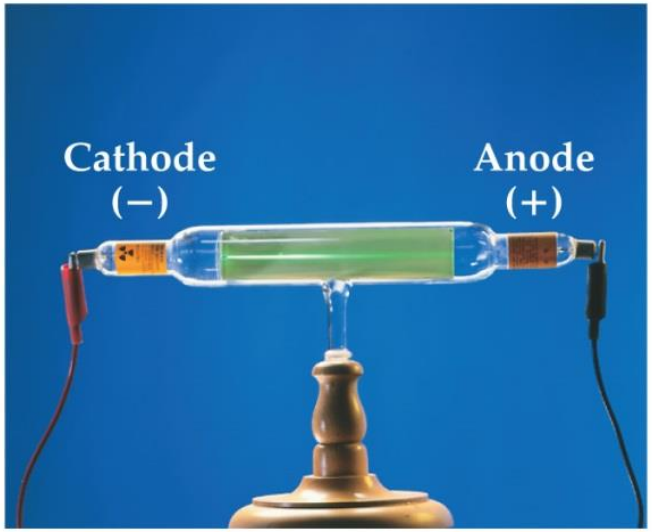


$$M(N) + M(O) = M(NO)$$

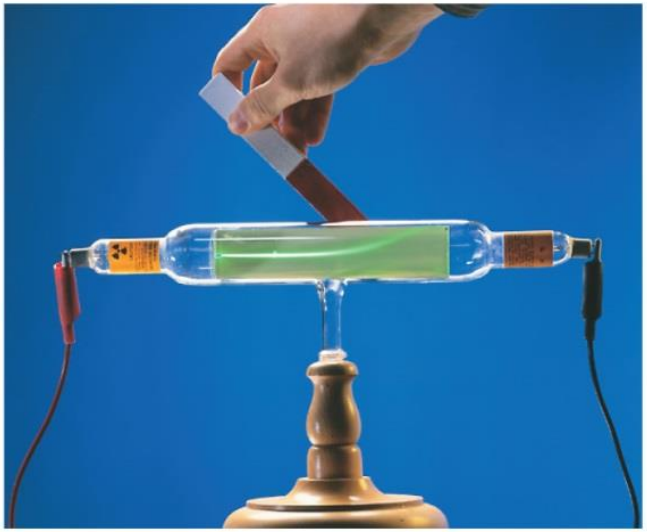
Beakers of silver nitrate ($AgNO_3$) and sodium chloride (NaCl) solutions before mixing (left) and after mixing (right).

The Discovery of Atomic Structure

The Electron (e^-)



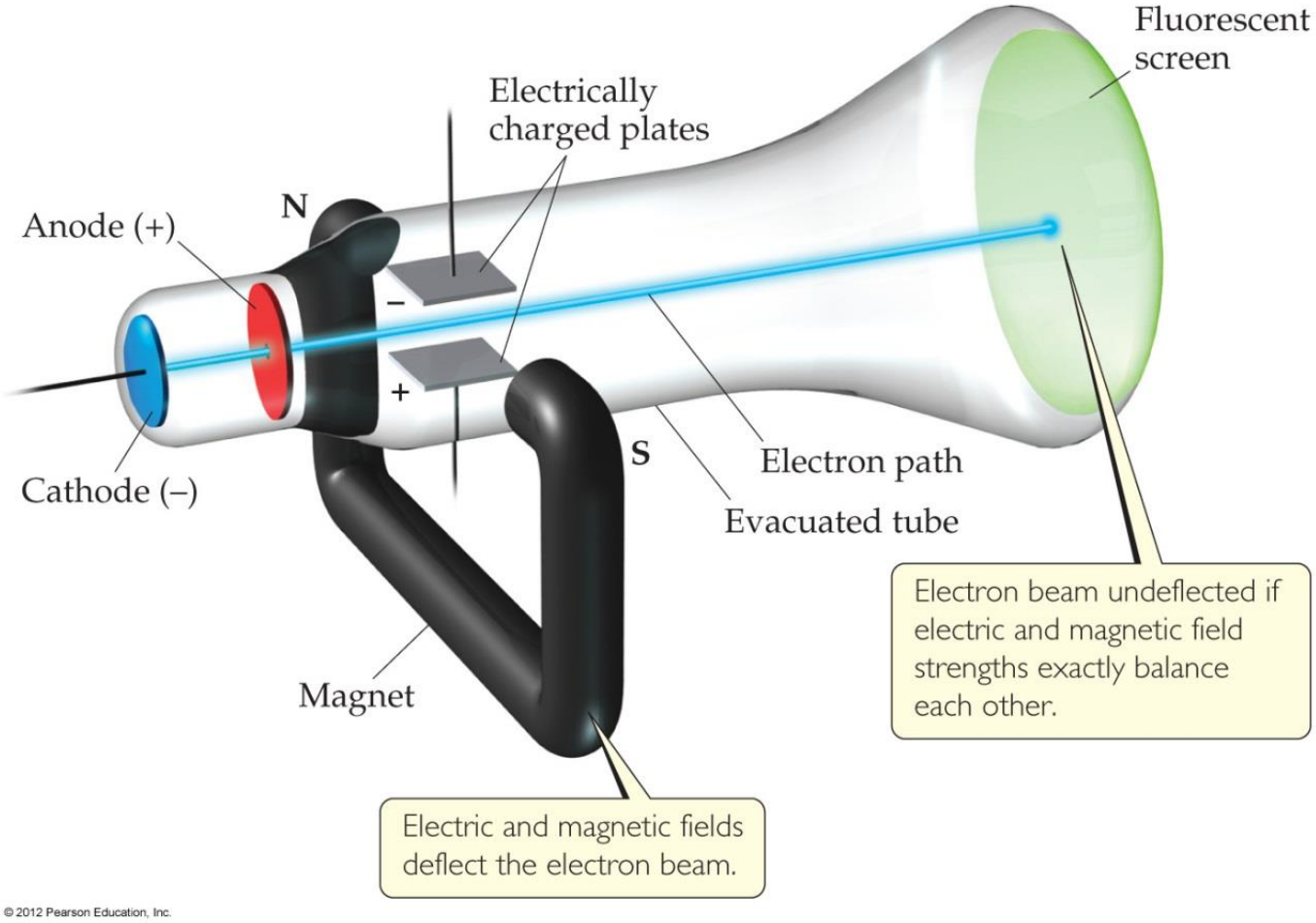
(a) Electrons move from the cathode (negative electrode) to the anode (positive electrode). The tube contains a glass screen (set diagonally to the electron beam) that fluoresces, showing the path of the cathode rays.



(b) The rays are deflected by a magnet.

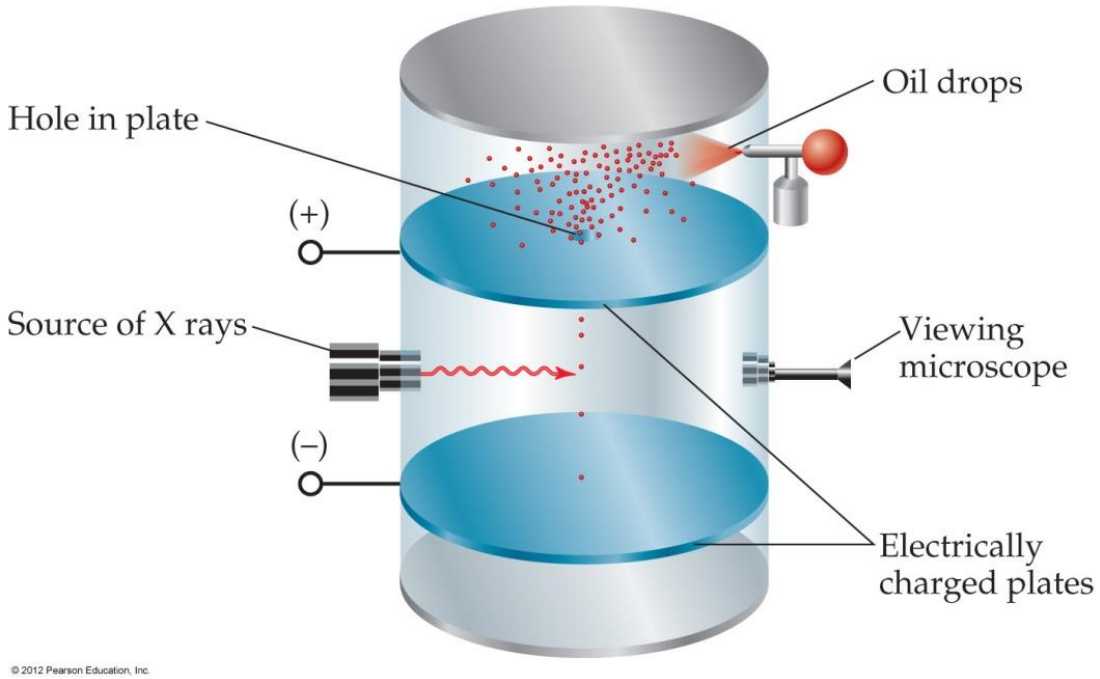
- Streams of **negatively charged particles** were found to emanate (发射) from negative cathode tubes (阴极射线管), causing fluorescence (荧光).
- J. J. Thomson is credited with their discovery (1897).

- Streams of negatively charged particles were found to emanate (发射) from cathode tubes (阴极射线管), causing fluorescence (荧光).



Thomson measured the **charge/mass ratio of the electron** to be 1.76×10^8 coulombs/gram (C/g).

Millikan Oil-Drop Experiment



As the charge/mass ratio of the electron was known (Thomson), determination of either the charge or the mass of an electron would be derived:

Charge → Mass

or

Mass → Charge

Robert Millikan determined the **charge on an electron** ($1.602*10^{-19}$ C) in 1909. Then, **mass of an electron** = $1.602*10^{-19}$ C / $1.76*10^{8}$ C/g = $9.10*10^{-28}$ g.

Millikan's experiment showed that the charges were always integral multiples of $1.602*10^{-19}$ coulombs (C).Therefore, an electron mass = $9.10*10^{-28}$ g.

Radioactivity (放射性)

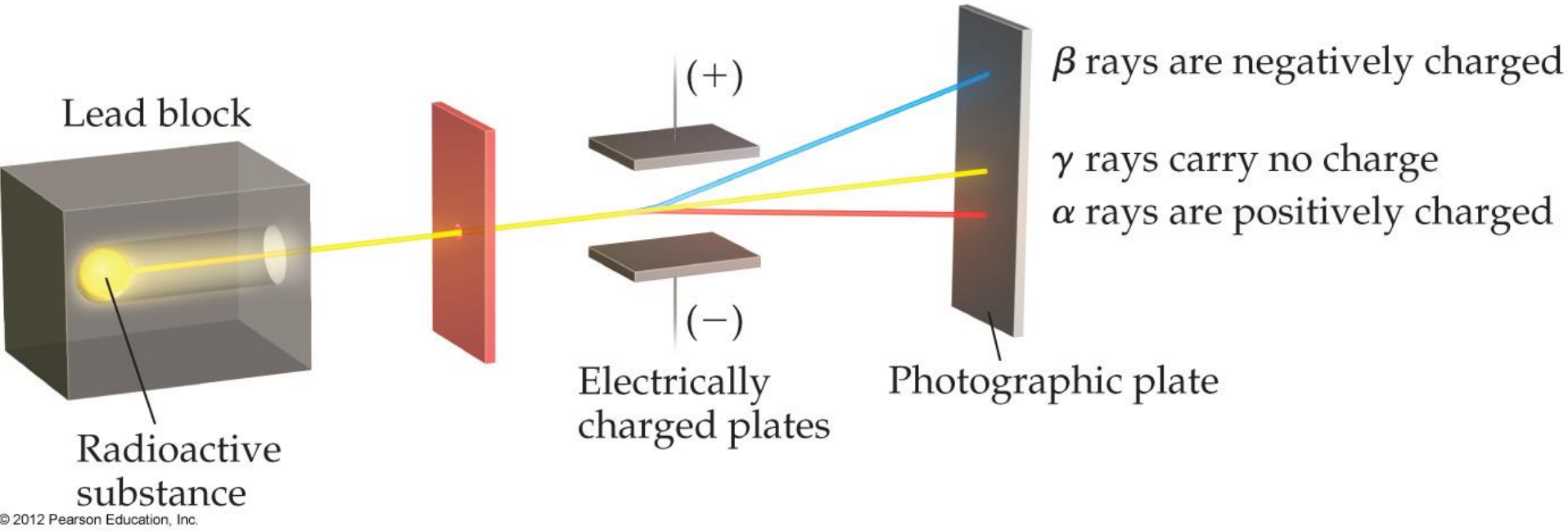
- **Radioactivity: spontaneous (自发的) emission of radiation (辐射)**.

- First observed by Henri Becquerel (贝克勒尔) from a compound of uranium (U) in 1896.

- Becquerel (Bq) named after him is a **measure of radioactivity**. A quantity of radioactive material has an activity of 1 Bq, if one nucleus decays per second.

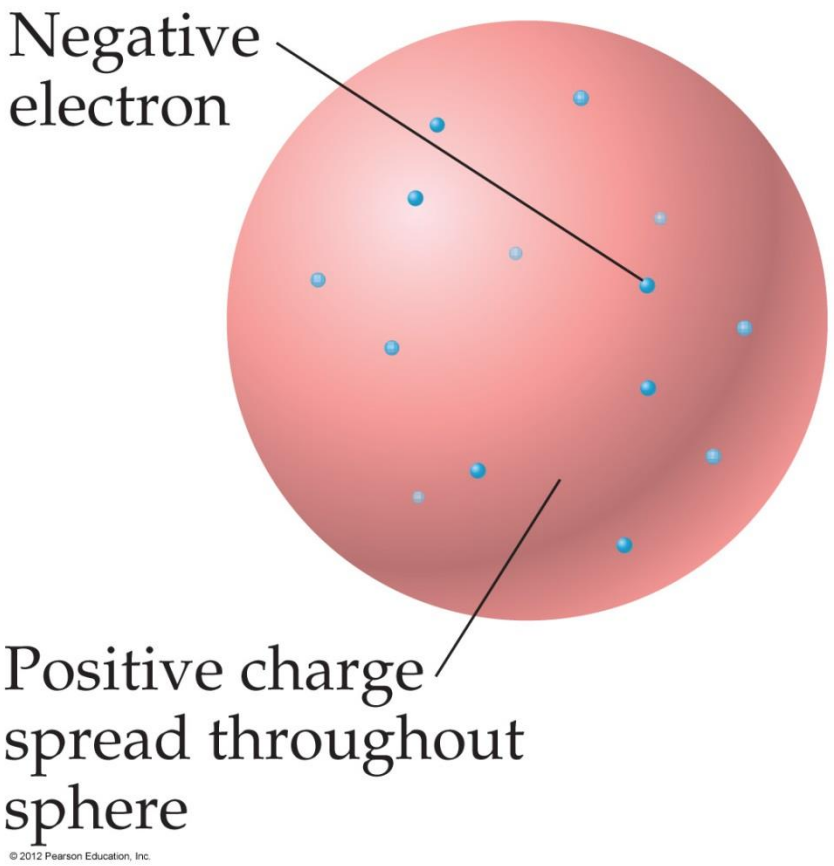
- Marie and Pierre Curie (居里) also studied and isolated it.

- Three types of radiation were discovered by Ernest Rutherford (卢瑟福):
  - **α particles (positively-charged)**
  - **β particles (fast & negatively-charged)**
  - **γ rays (no charge)**



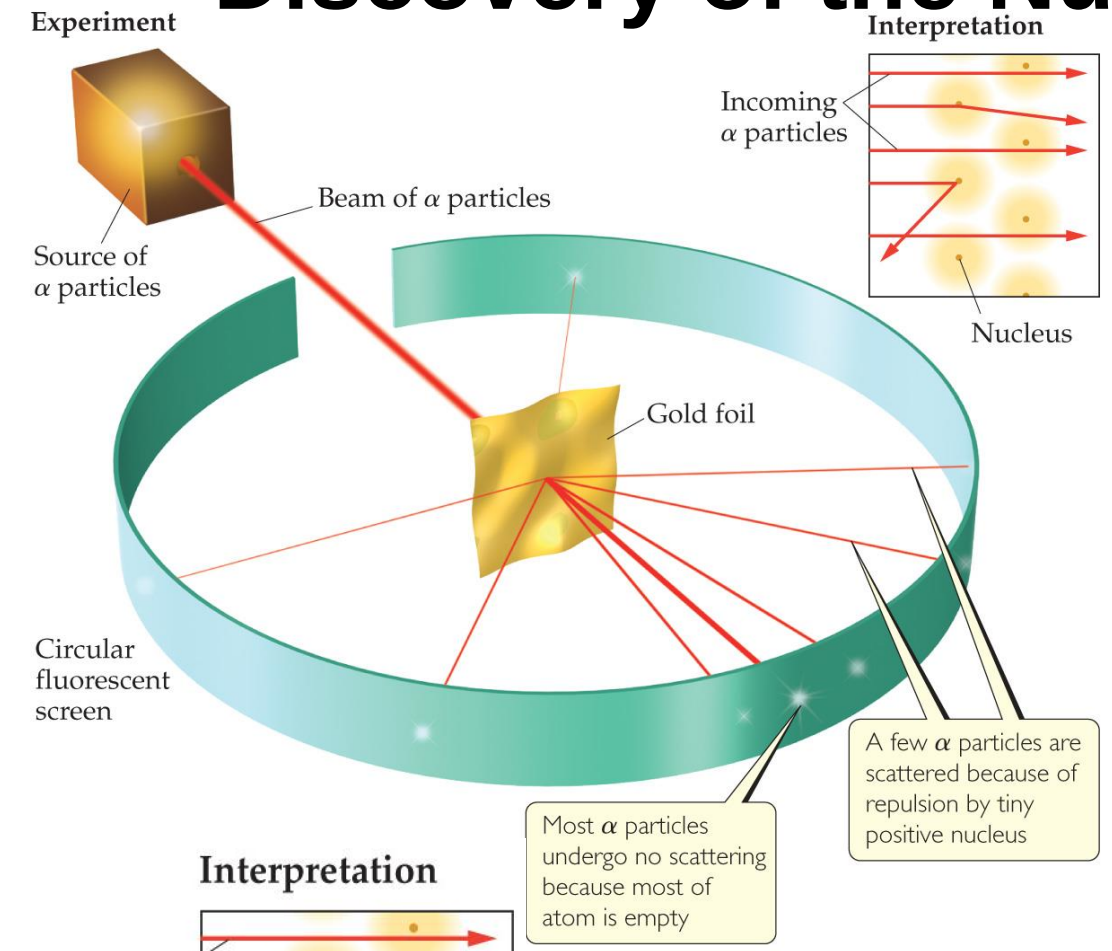

Separation of Alpha,
Beta, and Gamma Rays

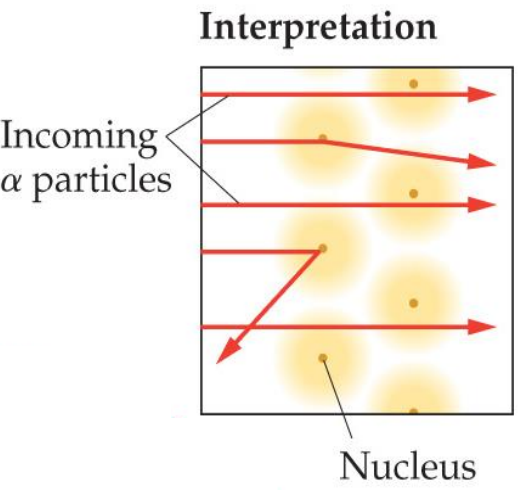
Thomson's Model of the Atom (~1900)



- The prevailing (流行) theory was the "plum pudding" (葡萄干布丁) model (by Thomson).
- Featured a uniform positive sphere of matter with negative electrons imbedded in it.

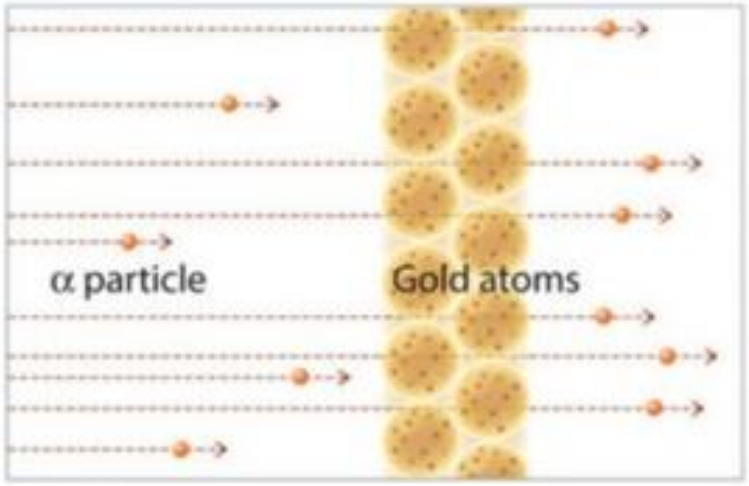
Discovery of the Nucleus (原子核)



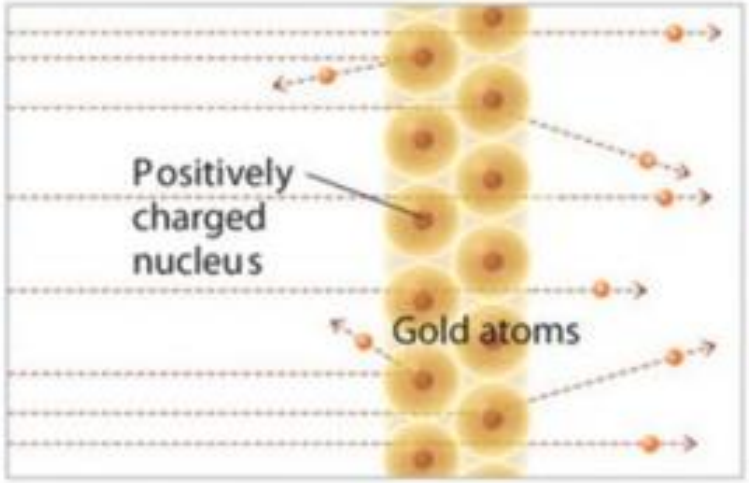


- Rutherford shot α particles at a thin sheet of gold foil, observed the pattern of **scatter of the particles** & **proposed nucleus**.

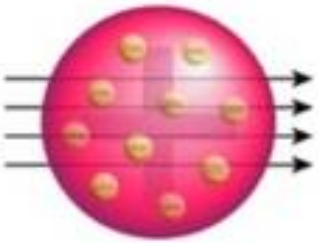
- As some particles were deflected (偏斜) at large angles, Thomson's model could not be correct.

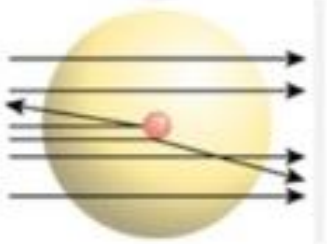


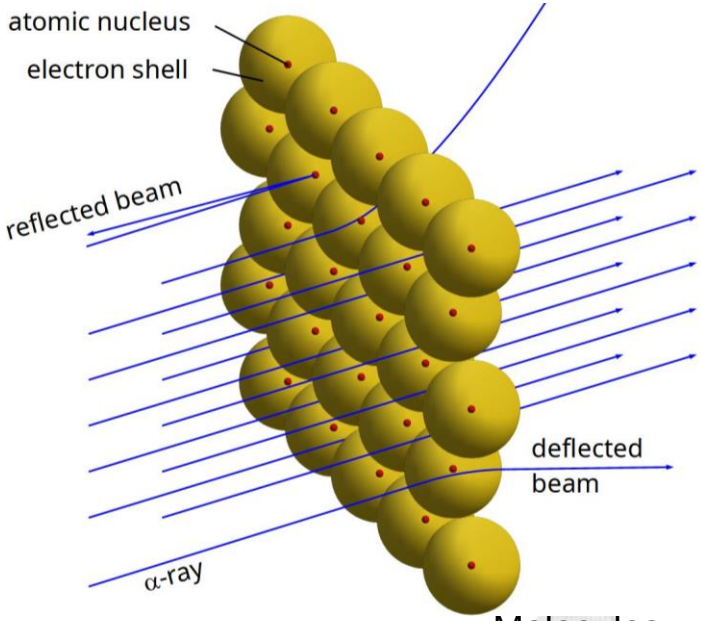
(b) What Rutherford expected if Thomson's model were correct

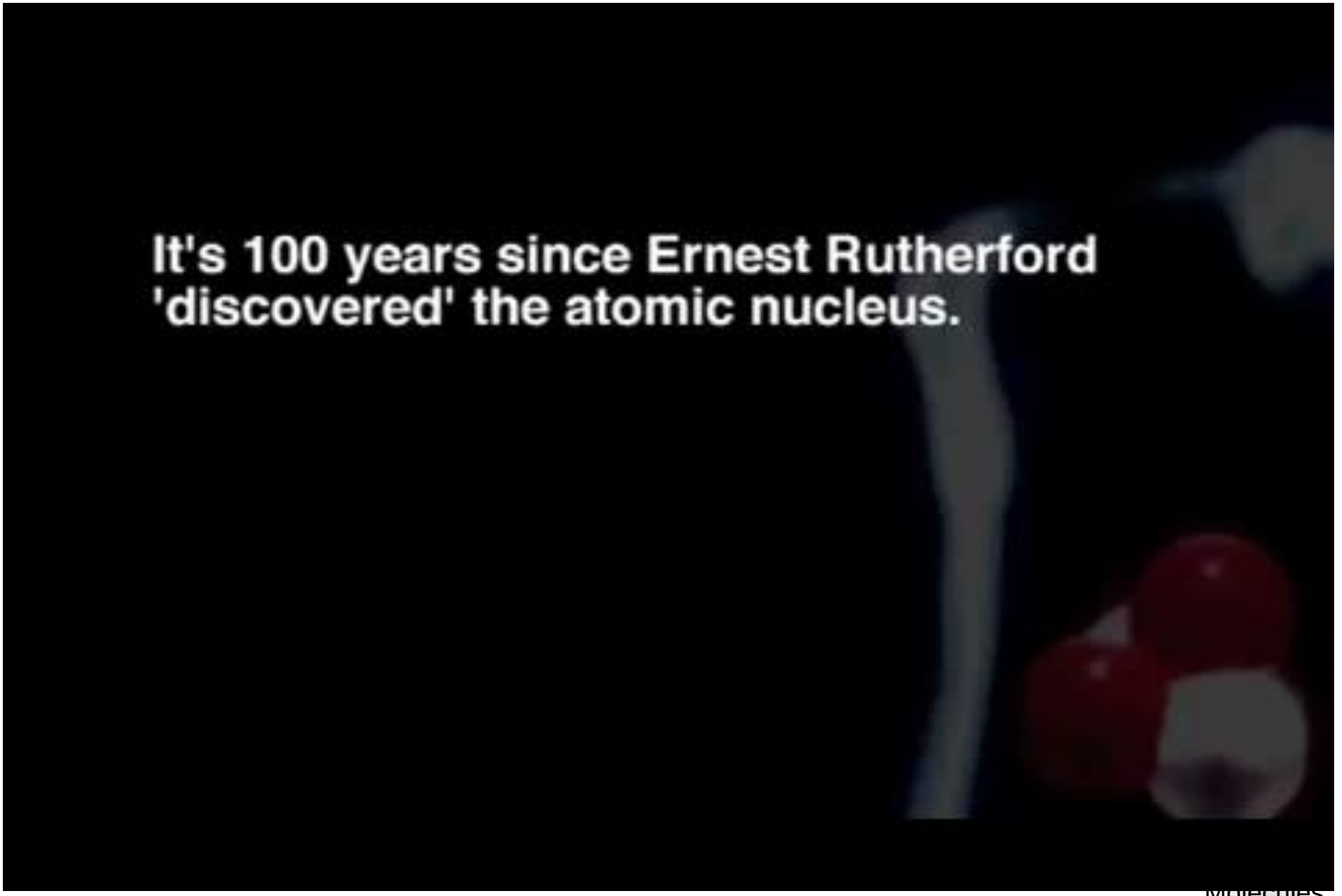


(c) What Rutherford actually observed



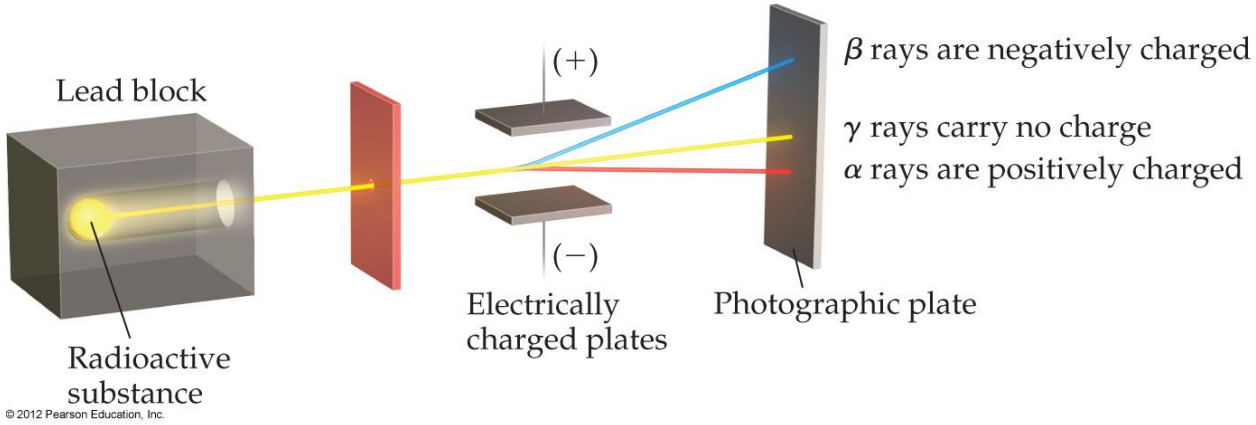





It's 100 years since Ernest Rutherford
'discovered' the atomic nucleus.

Which of the three kinds of radiation consists of electrons?

A. β
B. γ
C. α
D. (A) and (C)



Why more extend deflection of these rays?

A. β particles are negatively charged
B. α particles are positively charged
C. α particles are less massive than β particles
D. β particles are less massive than α particles

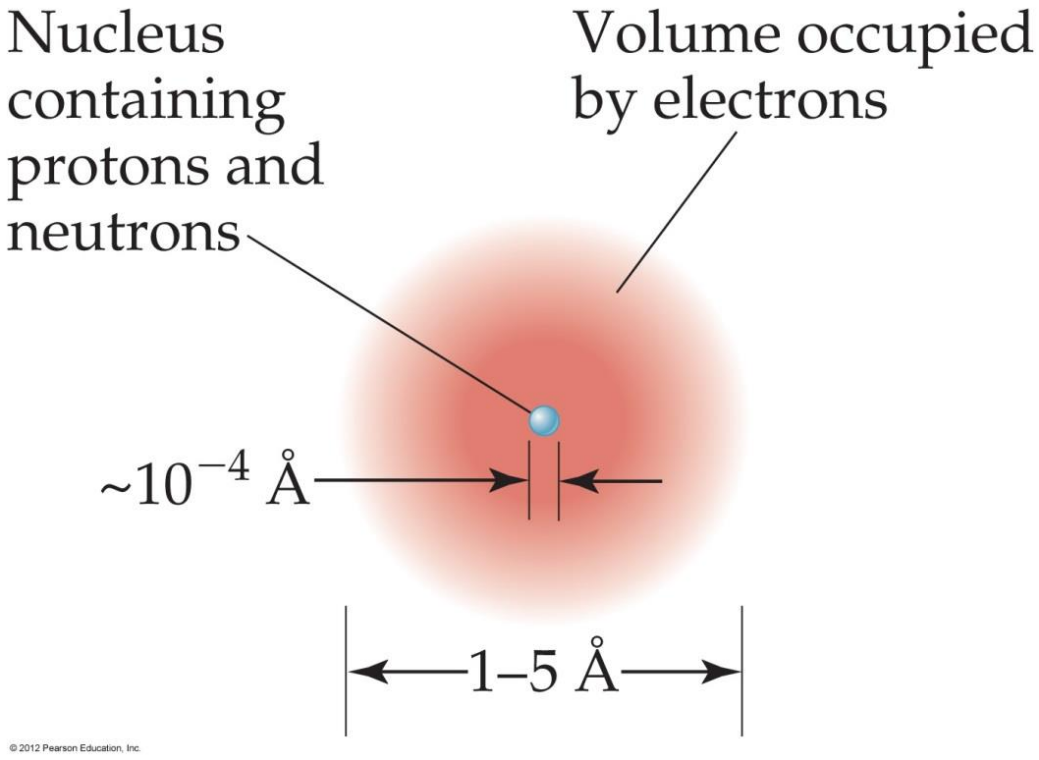
The Modern View of Atomic Structure

The Structure of the Atom

- Rutherford postulated a **very small, dense nucleus** with the electrons around the outside of the atom.

- Most of the volume of the atom is **empty space**.

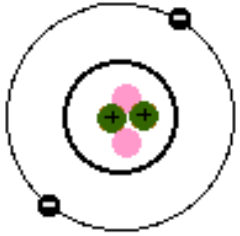
- The electrons play the major role in chemical reactions.



1 Å = 1×10^{-10} m

1 nm = 1×10^{-9} m

Other Subatomic Particles



- Protons (质子) was discovered by Rutherford (1919); Neutrons (中子) was discovered by Chadwick (1932).

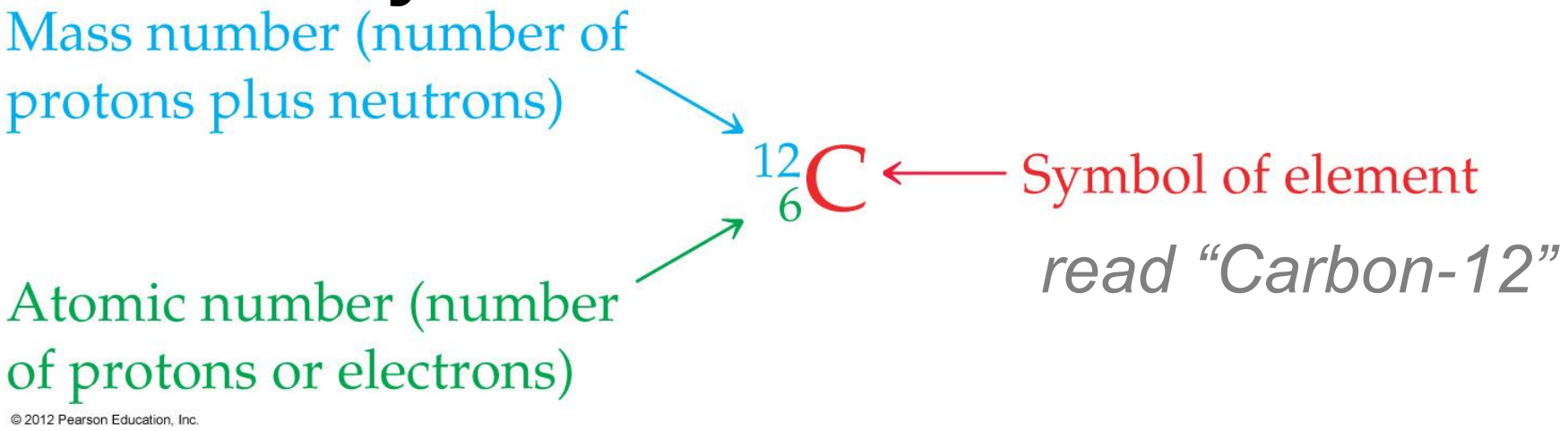
- **Protons & electrons**: the only particles that **have a charge** (but NOT neutrons).
- **Protons & neutrons**: essentially the **same mass;** whereas the mass of an electron is very small.

Atomic Mass Unit: (amu)

Particle	Charge	Mass (amu)
Proton	Positive (1+)	1.0073
Neutron	None (neutral)	1.0087
Electron	Negative (1−)	5.486×10^{-4}

1 amu = $1.66054*10^{-24}$g

Symbols of Elements



Elements are symbolized by one or two letters (e.g. C).

All atoms of the **same element** have the **same number of protons**, which is called the **atomic number**, *Z* (e.g. 6); **Different elements** have **different numbers of protons**.

The mass of an atom (called mass number) in atomic mass units (amu): the total number of protons & neutrons in the nucleus (e.g. 12).

Isotopes (同位素)

- **Isotopes:** atoms of the **same element** with **different masses**, due to **different numbers of neutrons**.

Symbol	Number of Protons	Number of Electrons	Number of Neutrons
^{11}C	6	6	5
^{12}C	6	6	6
^{13}C	6	6	7
^{14}C	6	6	8

*Almost 99% of the carbon found in nature is ^{12}C.

a. If an atom has 15 protons, how many electrons does it have?

b. Where do the protons reside in an atom?

a.

A. Cannot determine number of electrons without additional information.

B. The atom has 30 electrons.

C. The atom has 15 electrons.

D. The atom has no electrons unless it is charged.

b.

A. The protons reside in the nucleus of the atom.

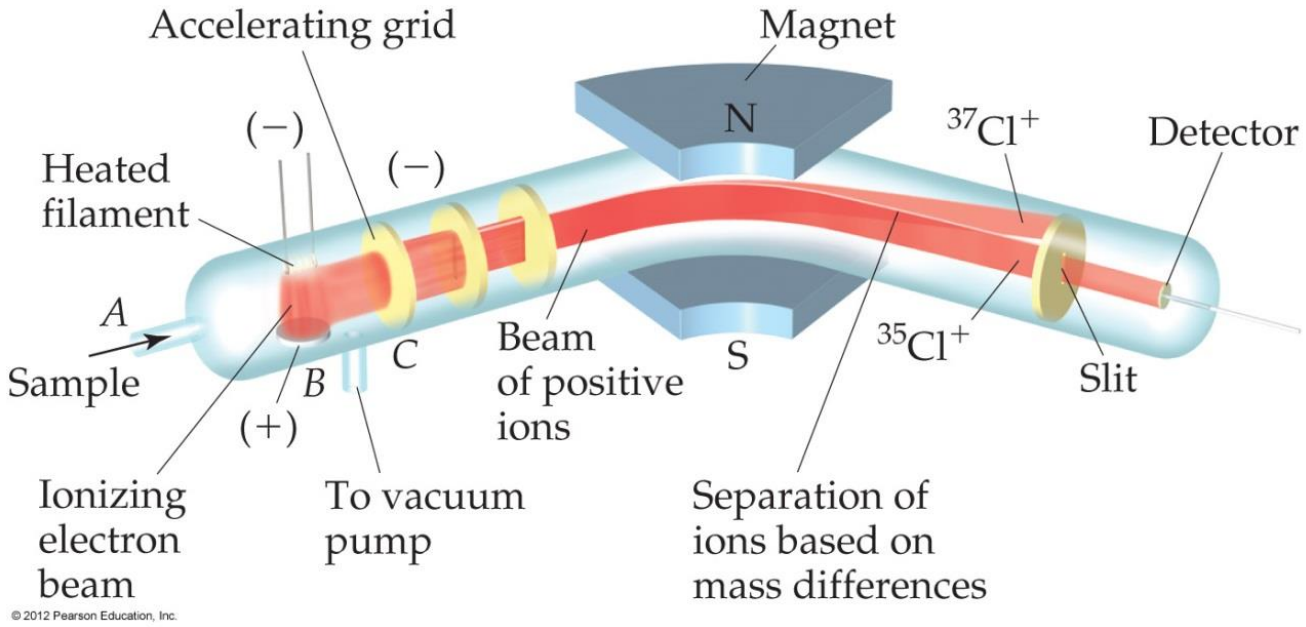
B. The protons are evenly distributed throughout the atom.

C. The protons are dispersed with the electrons around the nucleus.

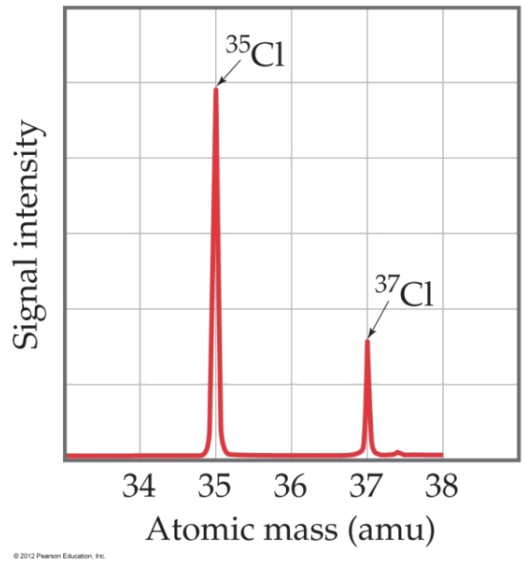
D. The protons reside in a shell just outside the nucleus.

Atomic Weights

Atomic Mass



Atomic & molecular masses can be measured with great accuracy by a mass spectrometer (MS, 质谱仪).



Exact atomic mass for **^{12}C**: **12** amu

Atomic mass for **^{1}H**: 1.0078 amu

Atomic Weight (Average Atomic Mass)

- **Atomic Weight** of an element is calculated from the isotopes of the element weighted by their relative abundances.

Atomic weight = Σ(isotope mass)*(relative ratio)

Mg: 23.98504*0.7899 + 24.98584*0.1 + 25.98259*0.1101

Isotope	Abundance	Atomic mass (amu)
^{24}Mg	78.99 %	23.98504
^{25}Mg	10.00 %	24.98584
^{26}Mg	11.01 %	25.98259

C: 12*0.9893 + 13.00335*0.0107 = 12.01 amu

A particular atom of chromium has a mass of 52.94 amu, whereas the atomic weight of chromium is 51.99 amu. Explain the difference in the two masses.

A. The 52.94 amu value and the 51.99 amu value represent two different isotopes of chromium.

B. The atomic weight of chromium does not depend on the atom with a mass of 52.94 amu.

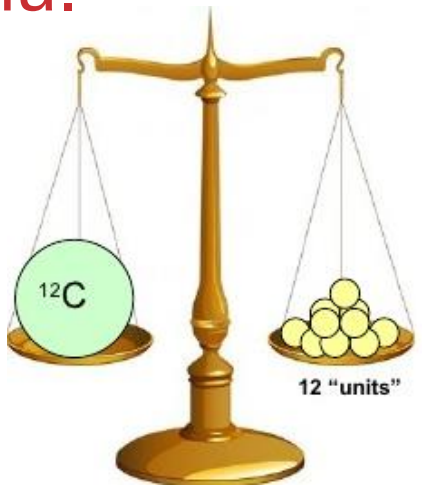
C. The atomic weight of 51.99 amu is for a different isotope than the 52.94 amu mass.

D. The atomic weight of chromium (51.99 amu) is an average atomic mass of all the naturally occurring isotopes of chromium.

(Relative) Atomic Mass (A.M.)

1 atomic mass unit (amu): **1/12** of the mass of **a ^{12}C atom exactly**; The relative atomic mass (RAM) of other elements is their mass relative to 1 amu.

$$RAM = \frac{\text{Mass of one atom of the element}}{\left(\frac{1}{12}\right)\text{Mass of one atom of carbon } (C^{12})}$$



A.M. for proton & neutron: 1.0073 &1.0087

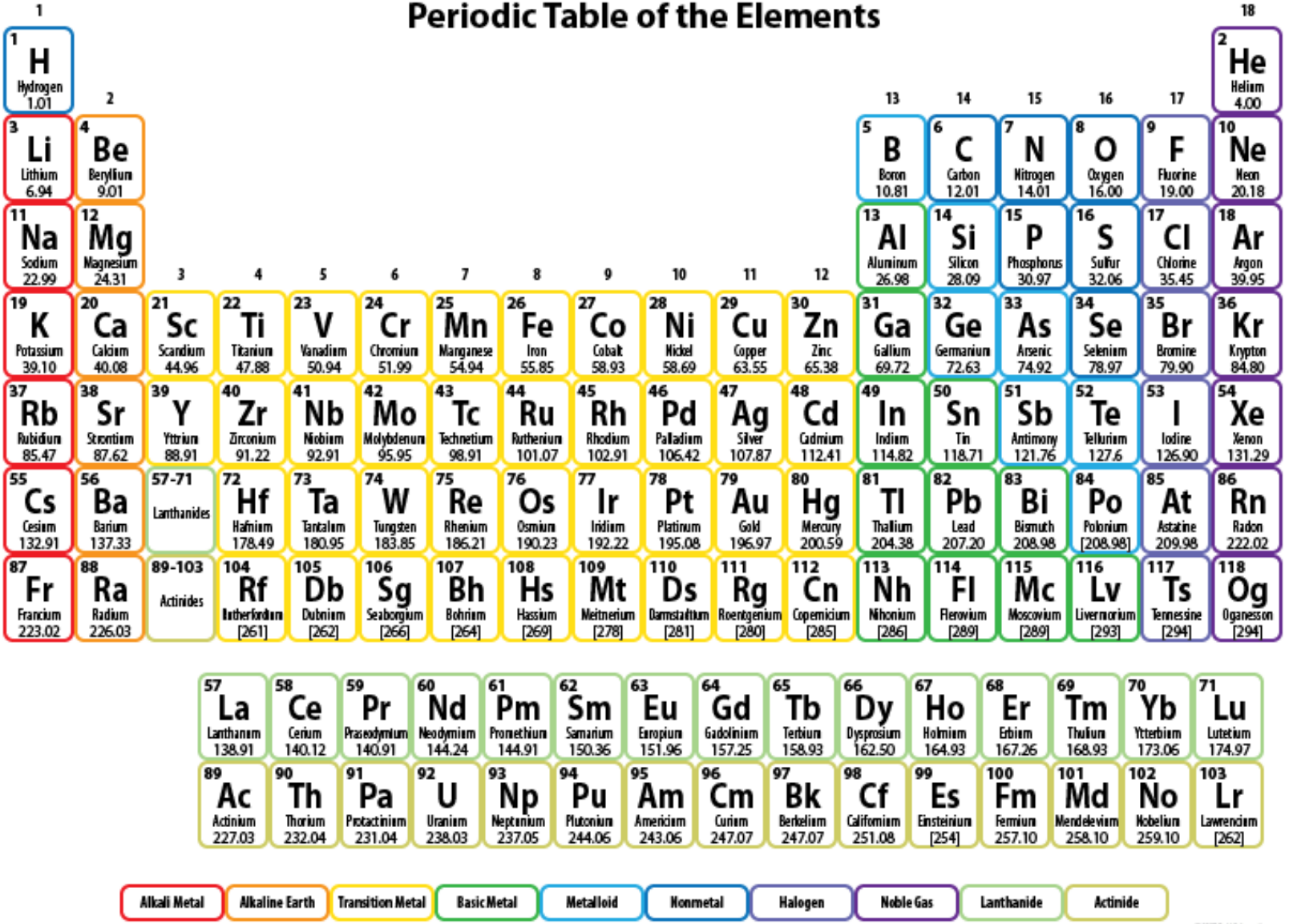
A.M. for ^{12}C = ***12.0*** *(exact)* **<** *6*(1.0073 + 1.0087)*

= ***12.096****!*

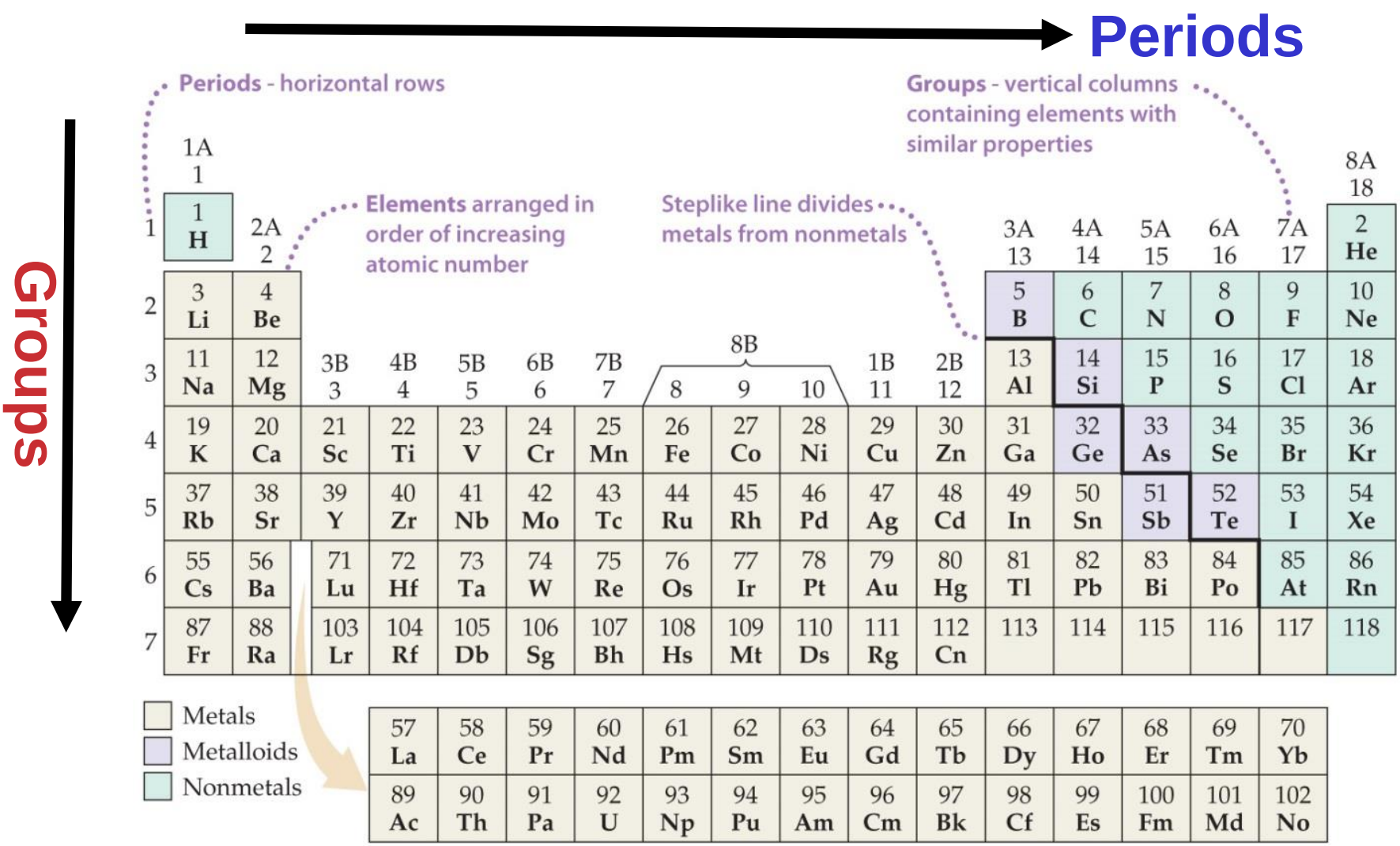
Extra Info. (Not included in the exam): A.M. of atoms is reduced ("mass defect"), compared to their isolated nuclei, due to nuclear binding energy mass loss ($E = mc^2$).

The Periodic Table

(learn more from Chapter 7)

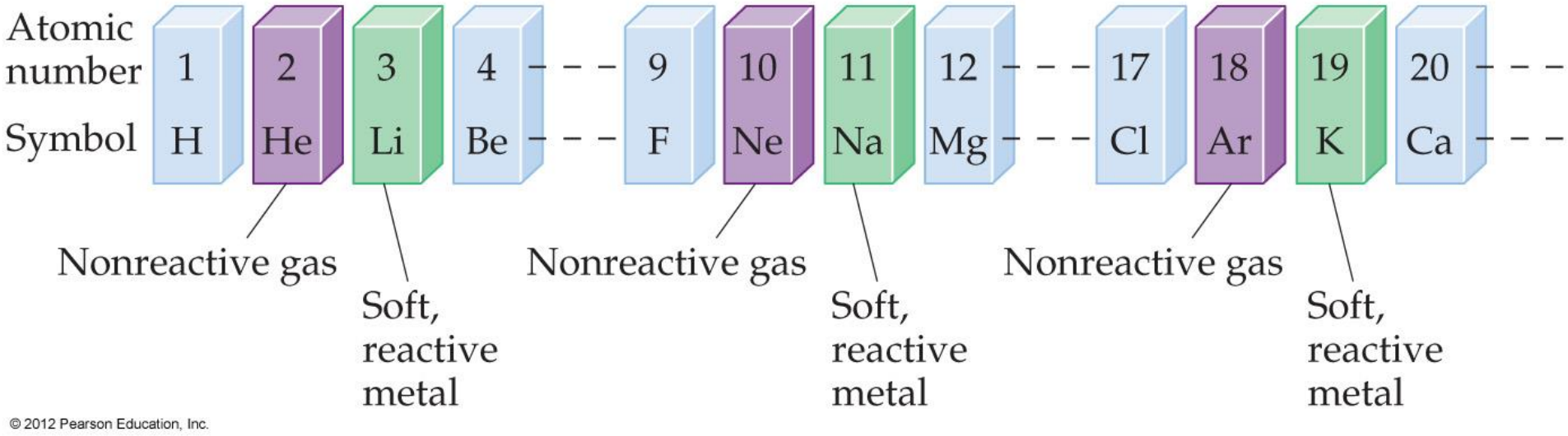


- The **periodic table**: a systematic catalog of **elements**.
- Elements are arranged in order of atomic number.



- The rows on the periodic chart are **periods** (周期).
- Columns are **groups** (族).
- Elements in the **same group**: **similar** chemical properties generally.

Periodicity (周期性)

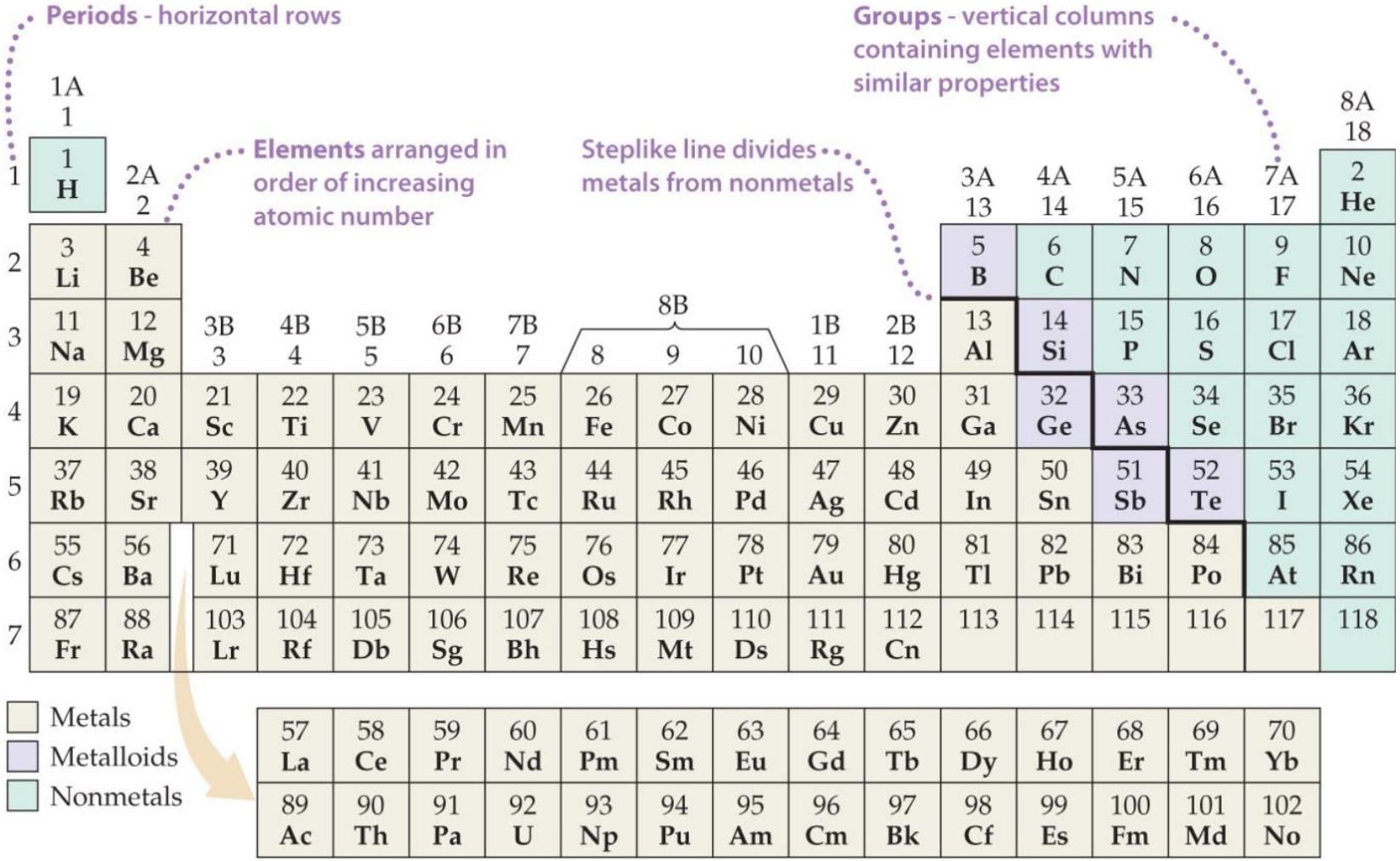


When one looks at the chemical properties of elements, one notices a repeating pattern of reactivities (活性).

Groups

Group		Name	Elements
1A	碱金属族	Alkali metals	Li, Na, K, Rb, Cs, Fr
2A	碱土金属族	Alkaline earth metals	Be, Mg, Ca, Sr, Ba, Ra
6A	氧族	Chalcogens	O, S, Se, Te, Po
7A	卤族	Halogens	F, Cl, Br, I, At
8A	稀有气体族	Noble gases (or rare gases)	He, Ne, Ar, Kr, Xe, Rn

These five groups are known by their names.



Nonmetals: **Right** side (with the exception of H).

Metalloids (类金属): border the **stair-step line** (with the exception of Al, Po, and At).

Metals: **Left** side.

If F is a reactive nonmetal, which other element or elements shown here do you expect to also be a reactive nonmetal?

A. He and Ar
B. Be and Ca
C. I and Cl
D. Ne and Ar

Molecules and Molecular Compounds

Chemical Formulas (方程式)

Hydrogen, H_2

Oxygen, O_2

Water, H_2O

Hydrogen peroxide, H_2O_2

Carbon monoxide, CO

Carbon dioxide, CO_2

Methane, CH_4

Ethylene, C_2H_4

Molecular compounds are composed of molecules and almost always **contain only (two or more) nonmetals**.

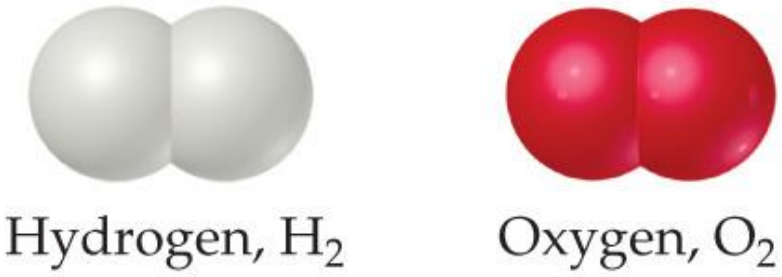
The **subscript** (下标) to the right of the **symbol of an element**: the number (**integral**) of atoms of that element in one molecule of the compound (→ composition).

e.g. H_2 ➔ 2 H atoms

Diatomic Molecules (双原子分子)

- These seven elements occur naturally as molecules containing two atoms:

Hydrogen (H_2)
Nitrogen (N_2)
Oxygen (O_2)
Fluorine (F_2)
Chlorine (Cl_2)
Bromine (Br_2)
Iodine (I_2)



Types of Formulas

- **Empirical formulas** (实验式): the **lowest whole number ratio** (整数比) of atoms of each element in a compound (generally for **ionic and metallic** compounds).

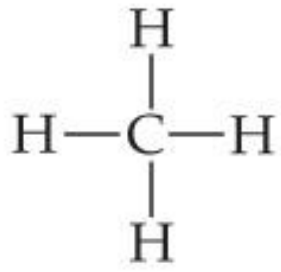
- **Molecular formulas** (分子式): the **exact number** of atoms of each element in a **molecular compound** (generally **NOT for ionic and metallic** compounds).

e.g. $H_2O_2 \leftrightarrow HO$ $H_2O \leftrightarrow H_2O$

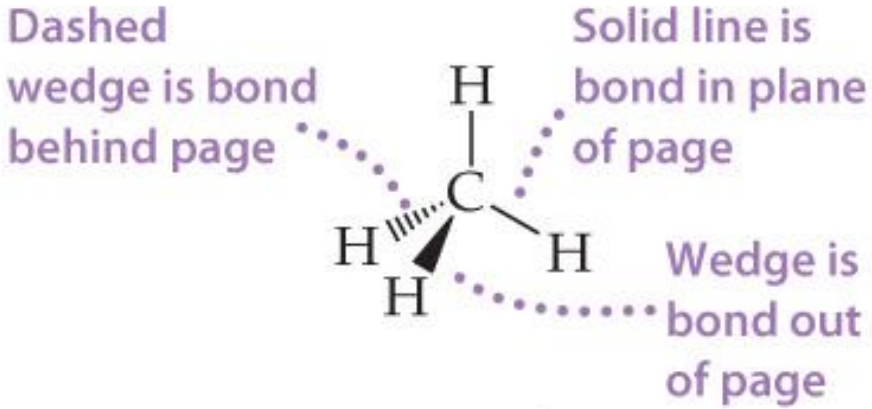
$C_2H_6 \leftrightarrow CH_3$ $C_6H_6 \leftrightarrow CH$

CH_4

Molecular formula

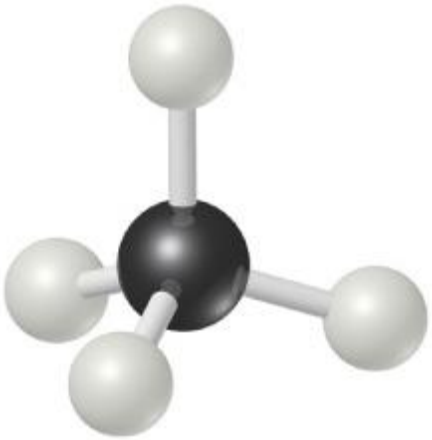


Structural formula

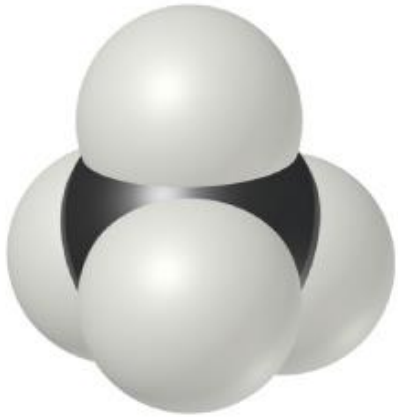


Perspective drawing

- **Structural formulas** show the order in which atoms are bonded.
- **Perspective drawings** show the 3-dimensional array of atoms in a compound.

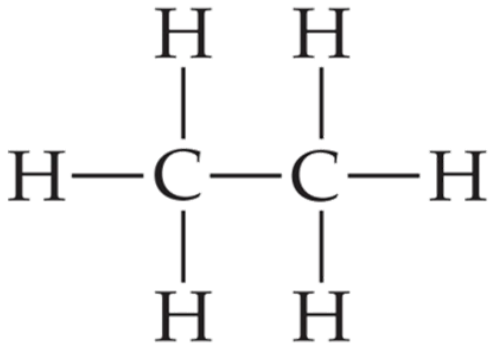


Ball-and-stick model



Space-filling model

The structural formula for ethane is



a. What is the molecular formula for ethane?
b. What is its empirical formula?
c. Which kind of molecular model would most clearly show the angles between atoms?

a.

A. CH
B. CH_3
C. CH_6
D. C_2H_6

b.

A. CH
B. CH_3
C. C_2H_2
D. CH_6

c.

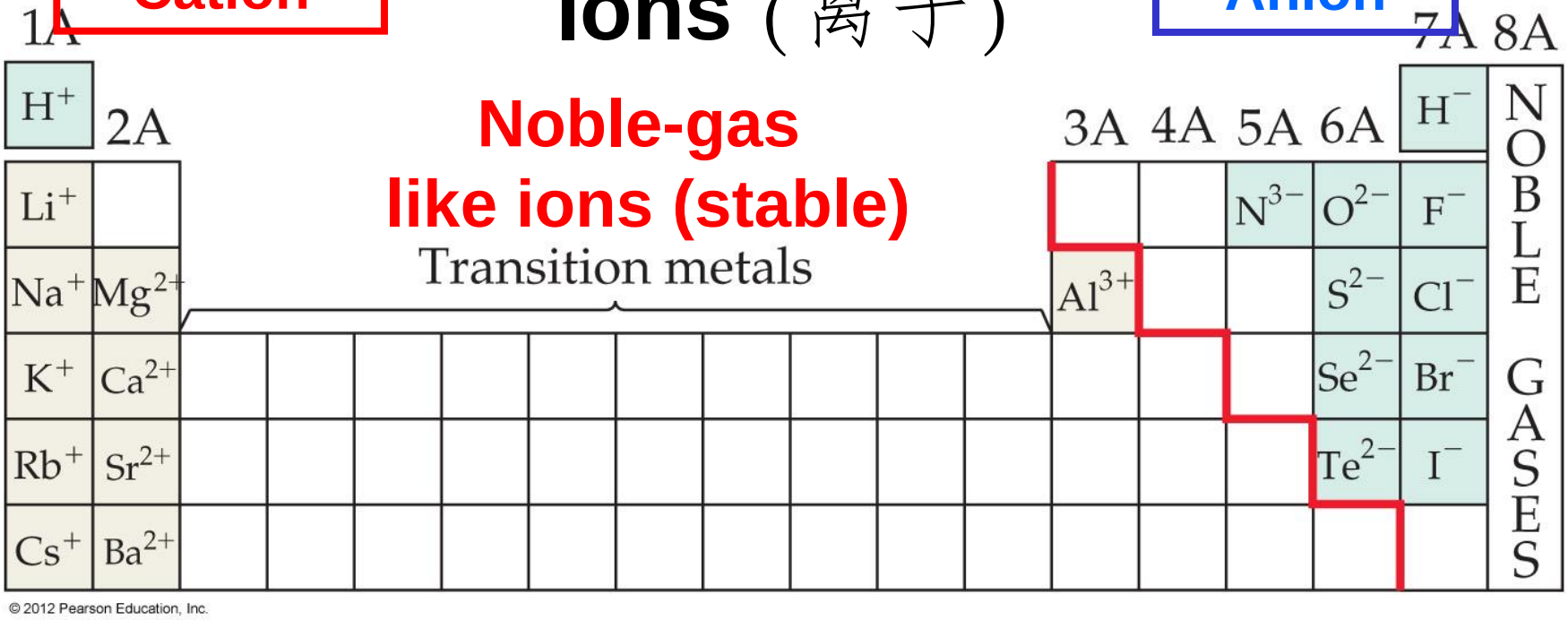
A. perspective model
B. visual depth model
C. ball and stick model
D. space-filling model

Ions and Ionic Compounds

Cation

Ions（离子）

Anion



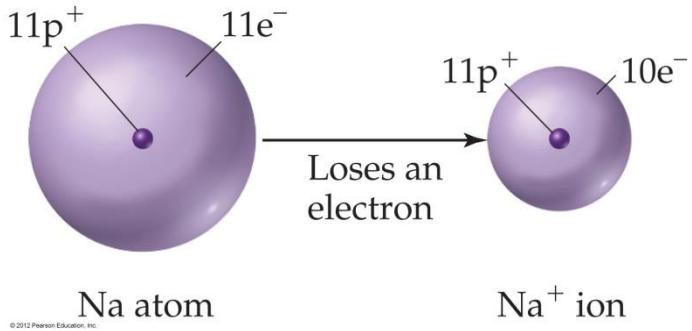
Noble-gas like ions (stable)

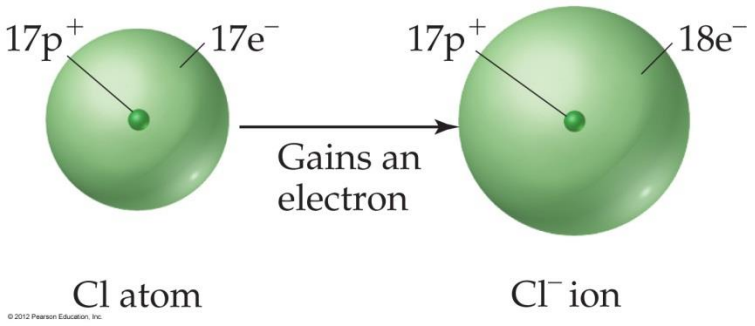
- When atoms **lose or gain electrons**, they become **ions** (***different chemical properties/*behaviors** from neutral atoms).
- **Cations** (loss): **positive** & formed by elements on the **left side**.
- **Anions** (gain): **negative** & formed by elements on the **right side**.

Molecules → polyatomic ions

Ionic Bonds (via Electrostatic)

Ionic compounds (such as NaCl) are generally formed between **metals (cation)** & **nonmetals (anion)**.





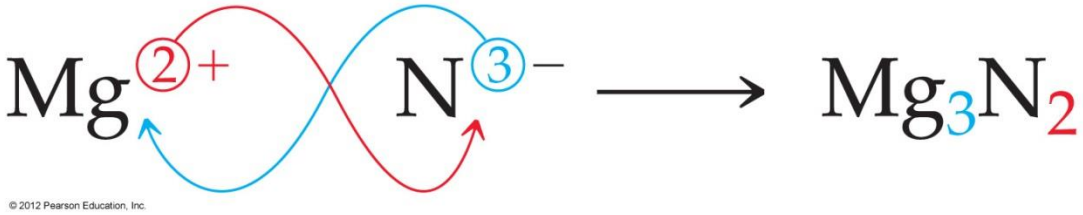
1A												3A	4A	5A	6A	7A	8A
H	2A						8B			1B	2B						He
Li	Be											B	C	N	O	F	Ne
Na	Mg	3B	4B	5B	6B	7B	8	9	10	1B	2B	Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe

6 most abundant essential elements

5 next most abundant essential elements

elements needed only in trace quantities

Writing Formulas



• As **compounds** are generally **electrically neutral**, one can determine the formula of a compound as follows:

1. The **charge** on the **cation** becomes the **subscript** on the **anion**.
2. The **charge** on the **anion** becomes the **subscript** on the **cation**.
3. If these subscripts are not in the lowest whole-number ratio, divide them by the **greatest common factor** (no molecular formulas for ionic lattice: **empirical formulas**).

The elements found on the left side of the periodic table tend to _____ electrons.

a. gain
b. lose
c. keep
d. share

Why don't we write the formula for the compound formed by Ca^{2+} and O^{2-} as Ca_2O_2?

A. The formula for calcium oxide is actually Ca_2O.

B. The number of Ca^{2+} ions paired with O^{2-} ions in a compound can vary.

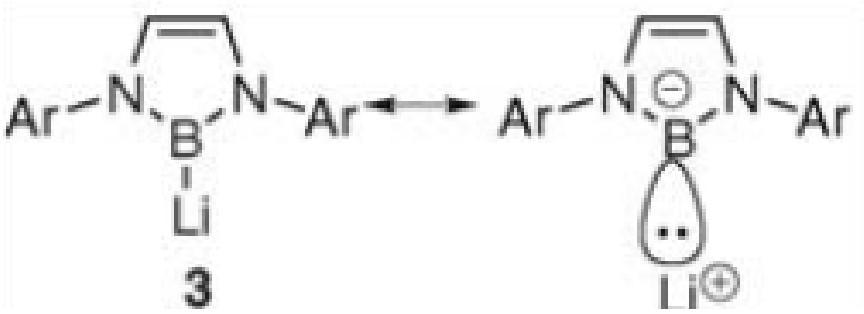
C. Two Ca^{2+} ions can never be found in nature with an O^{2-} ion.

D. Empirical formulas are used for ionic compounds.

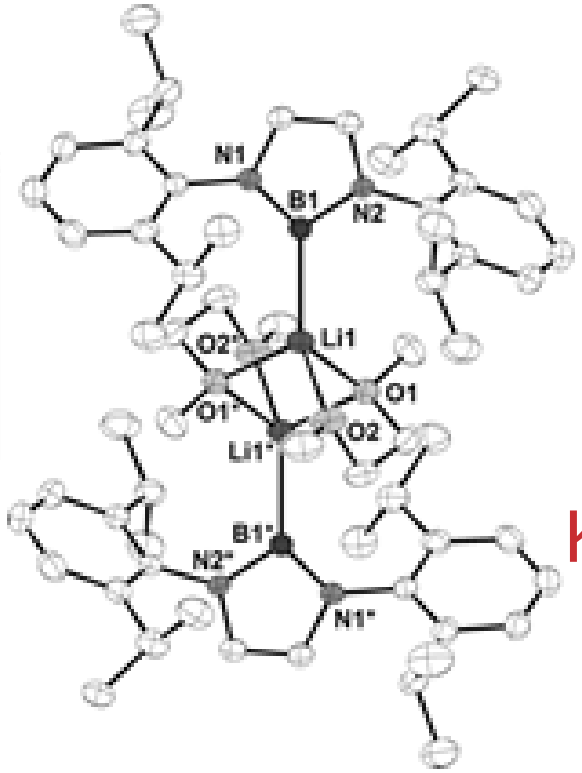
Isolation of a Boryl Anion (Extra Info.: Not included in the exam)

Boryllithium: Isolation, Characterization, and Reactivity as a Boryl Anion

Yasutomo Segawa *et al.*
Science **314**, 113 (2006);
DOI: 10.1126/science.1131914

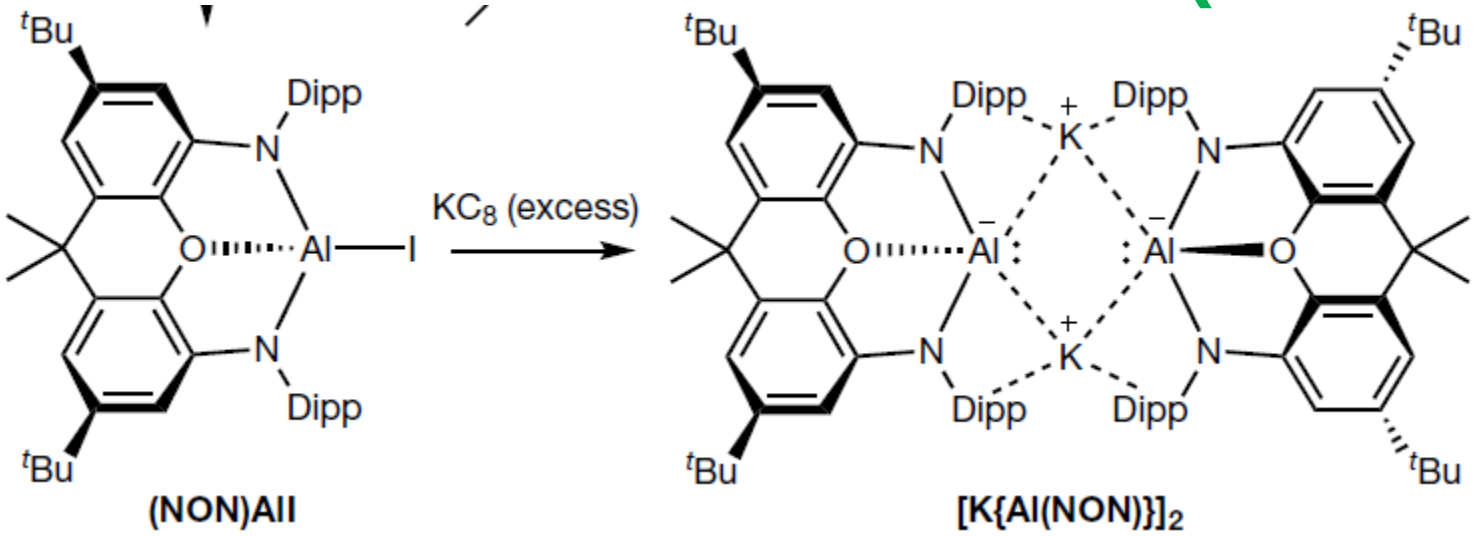


Boryl anion



Kyoko Nozaki
(Tokyo U)

Isolation of a Al Anion (Extra Info.)

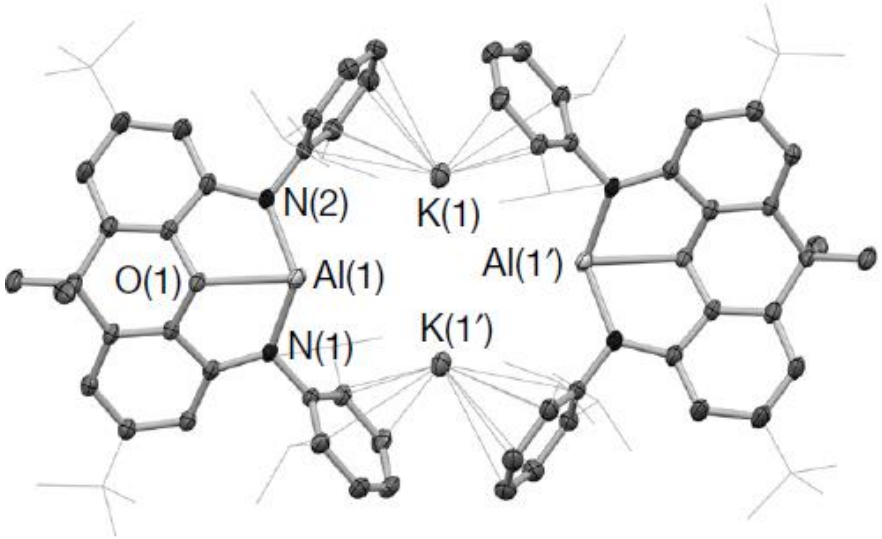


Al(I) anion

Synthesis, structure and reaction chemistry of a nucleophilic aluminyl anion

Jamie Hicks[1], Petra Vasko[1,2], Jose M. Goicoechea[1]* & Simon Aldridge[1]*

Simon Aldridge
(U of Oxford)



Naming of Inorganic Compounds

Inorganic Nomenclature (命名)

1. Write the **name** of the **element** for the **metal cation**, e.g. iron, sodium; For **non-metal cation** (**end** in -ium): ammonium ion (NH_4^+) and hydronium ion (H_3O^+).

2. If the **cation** (e.g. **transition metals**) can have **more than one possible charge**, write the charge as a **Roman numeral** (罗马数字) **in parentheses** (括号).

$FeSO_4$, Fe^{2+} and SO_4^{2-} Iron(II) sulfate (硫酸盐)

$Fe_2(SO_4)_3$, Fe^{3+} and SO_4^{2-} Iron(III) sulfate

3. For the **anion** of an **element**, change its ending to ***-ide***. E.g.

Fe_2O_3, Fe^{3+} and O^{2-} Iron(III) oxide

Naming for Common Cations

Charge	Formula	Name	Formula	Name
1+	**H^+**	**hydrogen ion**	**NH_4^+**	**ammonium ion**
	Li^+	lithium ion	Cu^+	copper(I) or cuprous ion
	Na^+	**sodium ion**		
	K^+	**potassium ion**		
	Cs^+	cesium ion		
	Ag^+	**silver ion**		
2+	**Mg^{2+}**	**magnesium ion**	Co^{2+}	cobalt(II) or cobaltous ion
	Ca^{2+}	**calcium ion**	**Cu^{2+}**	**copper(II)** or cupric ion
	Sr^{2+}	strontium ion	**Fe^{2+}**	**iron(II)** or ferrous ion
	Ba^{2+}	barium ion	Mn^{2+}	manganese(II) or manganous ion
	Zn^{2+}	**zinc ion**	Hg_2^{2+}	mercury(I) or mercurous ion
	Cd^{2+}	cadmium ion	**Hg^{2+}**	**mercury(II)** or mercuric ion
			Ni^{2+}	nickel(II) or nickelous ion
			Pb^{2+}	**lead(II)** or plumbous ion
			Sn^{2+}	tin(II) or stannous ion
3+	**Al^{3+}**	**aluminum ion**	Cr^{3+}	chromium(III) or chromic ion
			Fe^{3+}	**iron(III)** or ferric ion

NH_4^+: *polyatomic ion*

(多原子离子)

*The ions we use most often in this course are in boldface. Learn them first.

Patterns in Oxyanion Nomenclature

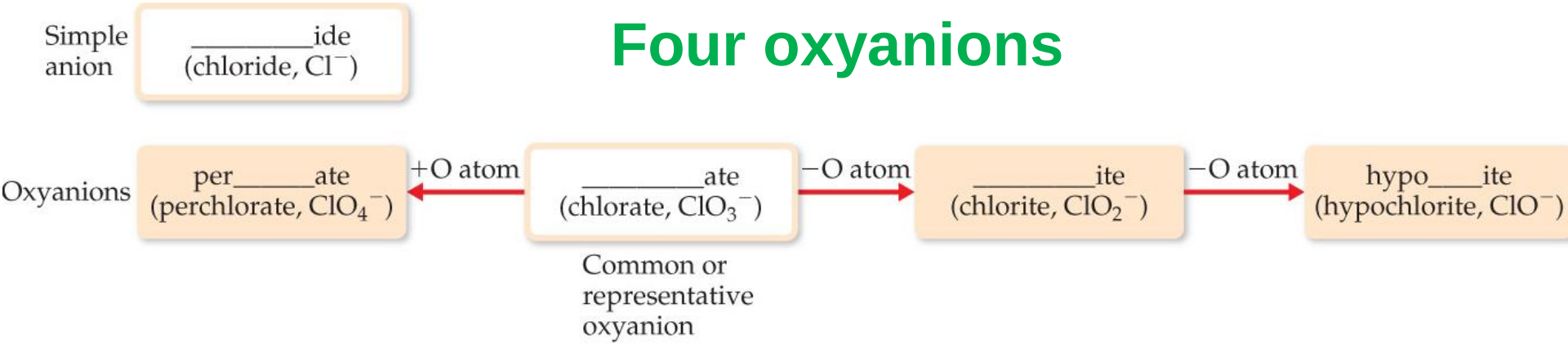
- When there are **two** **oxyanions** involving the **same element**:
  1. **Fewer** oxygens, ends in ***-ite***.
  2. **More** oxygens, ends in ***-ate***.

e.g.

- NO_2^- : nitrite; SO_3^{2-} : sulfite
- NO_3^- : nitrate; SO_4^{2-} : sulfate

HCO_3^- : **hydrogen** carbonate
$H_2PO_4^-$: **dihydrogen** phosphate

Four oxyanions



1. The second fewest oxygens, **ends** in ***-ite***.
2. The second most oxygens, **ends** in ***-ate***.

ClO_2^- : chlorite; ClO_3^- : chlorate

3. The fewest oxygens, add **prefix *hypo-*** and **ends** in ***-ite***.
4. The most oxygens, add **prefix *per-*** and **ends** in ***-ate***.

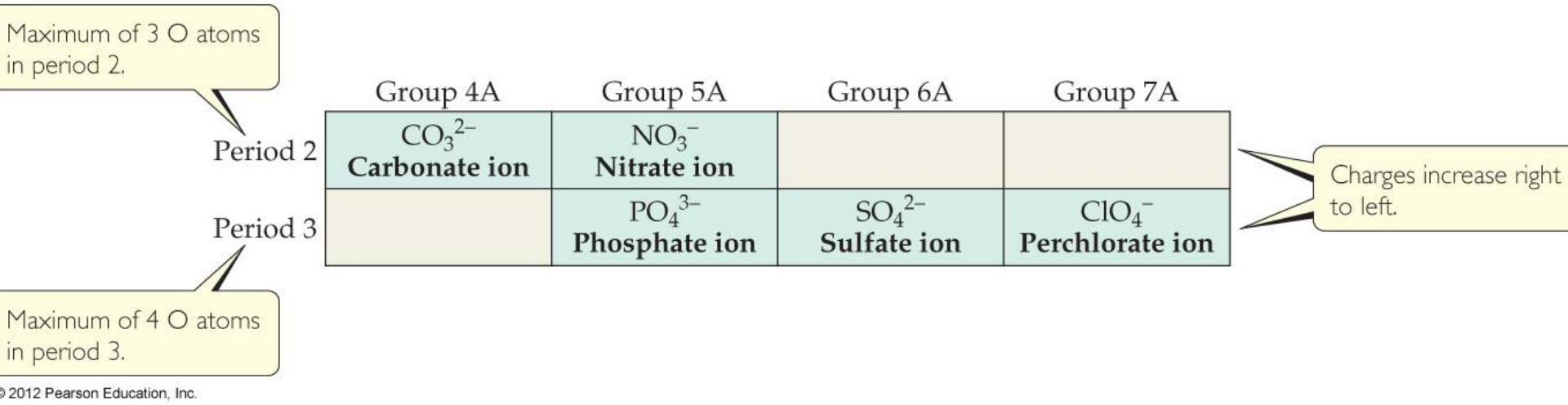
ClO^- : hypochlorite; ClO_4^- : perchlorate

Order: per-…-ate > …-ate > …-ite > hypo-…-ite

Naming for Common Anions

Charge	Formula	Name	Formula	Name
1−	H^-	hydride ion	**CH_3COO^-** (or $C_2H_3O_2^-$)	**acetate ion**
	F^-	**fluoride ion**	ClO_3^-	chlorate ion
	Cl^-	**chloride ion**	**ClO_4^-**	**perchlorate ion**
	Br^-	**bromide ion**	**NO_3^-**	**nitrate ion**
	I^-	**iodide ion**	MnO_4^-	permanganate ion
	CN^-	cyanide ion		
	OH^-	**hydroxide ion**		
2−	**O^{2-}**	**oxide ion**	**CO_3^{2-}**	**carbonate ion**
	O_2^{2-}	peroxide ion	CrO_4^{2-}	chromate ion
	S^{2-}	**sulfide ion**	$Cr_2O_7^{2-}$	dichromate ion
			SO_4^{2-}	**sulfate ion**
3−	N^{3-}	nitride ion	**PO_4^{3-}**	**phosphate ion**

*The ions we use most often are in boldface. Learn them first.



- Central atoms on the **second row** can form bonds with **at most three** oxygens; those on the **third row can** take up to **four oxygens**.
- **Negative charges increase** from *right* to *left*.

Predict the formulas for the borate ion and silicate ion, assuming they contain a single B and Si atom, respectively, and follow the trends shown in Figure 2.25.

A. BO_4^{4-} and SiO_3^{3-}

B. BO_3^{3-} and SiO_4^{4-}

C. BO_4^{3-} and SiO_3^{4-}

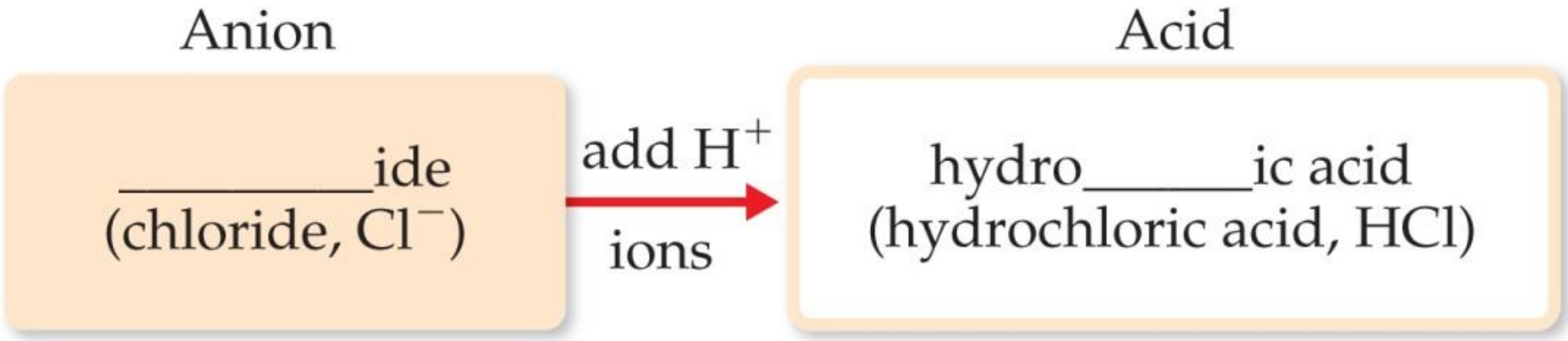
D. BO_3^{4-} and SiO_4^{3-}

atoms

	Group 4A	Group 5A	Group 6A	Group 7A
Period 2	CO_3^{2-} **Carbonate ion**	NO_3^- **Nitrate ion**		
Period 3		PO_4^{3-} **Phosphate ion**	SO_4^{2-} **Sulfate ion**	ClO_4^- **Perchlorate ion**

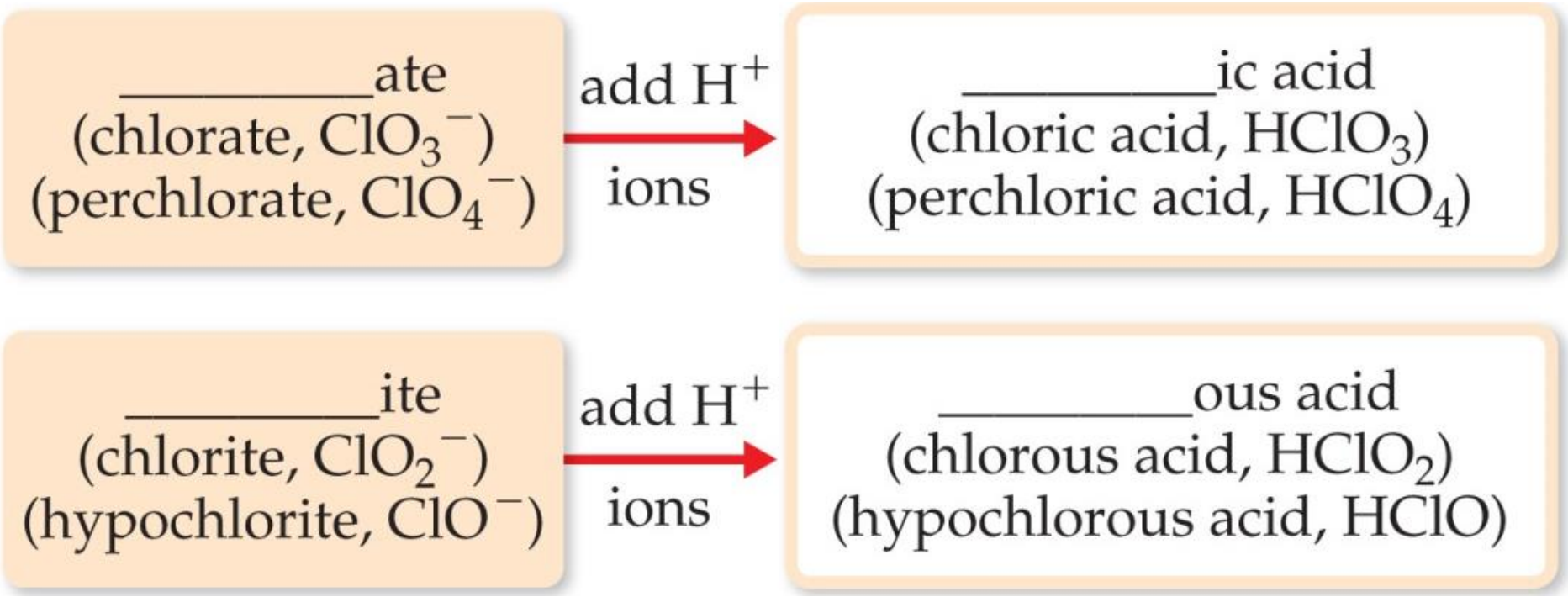
atoms

Acid Nomenclature



- If the **anion** in the **acid ends** in ***-ide***, change the ending to ***-ic acid*** and add the prefix ***hydro-***.

HCl: hydrochloric acid
HBr: hydrobromic acid
HI: hydroiodic acid



- If the anion in the **acid ends** in ***-ate***, change the ending to ***-ic acid***.

$HClO_3$: chloric acid $HClO_4$: perchloric acid

- If the anion in the **acid ends** in ***-ite***, change the ending to ***-ous acid***.

HClO: hypochlorous acid $HClO_2$: chlorous acid

Nomenclature of Binary (二元) Compounds (with nonmetals)

TABLE 2.6 • Prefixes Used in Naming Binary Compounds Formed between Nonmetals

Prefix	Meaning
Mono-	*1*
Di-	*2*
Tri-	*3*
Tetra-	*4*
Penta-	*5*
Hexa-	*6*
Hepta-	*7*
Octa-	*8*
Nona-	*9*
Deca-	*10*

- The **less electronegative** (电负性) atom is usually named **first** (except NH_3).

- A **prefix** is used to denote the **number** of atoms of each element in the compound (***mono*- is not used** on the first element listed, however). **Not usually used for ionic or metallic compounds.**

Prefix	Meaning
Mono-	*1*
Di-	*2*
Tri-	*3*
Tetra-	*4*
Penta-	*5*
Hexa-	*6*
Hepta-	*7*
Octa-	*8*
Nona-	*9*
Deca-	*10*

- The **name** of the **more electronegative** element is changed to ***-ide***.

CO_2: carbon **di**oxide
CCl_4: carbon **tetra**chloride

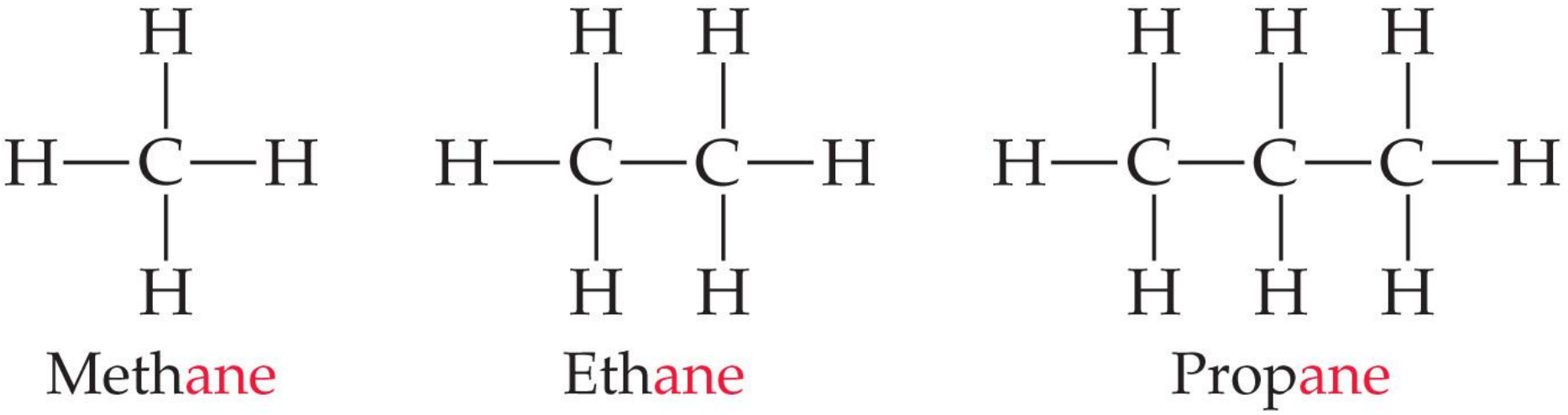
- If the **prefix ends** with ***a*** or *o* and the name of the element begins with a **vowel**, the two successive vowels are often changed into one.

CO: carbon **mon**o**o**xide
N_2O_5: **di**nitrogen **pent**o**o**xide

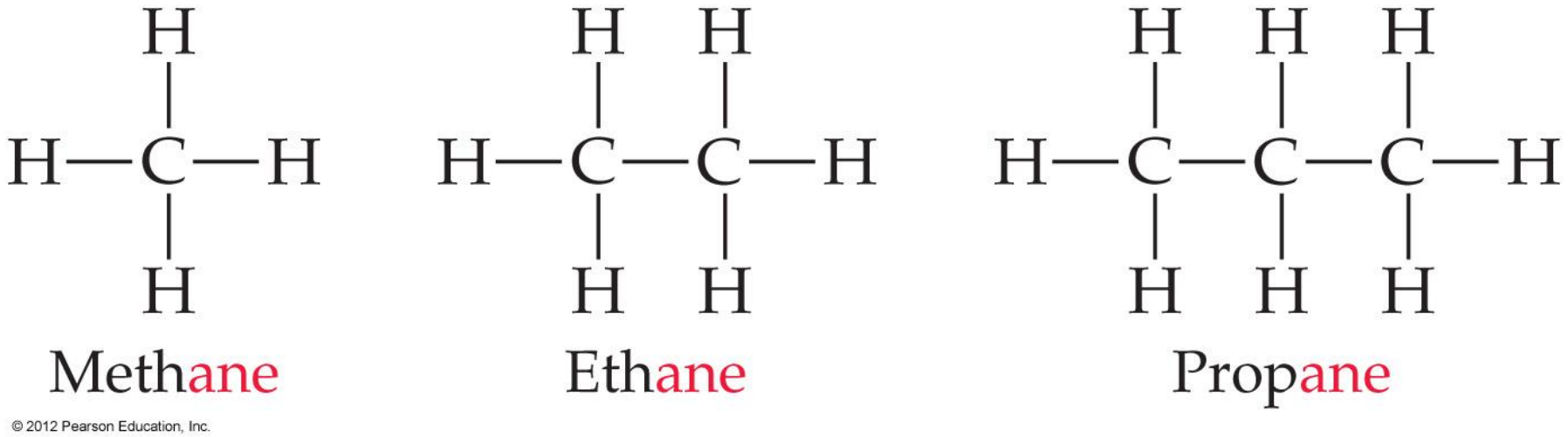
Naming of Simple Organic Compounds

Atoms, Molecules, and Ions

Nomenclature of Organic Compounds



- **Organic chemistry:** the study of compounds containing **carbon**.
- Organic chemistry: its own system of nomenclature (different from inorganic chemistry).



The **simplest hydrocarbons** (compounds containing only carbon and hydrogen) are **alkanes**: each C atom connects with 4 other atoms.

The **first** part of the names: listed the **number** (**n**) of **carbons**. E.g.

n = 1: ***meth-***; n = 2: ***eth-***;

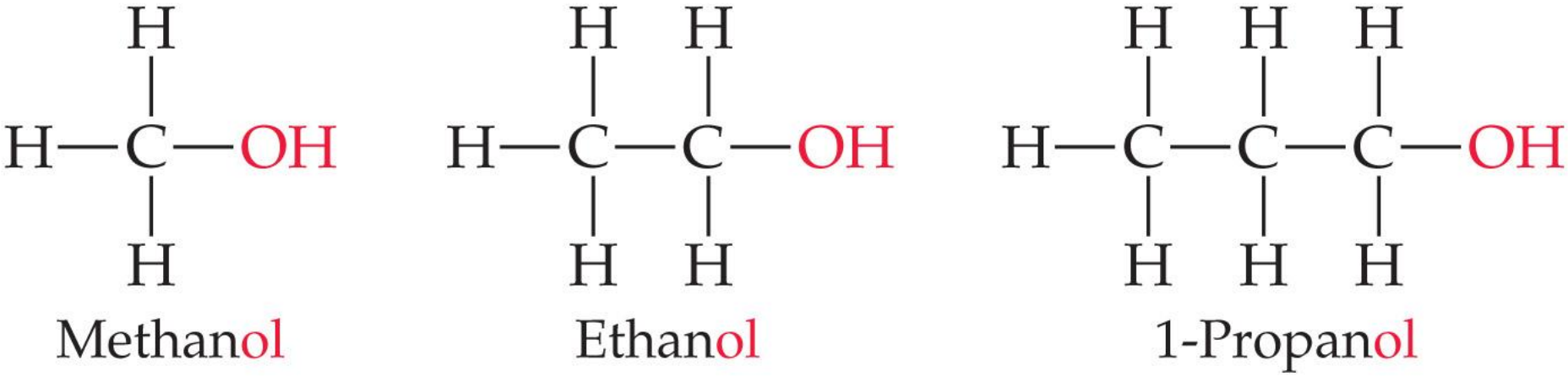
n = 3: ***prop-***; n = 4: ***but-***.

For n => 5; use prefix (right table)

n = 5: **penta-** (pentane);

n = 6: **hexa-** (hexane);… etc

Penta-	5
Hexa-	6
Hepta-	7
Octa-	8
Nona-	9
Deca-	10



- When a hydrogen in an alkane is replaced with something else (a **functional group**, like -OH), the name is derived from the name of the alkane.

- The ending denotes the type of a compound. E.g. an **alcohol** ends in *-ol*.

Methane → Methanol; Ethane → Ethanol;
Propane → 1-Propanol or 2-Propanol (**isomers**: *same molecular formula & **different structures***)

NaOCl is named

a. sodium chlorate.
b. sodium chlorite.
c. sodium perchlorate.
d. sodium hypochlorite.

$LiNO_3$ is named

a. lithium nitrate.
b. lanthanum nitrate.
c. lanthanum nitrite.
d. lithium nitrite.

Fe_2O_3 is named

a. diiron trioxide.
b. iron(III) oxide.
c. ferrous oxide.
d. ironic oxide.

HIO_4 is named

a. iodic acid.
b. iodous acid.
c. periodic acid.
d. hydrogen iodate.

Cl_2O_7 is named

a. chlorine(VII) oxide.
b. dichlorine hexoxide.
c. dichlorine heptoxide.
d. bichlorine heptoxide.

C_3H_8 is named

a. ethane.
b. propane.
c. propanol.
d. pentane.

Key Summary

Atoms:

Atomic Theory; Atomic Structure (nucleus, electron, proton & neutron); Atomic Weight (atomic number; isotopes); Periodic Table (periods & groups)

Molecules:

Compounds; Chemical formula and empirical formula

Ions:

Cations, anions, ionic bonds

Naming of Inorganic & Organic Compounds

Thank You for Your Attention!
Any Questions?