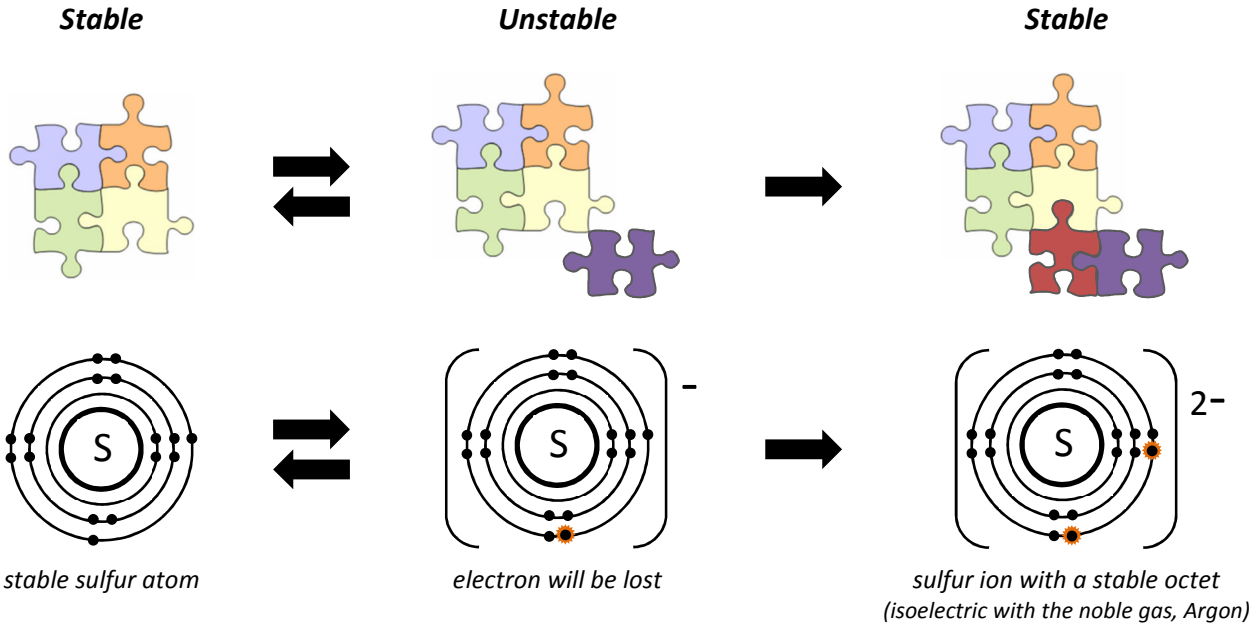
Chemical Bonding

Finding Stability (The Octet Rule)

Matter remains stable when it has reached some form of equilibrium or has achieved a different configuration with either the same, or a lower energy state. If an atom gains or loses an electron, this new arrangement has upset the balance of charge. Typically, this is a destabilization of the atom, which would lead to the reversal of the process in order to return the atom to a balanced, lower energy state. If however, the gain or loss of a specific number of electrons results in a new stable arrangement, the atom will remain this way. This usually occurs when an atom becomes isoelectric (has the same electron configuration) with a noble gas.



stable sulfur atom *electron will be lost* *sulfur ion with a stable octet (isoelectric with the noble gas, Argon)*

Atoms form ions, or form chemical bonds in order to achieve this <u>stable arrangement</u> of electrons. This generalization is known as the **Octet Rule**.

Duplet arrangement – _____

Octet arrangement – _____

A stable octet can be achieved in three main ways

1. An atom may _____.
2. An atom may _____. } Ionic bonding
3. Atoms may _____. } Covalent bonding

Multivalent Metals

Some elements, particularly the transition metals, have more than two stable electron configurations. They may form two or more different stable ions.

Name	*Ion*	*Classical Name*	*IUPAC Name*
Copper (Cu) *cuprum*	Cu^{+} Cu^{2+}	cuprous cupric	copper (I) copper (II)
Iron (Fe) *ferrum*	Fe^{2+} Fe^{3+}	ferrous ferric	iron (II) iron (III)
Tin (Sn) *stannum*	Sn^{2+} Sn^{4+}	stannous stannic	tin (II) tin (IV)
Lead (Pb) *plubum*	Pb^{2+} Pb^{4+}	plumbous plumbic	lead (II) lead (IV)
Gold (Au) *aurum*	Au^{+} Au^{3+}	aurous auric	gold (I) gold (III)
Mercury (Hg)	Hg^{+} Hg^{2+}	mercurous mercuric	mercury (I) mercury (II)
Cobalt (Co)	Co^{2+} Co^{3+}	cobaltous cobaltic	cobalt (II) cobalt (III)

Polyatomic Ions

Some combinations of atoms form stable ions. They are so stable that they tend to act as a unit, as one whole anion, or as one whole cation (in the case of ammonium, NH_4^+) when forming chemical bonds.

Name	*Formula*	*related ions*	
ammonium	**NH_4^+**		
hydroxide	**OH^-**		
nitrate	**NO_3^-**	nitrite	NO_2^-
chlorate	**ClO_3^-**	hypochlorite chlorite perchlorate	ClO^- ClO_2^- ClO_4^-
bromate	**BrO_3^-**		
iodate	**IO_3^-**		
carbonate	**CO_3^{2-}**		
sulfate	**SO_4^{2-}**		
phosphate	**PO_4^{3-}**	phosphite	PO_3^{3-}
permanganate	**MnO_4^-**		
acetate	**CH_3COO^-**		
chromate	**CrO_4^{2-}**		
dichromate	**$Cr_2O_7^{2-}$**		
cyanide	**CN^-**	cyanate thiocyanate	OCN^- SCN^-
hydrogen carbonate	**HCO_3^-**		
hydrogen sulfate	**HSO_4^-**	hydrogen sulfite	HSO_3^-
hydrogen phosphate	**HPO_4^{2-}**	hydrogen phosphite	HPO_3^{2-}
dihydrogen phosphate	**H_2PO_4**	dihydrogen phosphite	$H_2PO_3^{2-}$

Chemical Bonds

Atoms are in constant motion. If collisions between atoms are sufficiently energetic, the valence electrons between atoms can interact. Electrons may either be transferred from one element to another (ionic bonding), or shared between atoms (covalent / molecular bonding). Just as was discussed in the formation of ions, these interactions result in more stable electron configurations (each element becomes isoelectric with a noble gas for instance), then the elements will remain this way as a compound.

	Ionic Bonding	***Covalent / Molecular Bonding***
Between:		
Mechanism:		
Example:		
Force of Attraction:		
Conceptual Diagram:		
Structure:		