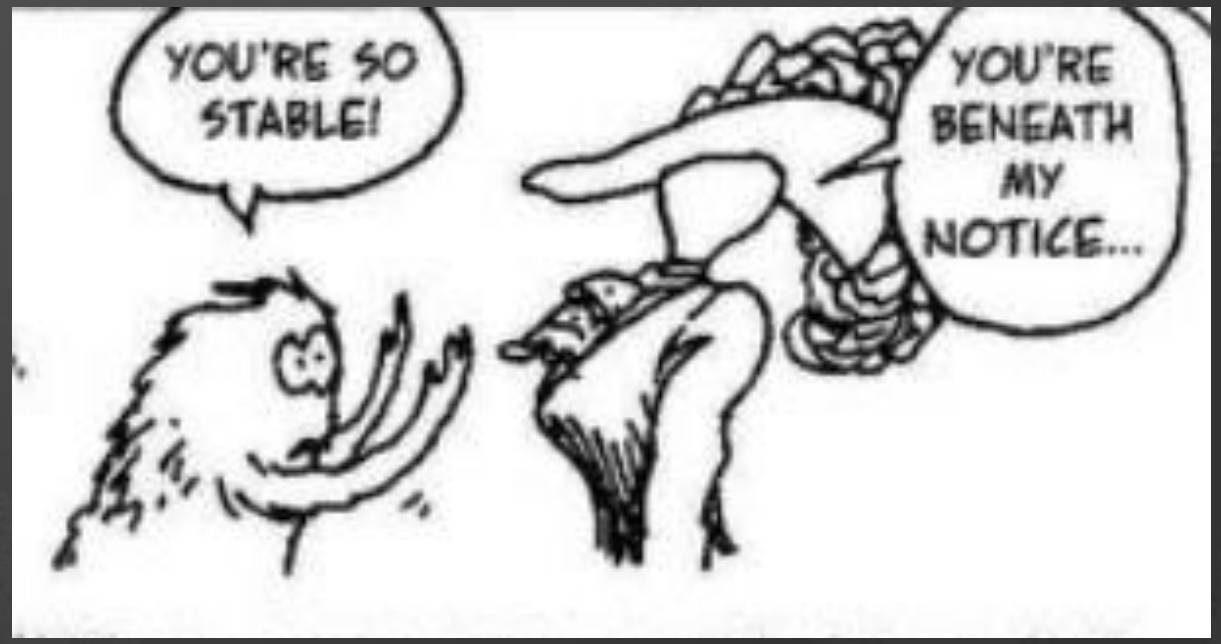
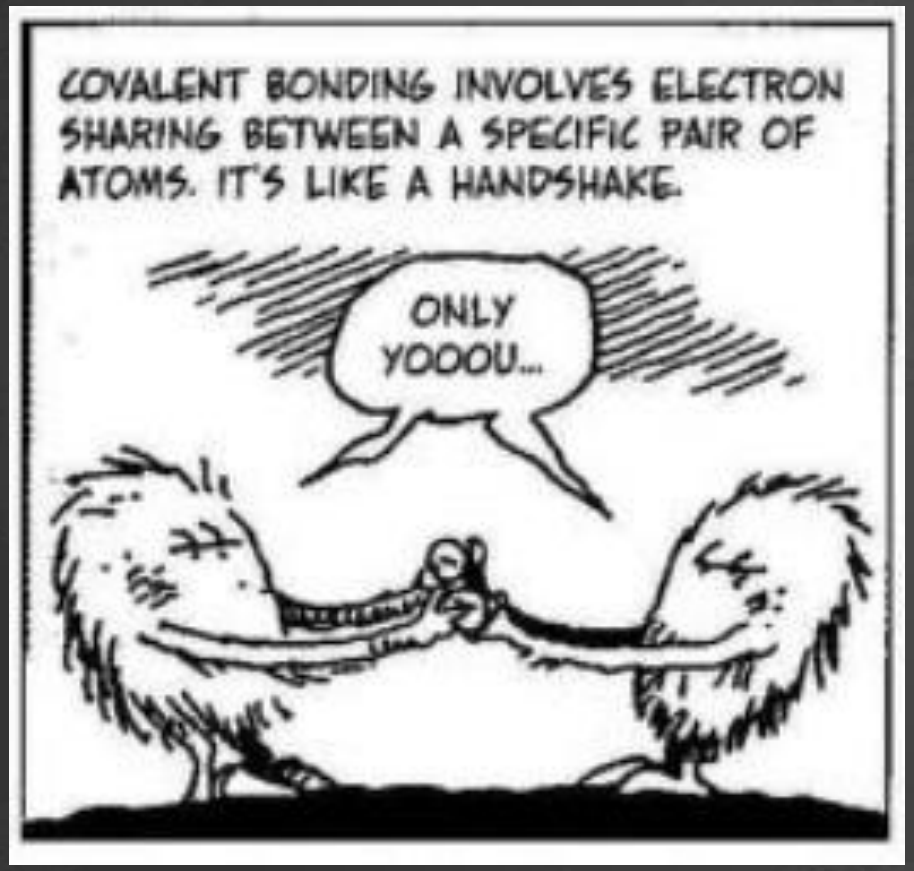

Chemistry - 1
Let’s continue the journey

A complete outer shell, ns^2np^6, is energetically more advantageous than an incomplete one.

We call it the **RULE OF EIGTH**: at atom tends to pick up or give away just enough electrons to make eight in its outer shell – AN **ELECTRON OCTET**.

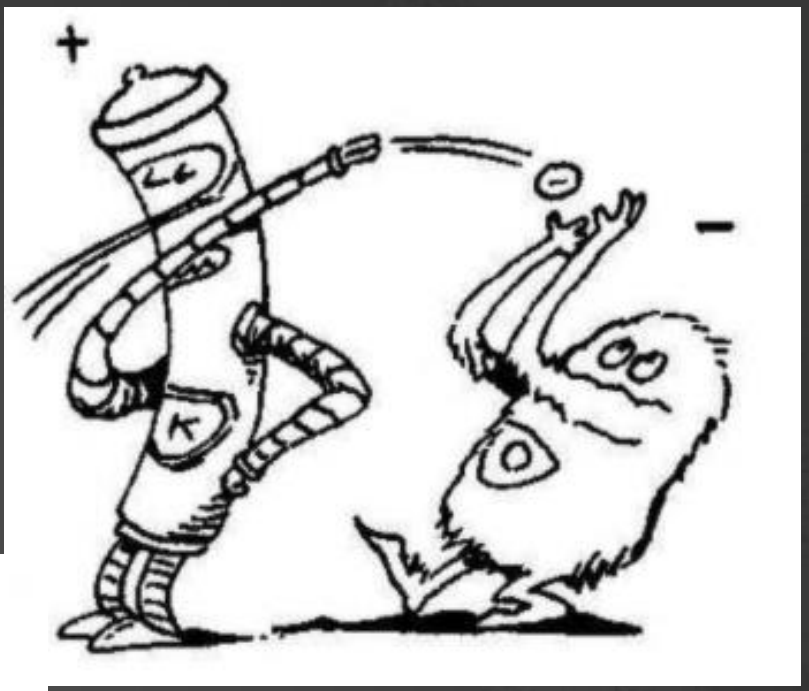


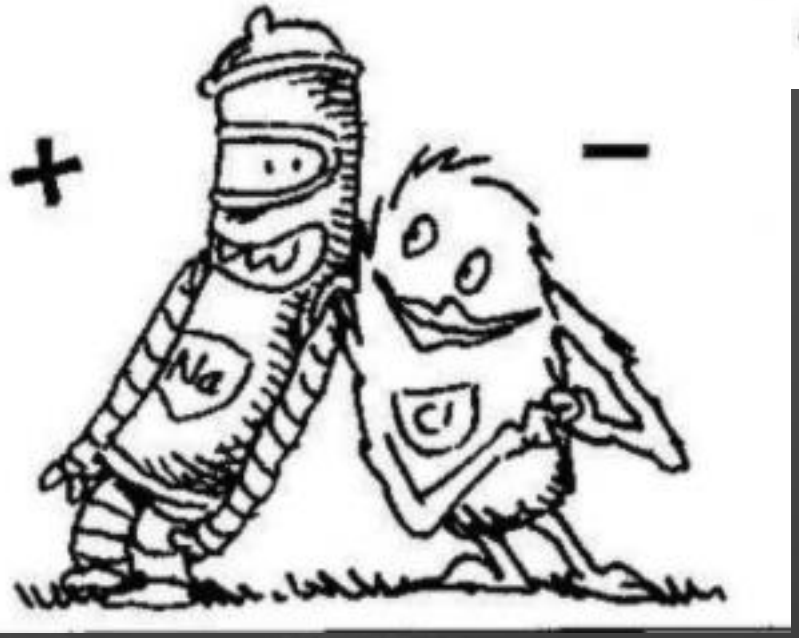
Atoms form chemical bonds by combining such number of electrons that allows them to obtain an electron configuration of noble elements



- Hydrogen binds into a molecule resulting in the electron configuration of helium ($1s^2$)
- Chlorine combines into a molecule with the electron configuration of argon ($...3s^23p^6$)

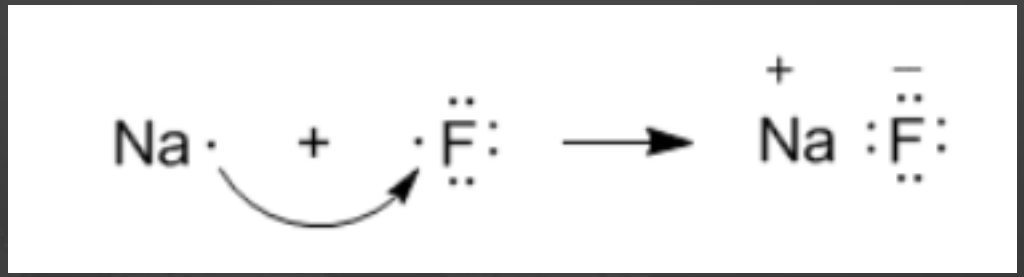
Ionic bonds



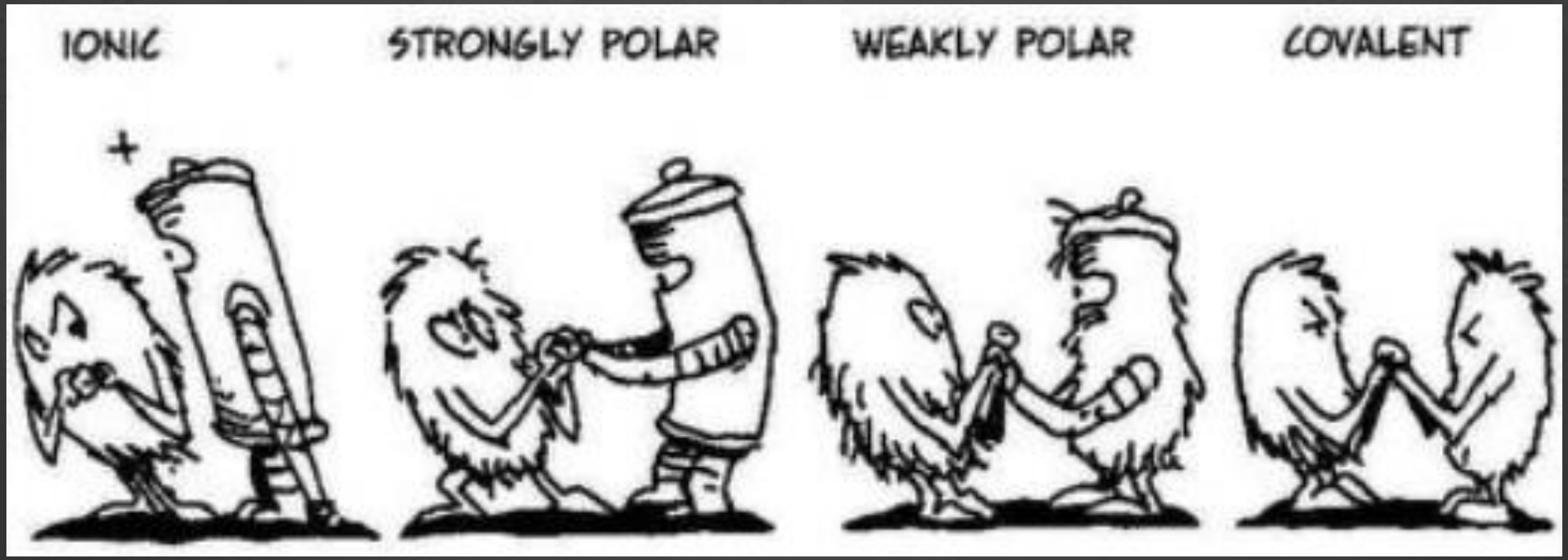


Ionic bond

- Let's consider interactions between $_{11}Na$ and $_{9}F$
- The electron configurations of these elements are:
  - $_{11}Na: 1S^2 2S^2 2p^6 3s^1$
  - $_{9}F: 1S^2 2S^2 2p^5$
- When Na and F bind, they acquire electron configuration of the noble gas Ne
- The electron configuration of the noble gas $_{10}Ne$ is:
  - $Ne: 1S^2 2S^2 2p^6$
- In the electron formula we need to consider only the outer shells

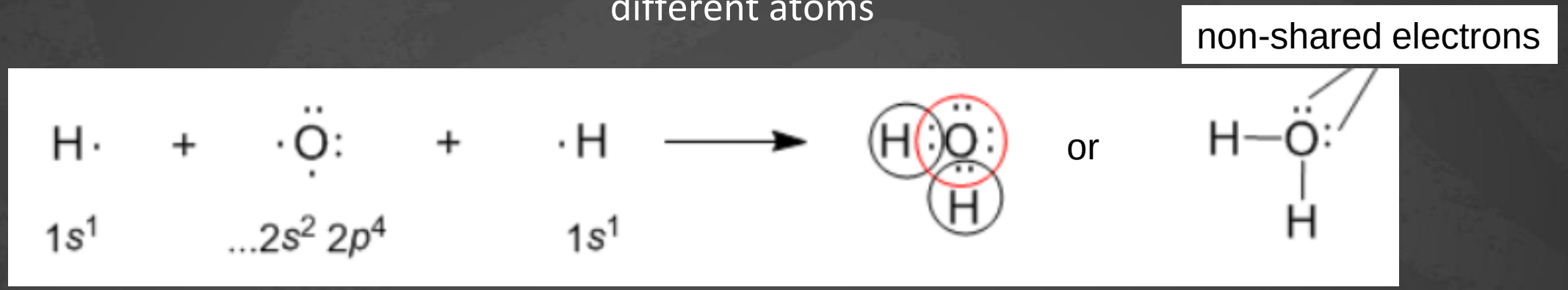


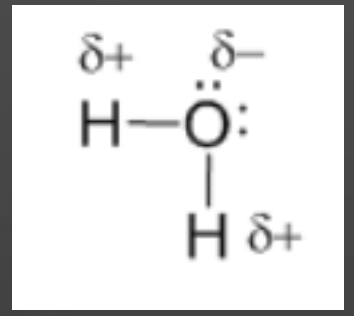
Different bond types

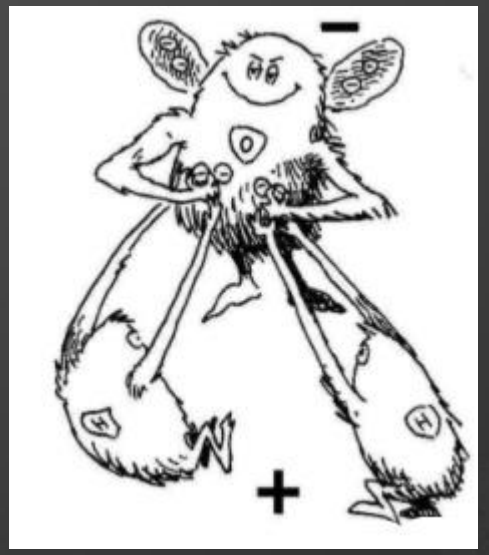


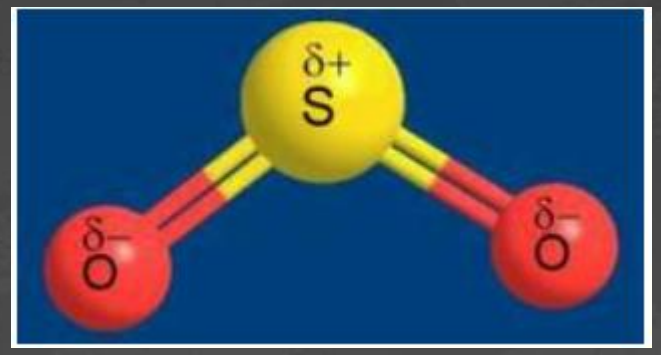
Polar covalent bond

- It is an intermediate between covalent and ionic bonds and like for ionic bond it forms between different atoms









SO_2 molecule with polar covalent bond

Electronegativity is a relative ability of atoms to attract electrons while binding to other atoms. It is an ability to polarize a covalent bond

Bond’s polarity depends on the difference in electronegativity between two atoms. Bigger differences mean more polarity, with a difference of 2 or more being considered ionic

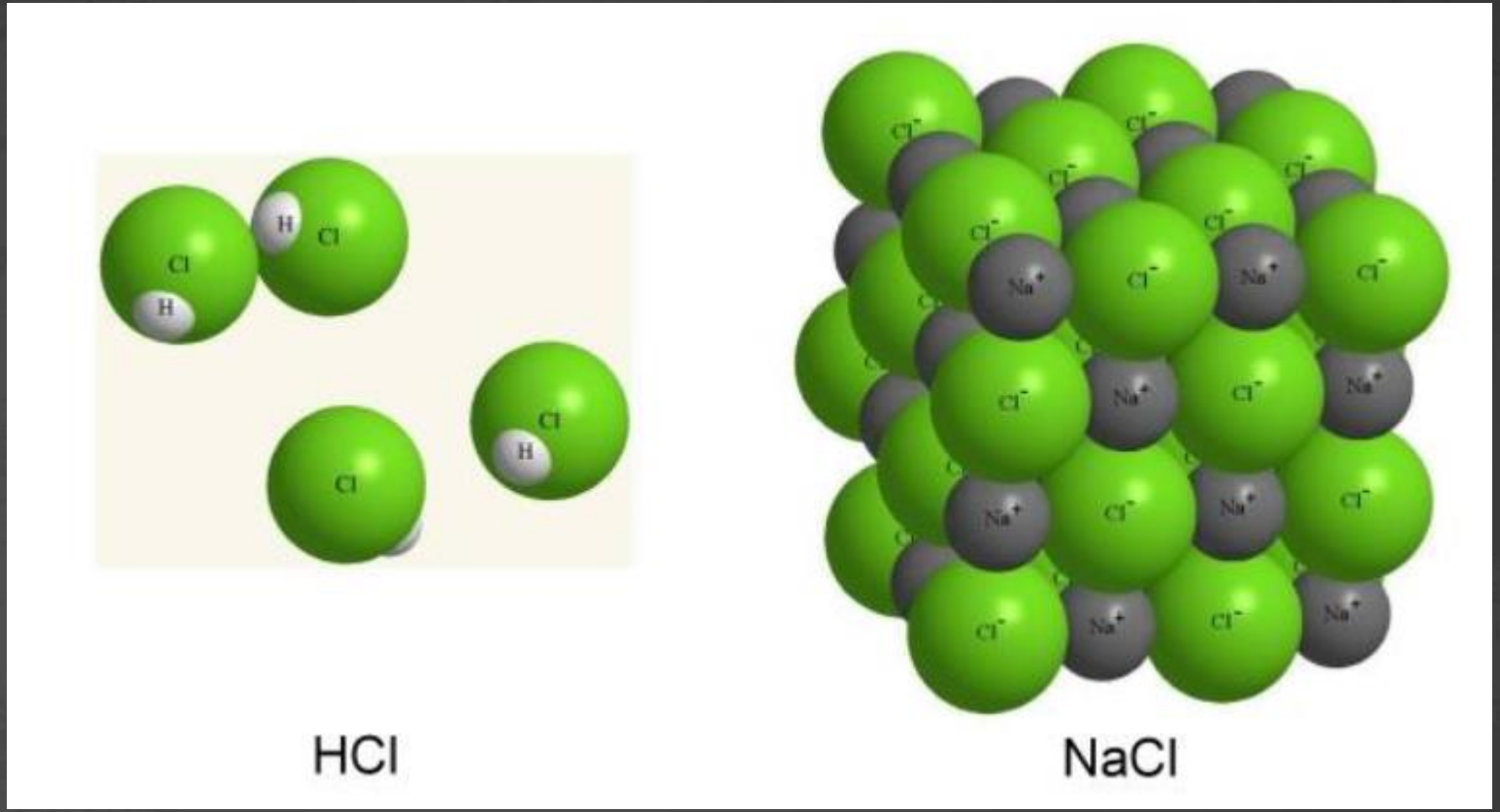
SAMPLE ELECTRONEGATIVITIES			
H	2.1	Na	0.9
Li	1.0	Mg	1.2
C	2.5	S	2.5
N	3.0	Cl	3.0
O	3.5	K	0.8
F	4.0	Ca	1.0

H : H

Cl : Cl

H :Cl

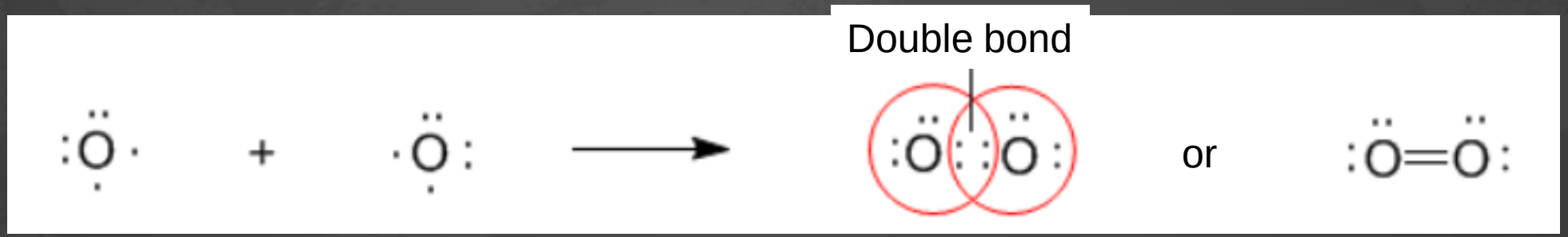
Na^+Cl^-



- Increased bond polarity results in different properties of the substance - hydrogen chloride (polar covalent bond) is a gas at room temperature while sodium chloride(ionic bond between the atoms) is a solid crystalline substance

Multiple bonds

- If the octet rules requires multiple bonds can form between two atoms (each bond is two shared electrons)
  - These bonds are called double or triple bonds
- E.g. oxygen can form a molecule from two oxygen atoms only when there are two shared electron pairs between the atoms:



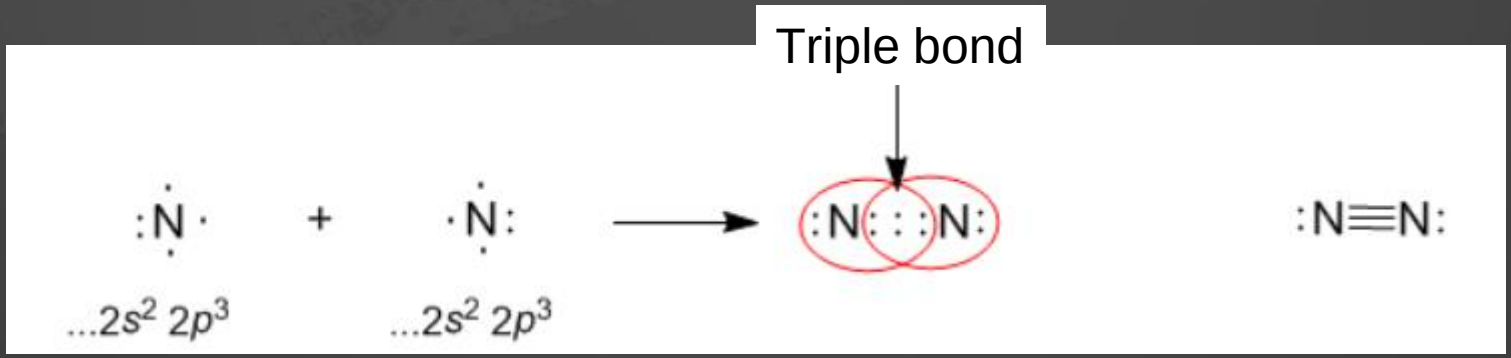
Each oxygen atom has 6 electrons

Each oxygen atom has 8 electrons

Structural formulas identify the location of **chemical** bonds between the atoms of a **molecule**. A **structural formula** consists of symbols for the atoms connected by short lines that represent **chemical** bonds — one, two, or three lines standing for single, double, or triple bonds, respectively.

How many electron pairs do atoms of nitrogen need to get the octet?

$_{7}$N electron configuration:



Multiple bonds

Bond	Bond length (A=10^{-8} cm)	Bond strength, kJ
Single (N-N)	1.45	58.5
Double (N=N)	1.25	456
Triple (N≡N)	1.098	945

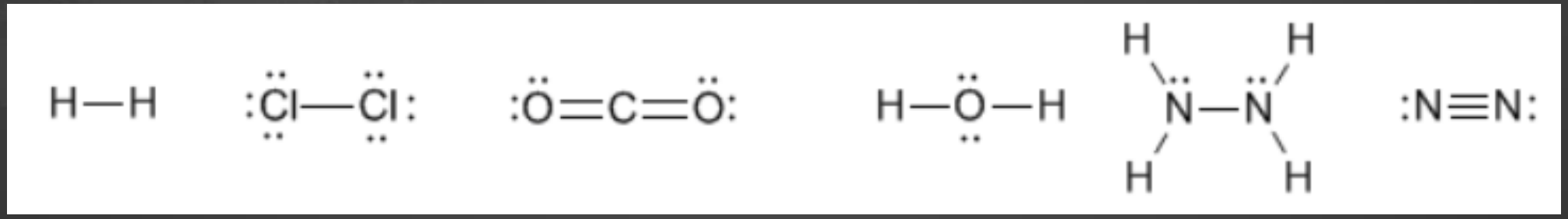
Bond order is the number of chemical bonds (shared electron pairs) between a pair of atoms and the bond stability. The highest bond order is 3.

Valence

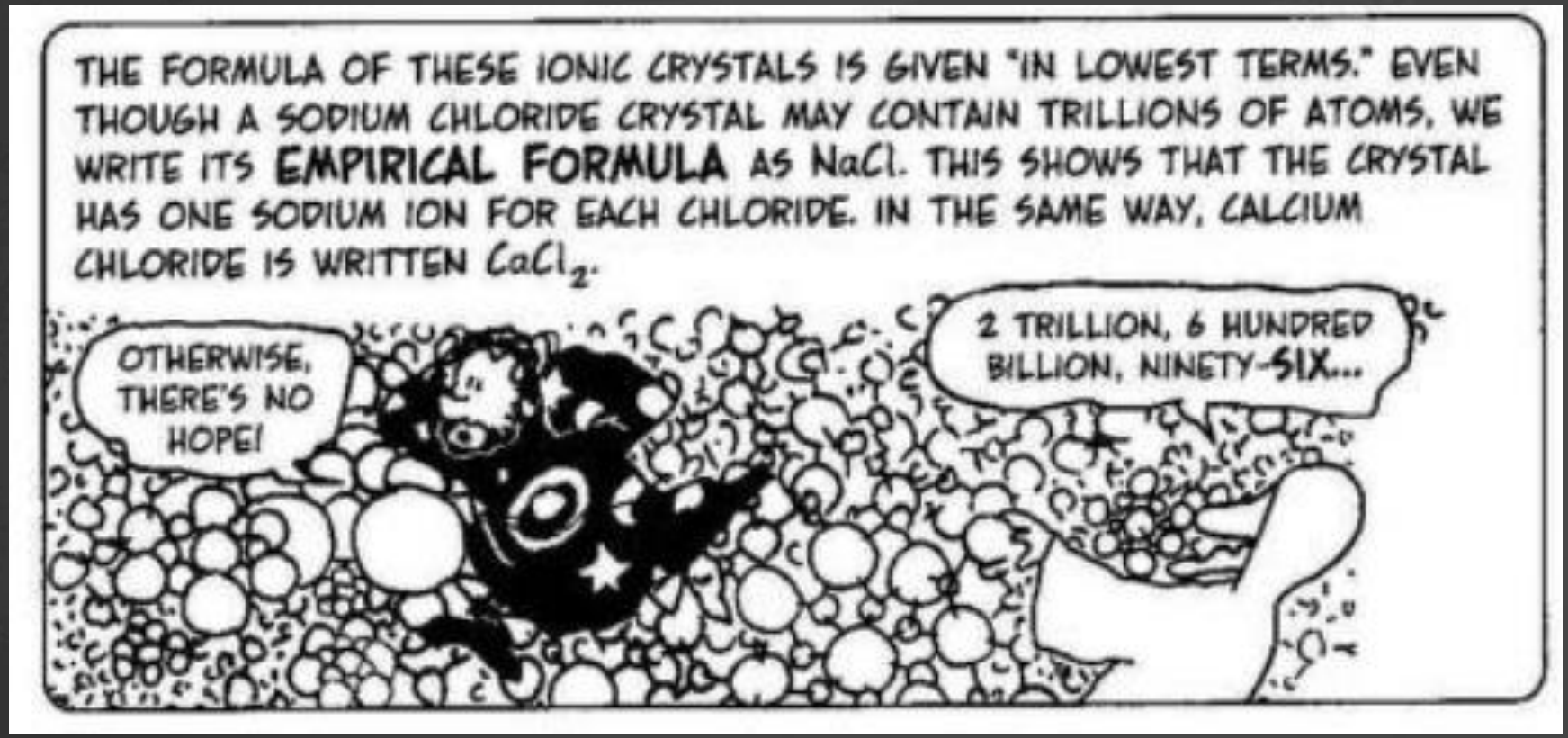
The valence or valency of an element is a measure of its combining power with other atoms when it forms molecules

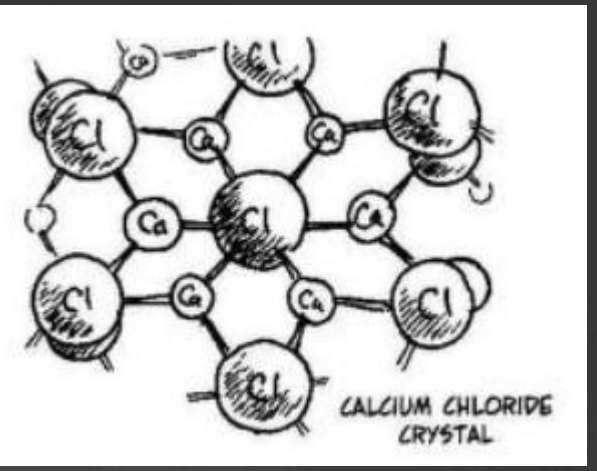
Or

The valence is the number of electron pairs that binds the atom with other atoms



Consider crystals of calcium chloride – $CaCl_2$





Some substances do not form separate molecules but make a continues network of repeating atoms (metals) or units (e.g. quartz). In this case the formulas of such matter are those of the repeating units – Cu, or SiO_2

This class uses the materials from the following books:
Larry Gonick and Graig Criddle “The cartoon guide to chemistry”
Manyuilov and Rodionov “Chemistry for children and adults”
Kuzmenko, Eremin, Popkov “Beginnings of chemistry”