

Bonding

Power Standards

1. **OBJ: Students will be able to identify an ionic compound**
2. **OBJ: Students will be able to write out an ionic compounds in name and formula.**
3. **OBJ: Students will be able to characterize an ionic compound as ionic crystal.**
4. **OBJ: Students will be able to identify a covalent compound.**
5. **OBJ: Students will be able to write out a covalent compound in name and formula.**
6. OBJ: Students will be able to identify an acid.
7. OBJ: Students will be able to write out an acid in name and formula.
8. OBJ: Student will be able to calculate the percent composition of an atom based on atomic mass.
9. OBJ: Student will be able to calculate percent composition based on quantities.

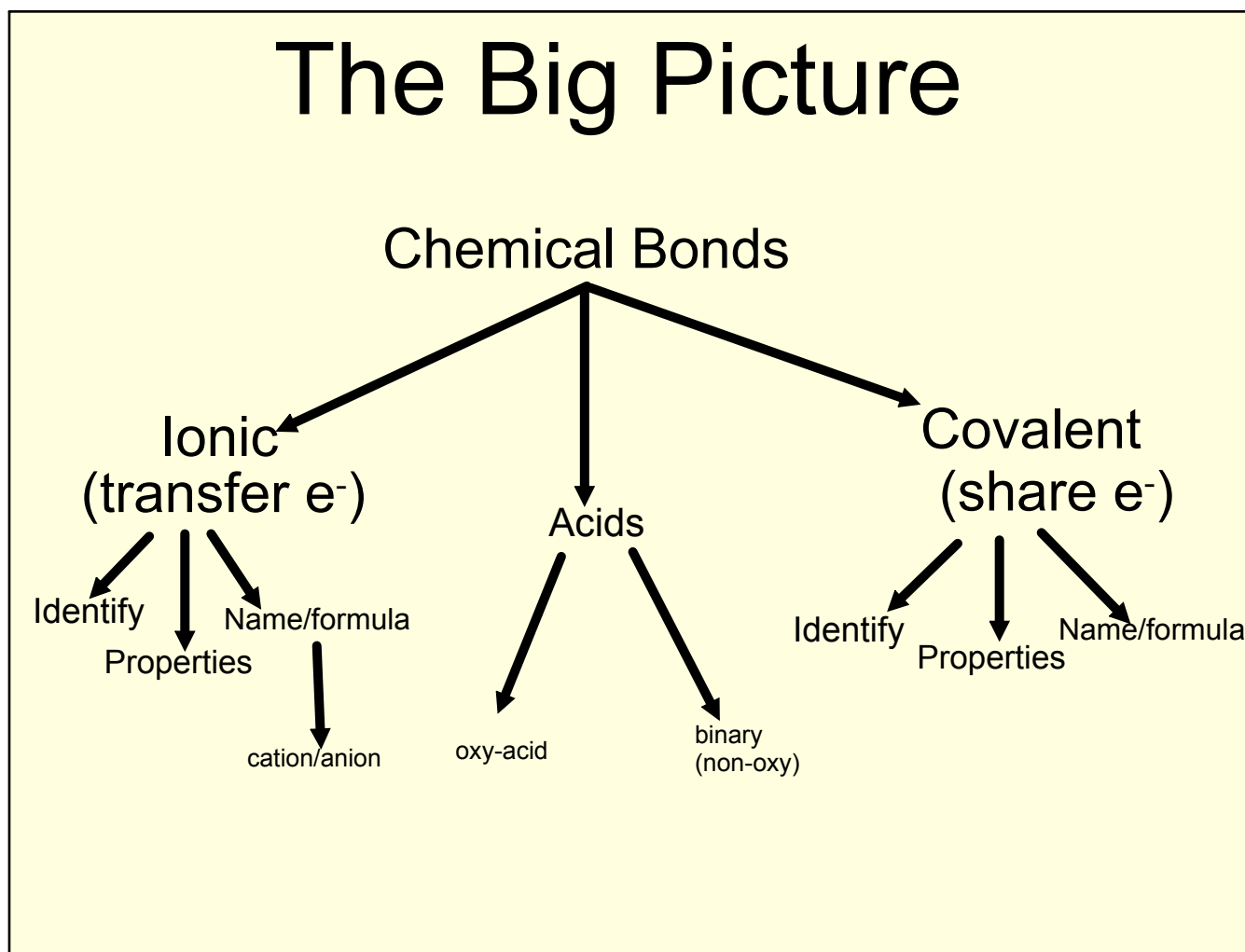
Minor Standards (discuss but will not be the focus of a summative assessment)

- a. **OBJ: Properties of ionic compounds as a result of being a crystal. (Melting point, dissociation via dissolving)**
- b. **OBJ: Students will understand properties of covalent compounds as a result of being a molecule (melting point, intermolecular forces)**
- c. **OBJ: Write lewis structures.**
- d. **OBJ: Students will understand polarity**



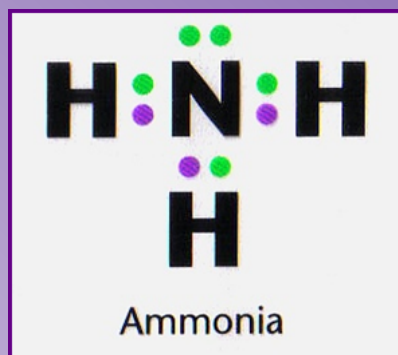
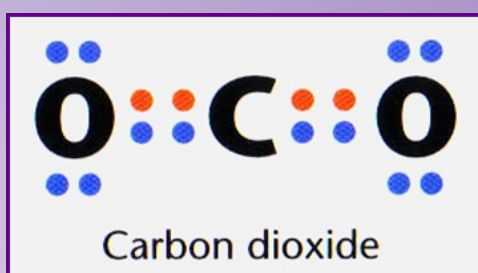
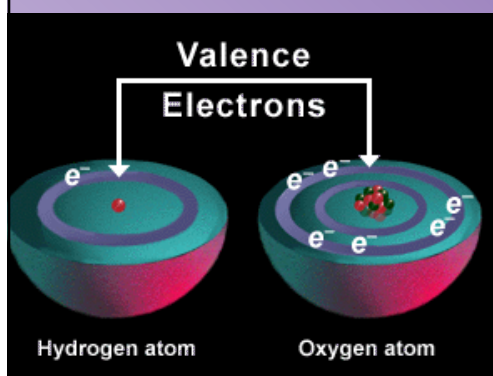
Types of Bonds

The Big Picture



CHEMICAL BONDS

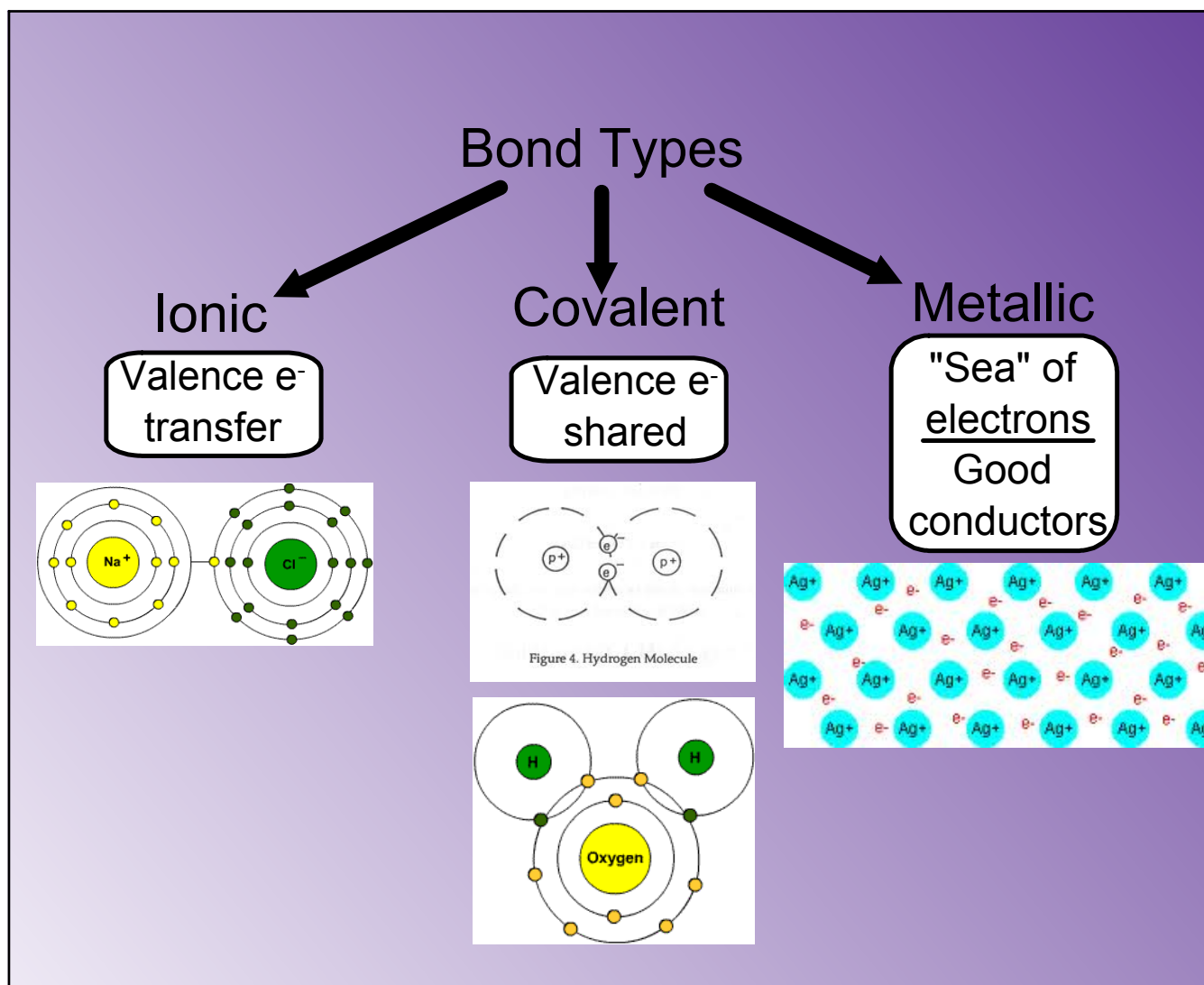
the attractive force holding atoms together



At
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•
•

4 forces in nature:

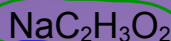
- **Nuclear Force:** Very strong forces holding nucleus together
- **Electrostatic attraction:** the attraction of positive and negative particles together
- **Gravitational:** Mass attracting to other masses. (Weak force)
Planets
- **Magnetic force**



OBJ: Students will be able to identify an ionic compound



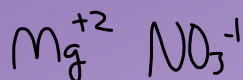
Which of these are ionic (salts) compounds?



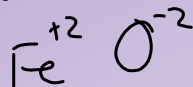
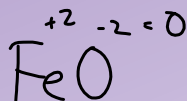
NH_4^+ ionic
some H^+



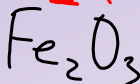
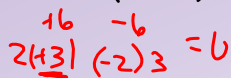
Aluminium Chloride



ammonium sulfate



Iron(II) oxide



Iron(III) oxide

"I'm positive!" Determine ionic salts

BJ: Students will be able to identify an ionic compound

Ionic

Cation = Anion
 $\text{Na}^{+1} \text{Cl}^{-1}$

Metal (cation) bonded to a non-metal (anion)

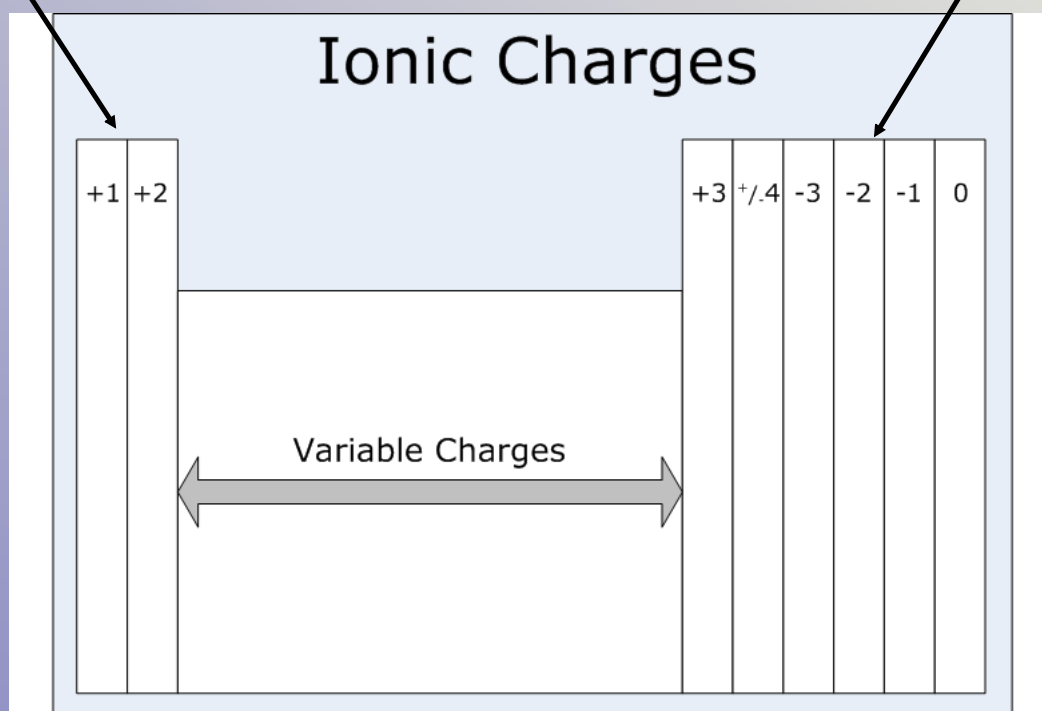
cation

- positive ion
- loss of e^-
- metal

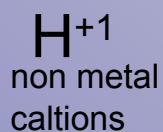
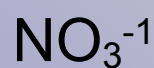
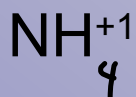


anion

- negative ion
- gain of e^-
- nonmetal



A family might fill role of cation or anion

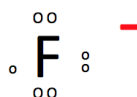


Formation of an Ionic Substance

- Metal

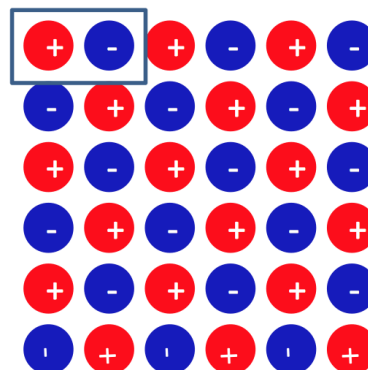


Non-metal



What does KF mean?

Empirical formula: simplest ratio of atoms



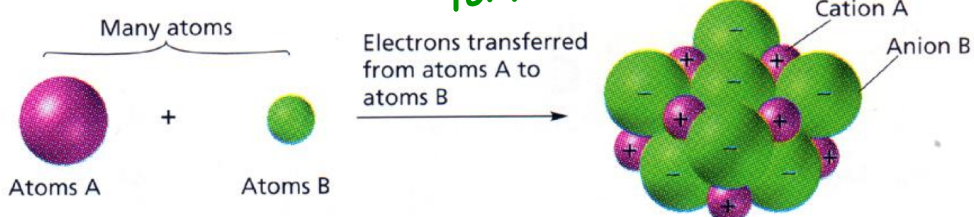
Ionic vs. Covalent

formula unit vs. molecule

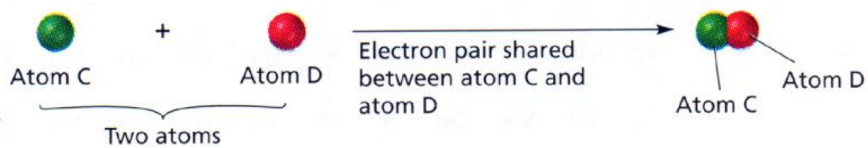
empirical

molecular formula

Ionic bonding



Covalent bonding



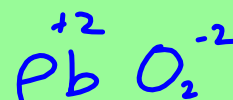
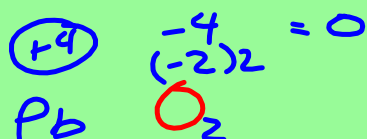
Naming Ionic Compounds

1. What is the correct name for PbO_2 ?
2. What is the correct chemical formula for iron(III) sulfide?
3. Explain why the name magnesium chloride does not contain a Roman numeral.

Naming Ionic Compounds

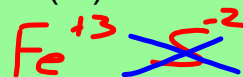
1. What is the correct name for PbO_2 ?

lead(IV)oxide



lead(II)peroxide

2. What is the correct chemical formula for iron(III) sulfide?



3. Explain why the name magnesium chloride does not contain a Roman numeral.

one charge (not variable)

- check ion sheet (no roman numeral)

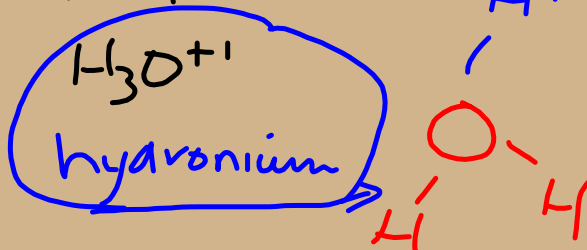
Ions to memorize

Look for patterns

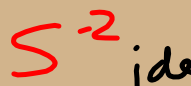
know common ions

N

Cations



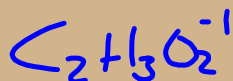
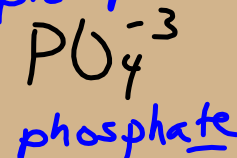
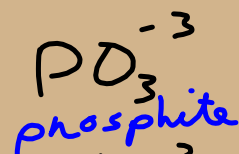
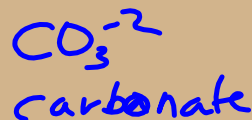
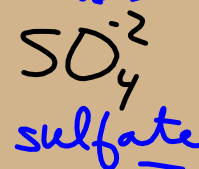
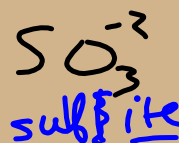
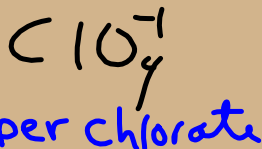
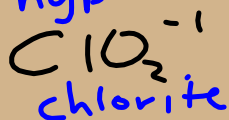
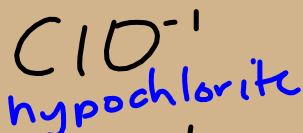
does not match
(N-3)



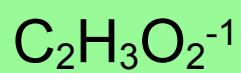
nitrite



nitrate



Sample quiz questions: Write the formula or the name:



Nitrate NO_3^{-1}

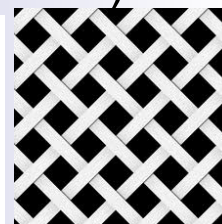
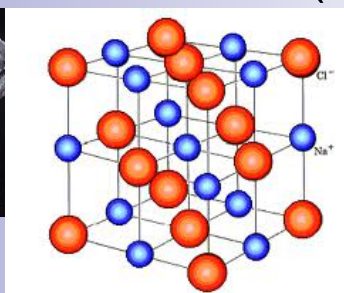
SO_4^{-2} sulfate

Phosphite PO_3^{-3}

OH^{-1} hydroxide

BJ: Students will be able to characterize an ionic compound as ionic crystal.

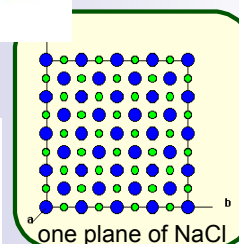
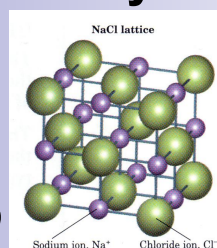
Ionic compounds form uniform crystalline structures (lattice)



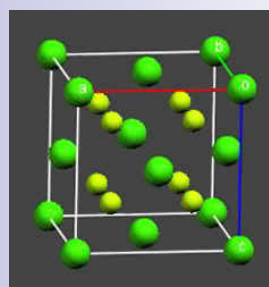
In NaCl,
there are **many** Na and **many** Cl

Ionic formulas

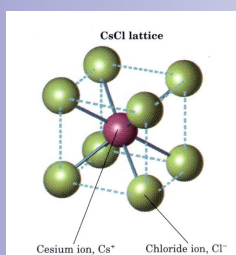
- always simplest ratio
- NaCl means there is 1 Na for every Cl
- CaF_2 means there is 1 Ca for every 2 F



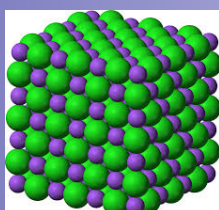
CaF_2



CaF_2



CsCl lattice



Why don't we write
 Na_2Cl_2 or $\text{Na}_{100}\text{Cl}_{100}$?



OBJ: Properties of ionic compounds as a result of being a crystal. (Melting point, dissociation via dissolving)

Properties of Ionic Salts

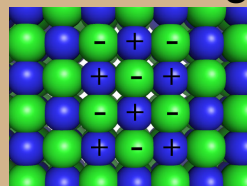
1. High melting and boiling points

a lot of energy holds cations and anions together

Coulomb's Law

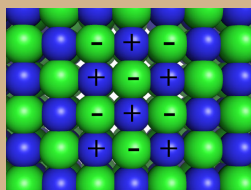
$$F = \frac{kq_1q_2}{r^2}$$

many opposite charges held close together

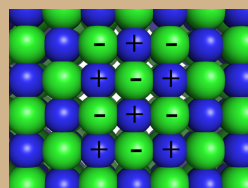
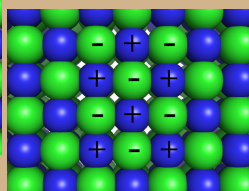


2. Hard but brittle

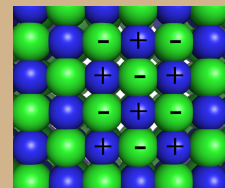
- Slight shift will line up repulsive forces
- Difficult to move (hard) but falls apart completely if shifted (brittle)



attractive forces



repulsive forces



3. Solubility

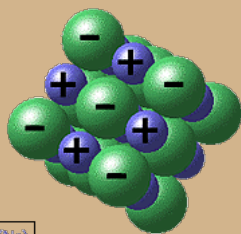
salts

soluble-dissolves in water

- ions dissociate (separate)
- will conduct electricity

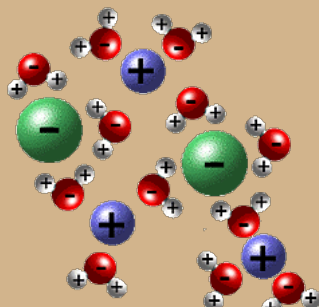
electrolyte

NaCl crystal structure



(Na)
(Cl)

NaCl in water



δ^-

water "pulls" apart

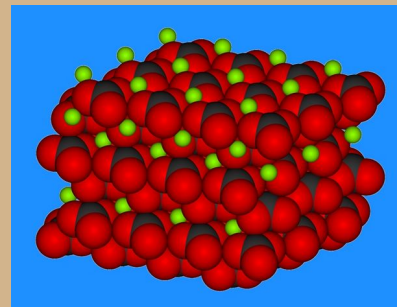


δ^+

insoluble-doesn't dissolve

- ionic attraction is greater than water's polarity
- does not conduct electricity

non-electrolyte



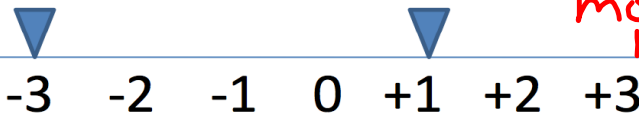
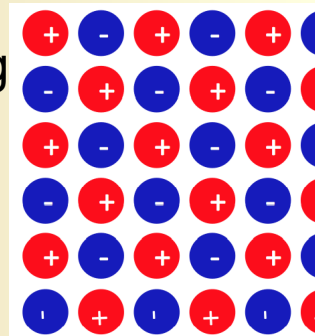
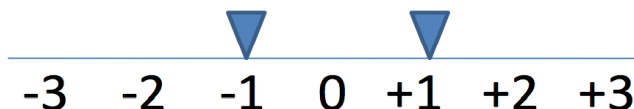
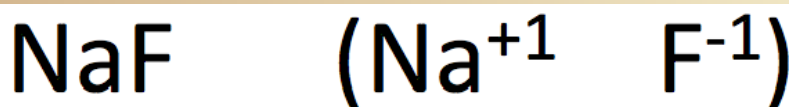
water can't "pull" this apart

What factors affect the melting point of ionic compounds?

1. Difference of Charge
2. Atomic Radius

1. Difference of Charge

more +'s to more -'s have higher melting



*greater charge
more Coulombic Force, ↑ melt Pt*

Practice:

Assign charges

Rank order of increasing melting point.

	Assign charges	Rank	
Ca₃P₂	Ca^{+2} P^{-3}	4	
NaI	Na^{+1} I^{-1}	1 (lowest)	
MgSO₄	Mg^{+2} SO_4^{-2}	3	
MgCl₂	Mg^{+2} Cl^{-1}	2	
AlN	Al^{+3} N^{-3}	5 (highest)	

What factors affect the melting point of ionic compounds?

1. Difference of Charge
2. Atomic Radius

2. Atomic Radius

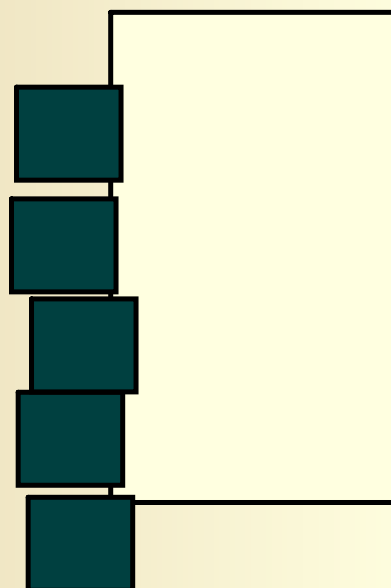


larger atomic radius = weaker bonds

→ needs less energy - lower M.P.

Practice:

	Charges		
CaCl ₂	Ca ⁺²	Cl ⁻¹	3
NaCl	Na ⁺¹	Cl ⁻¹	1
NaF	Na ⁺¹	F ⁻¹	
AlCl ₃	Al ⁺³	Cl ⁻¹	4
AlP	Al ⁺³	P ⁻³	5



Look at charge first

Then look at radius with same charge difference
(+1, -1)

Weaker (larger) melts at lower temperature

Dissolving Ionic Crystals

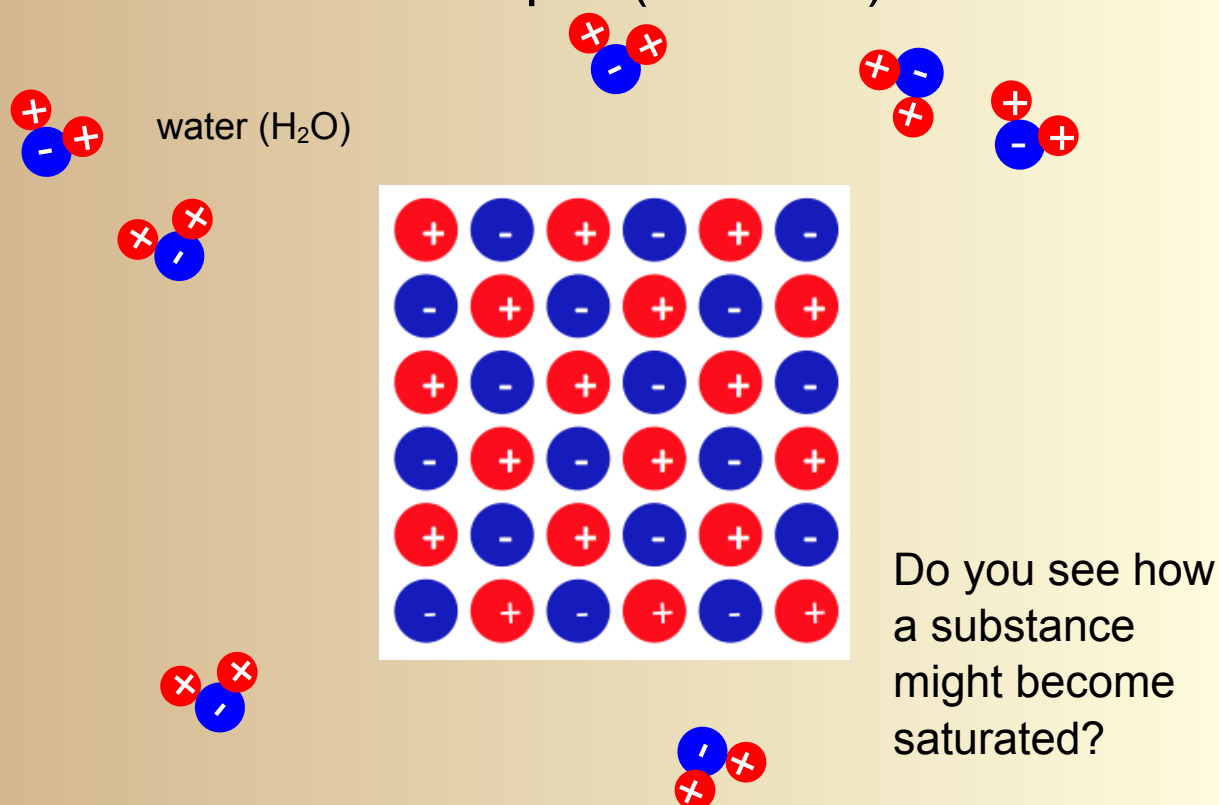
<http://www.nbclearn.com/portal/site/learn/chemistry-now/chemistry-of-water>

<http://workbench.concord.org/database/activities/55.html>

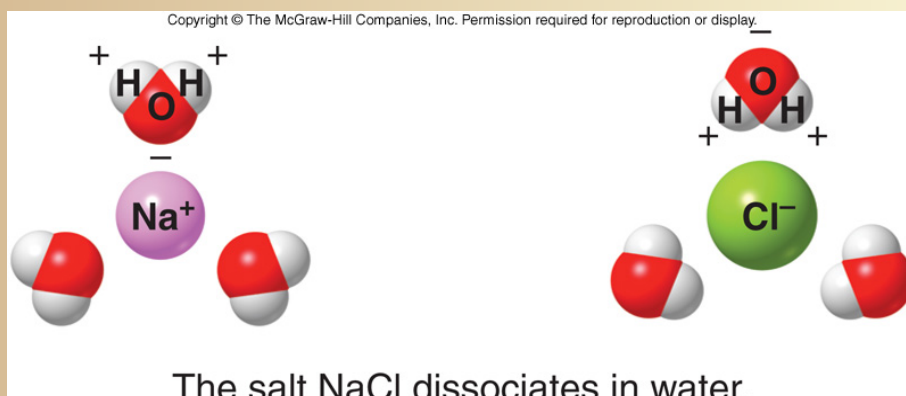
Electrostatic attraction hold ions together,

How are ionic substances affected by other +/- in solutions?

salt will break apart(dissolve)

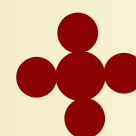
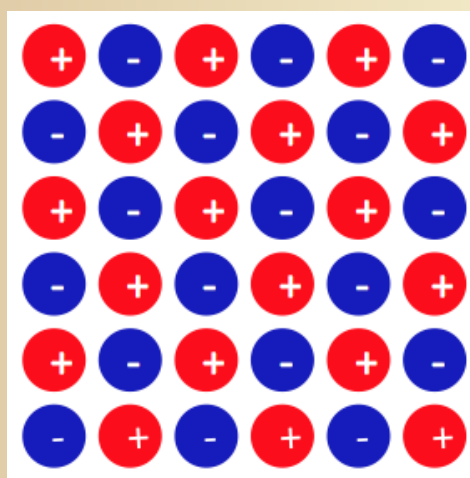
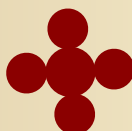


Electrostatic attraction pull apart the salt



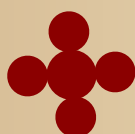
Dissolve in non-polar solvent?

Nonpolar



No attraction

No reason for ions to separate



Solution

one substance dissolved in another

ex: solid in liquid

smaller
part

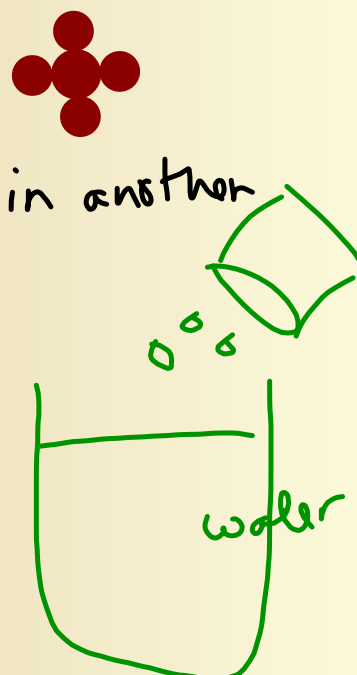
larger
part

↓
solute

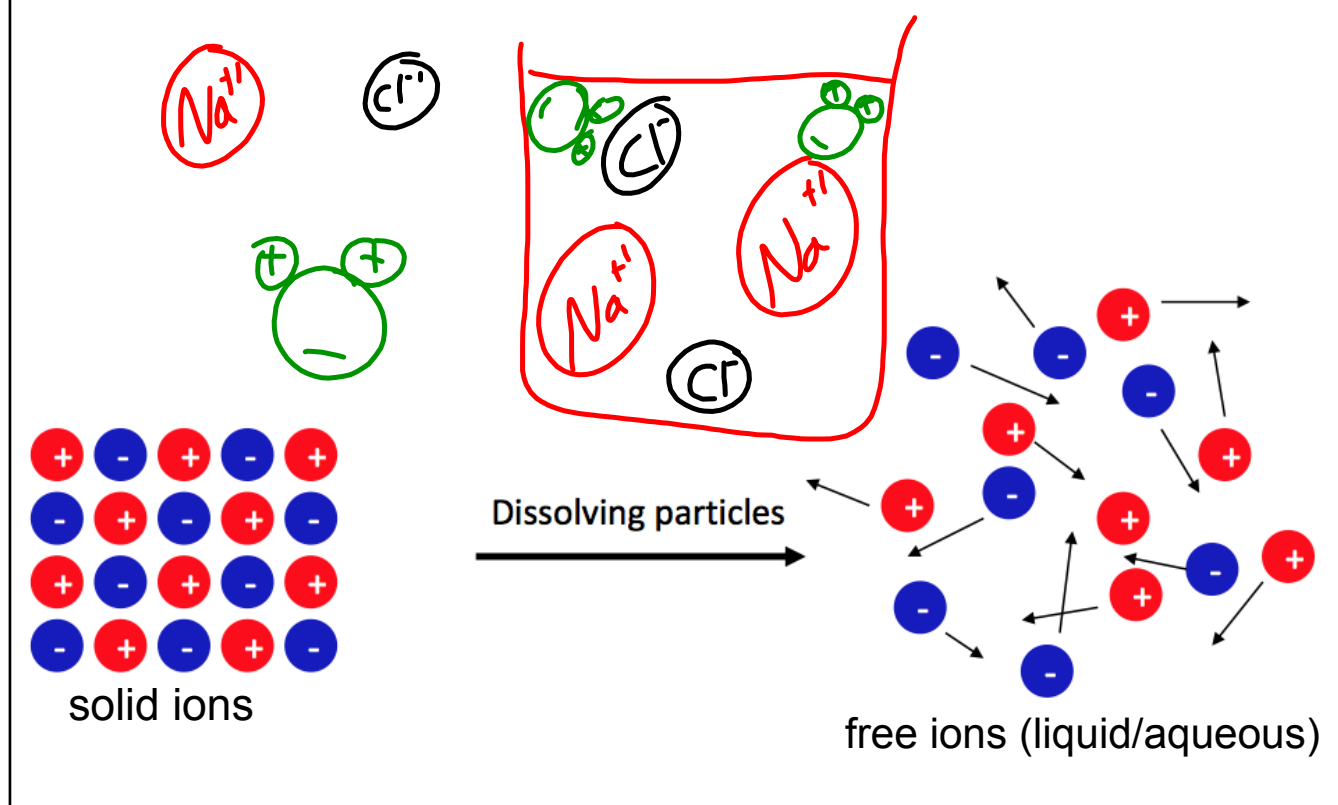
↓
solvent

salt

water



ionic crystals dissociate in solution

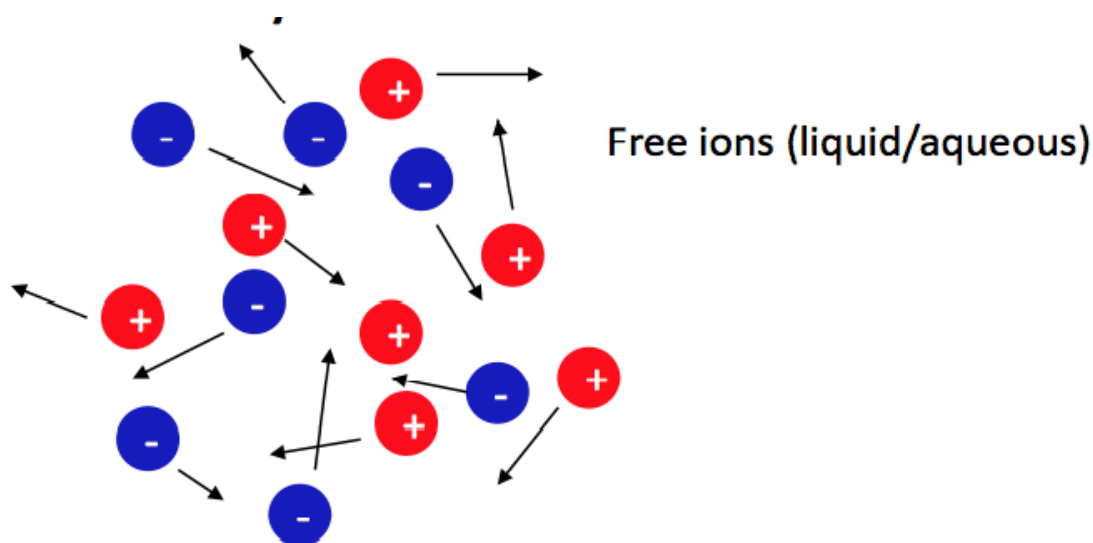


Properties of ionic solutions

charged ions conduct e^-

-pure water does not conduct electricity
(non-electrolyte)

-dissolve some ionic compound in water and
it conducts electricity (electrolyte)



requirement for a solution to conduct
electricity: **free moving charges**

Phosphite PO_3^{-3}

phosphite	P^{-3}	ite S^{-2}
phosphate	PO_4^{-3}	ate SO_4^{-2}
phosphite	PO_3^{-3}	ite SO_3^{-2}

chloride Cl^{-1}

ClO
 ClO_2
 ClO_3
 ClO_4

Review

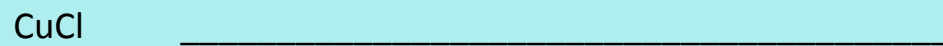
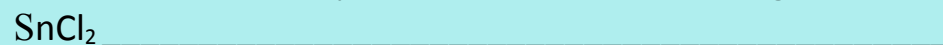
1. Write the formula for the compound with the following ions: 3



2. Write the formula for the compound with the following names: (hint—write ions first)



3. Write the correct compound name of the following:



Review

1. Write the formula for the compound with the following names: (hint—write ions first)

Nickel (II) Carbonate _____

magnesium cyanide _____

Iron (III) silicate _____

2. Write the correct compound name of the following:

SnCl_2 _____

Ag_2SO_3 _____

CuCl _____

Reviewing types of chemical bonds**(Move each statement under the correct category.)****IONIC BONDS****COVALENT BONDS****Each element has a charge**
Opposite charges attract**Polar or nonpolar****Forms molecules that have**
intermolecular forces**Forms large crystalline structure****Use empirical formula**
Use molecular formula**Two non-metals combine**
A metal and a non-metal combine**Electrons are transferred**
Electrons are shared