Properties of Solutions

Outcomes:

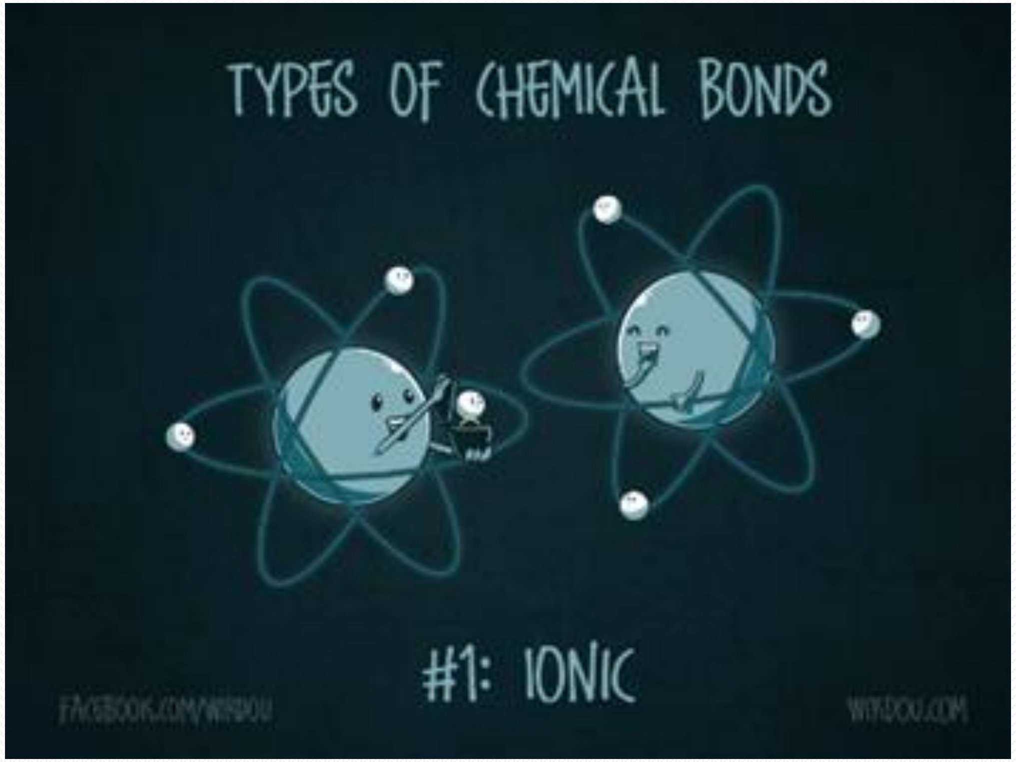
1-01 Explain observed examples of solubility and precipitation at the molecular and symbolic levels.

2-02 Use a table of solubility rules to predict the formation of a precipitate.

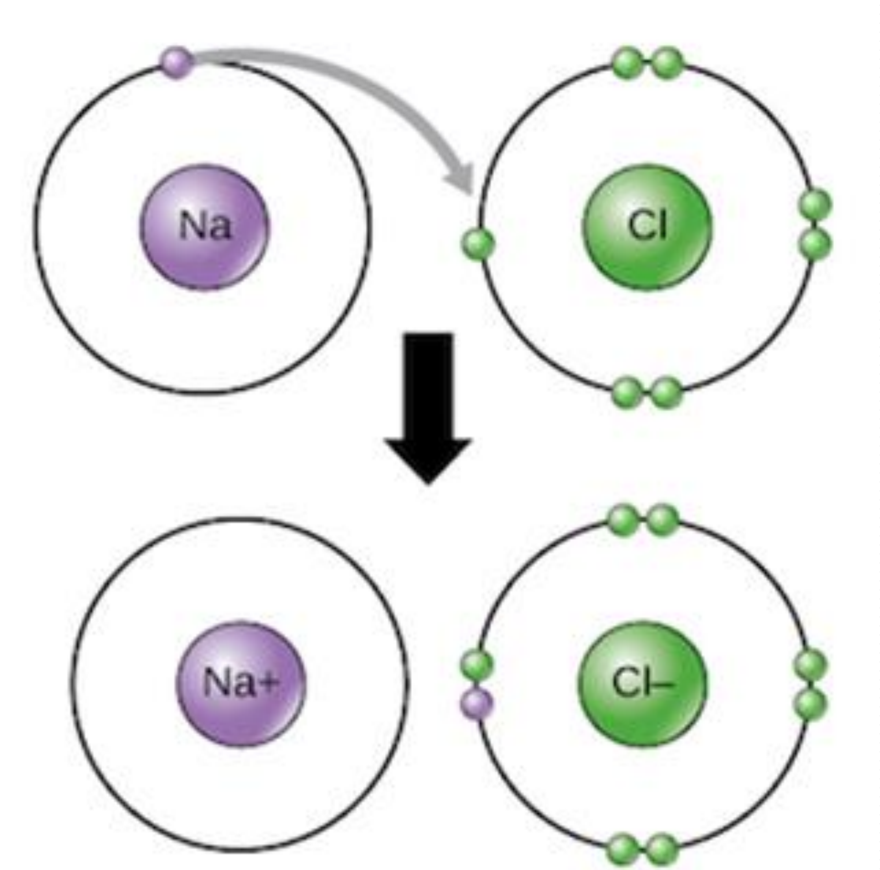
Solutions Review:

Ionic Bonds:

- Bonds between a **METAL** and a **NON-METAL**, involving a **TRANSFER** of electrons.
- Form **IONIC COMPOUNDS**



http://www.eoht.info/page/Chemical+bond

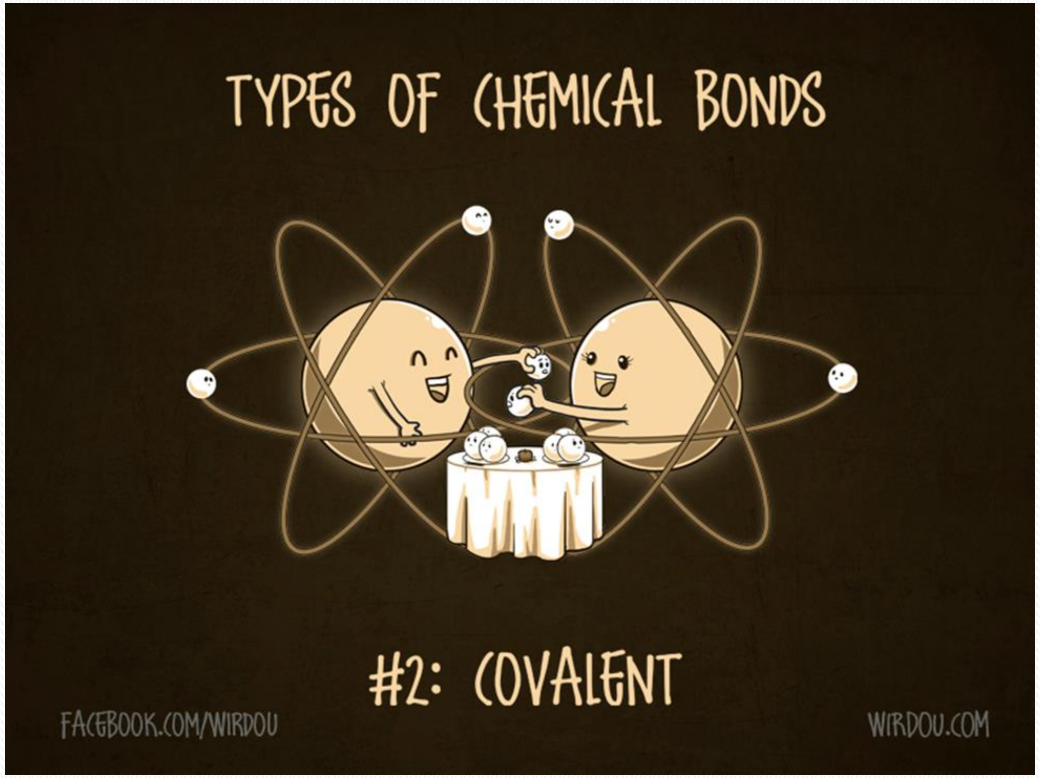


https://study.com/cimages/multimages/16/d549316e-3195-4daa-9fb4-07c52547e1ef_nacl.png

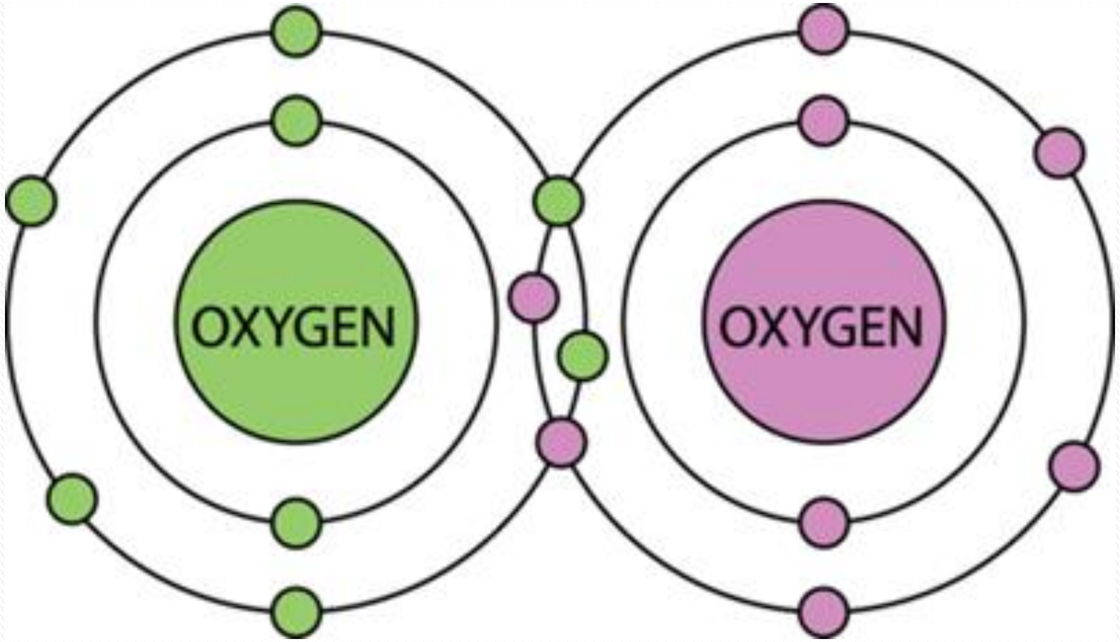
Solutions Review:

Covalent Bonds:

- Bonds between **TWO NON-METALS**, involving the "**SHARING**" of electrons.
- Form **MOLECULAR COMPOUNDS**



http://www.eoht.info/page/Chemical+bond

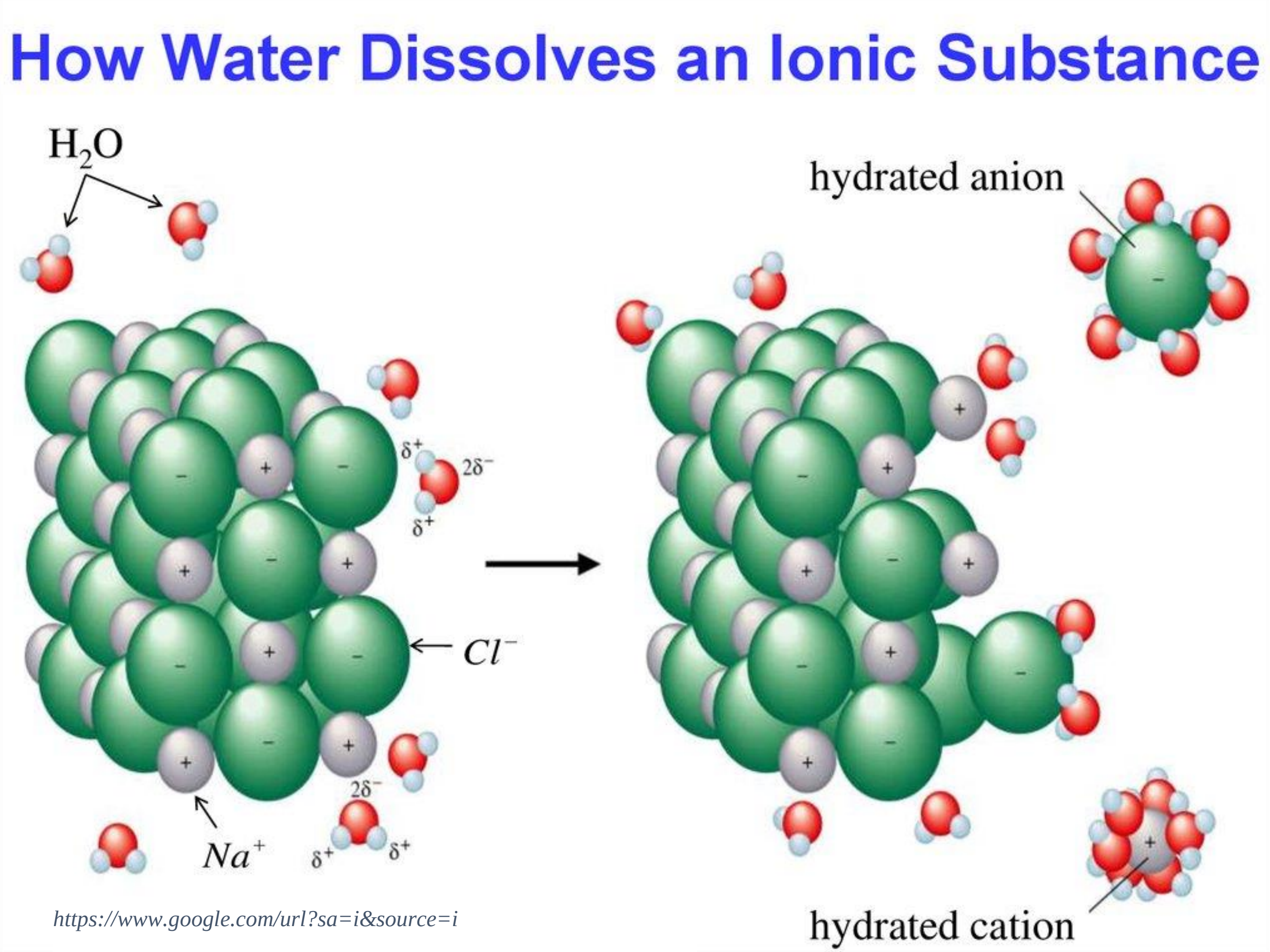


https://www.ck12.org/c/physical-science/covalent-bond/lesson/Covalent-Bonding-MS-PS/

Solutions Review:

Dissociation:

- The "**BREAKING UP**" of an **IONIC SOLUTE** by dissolving in a **SOLVENT**.



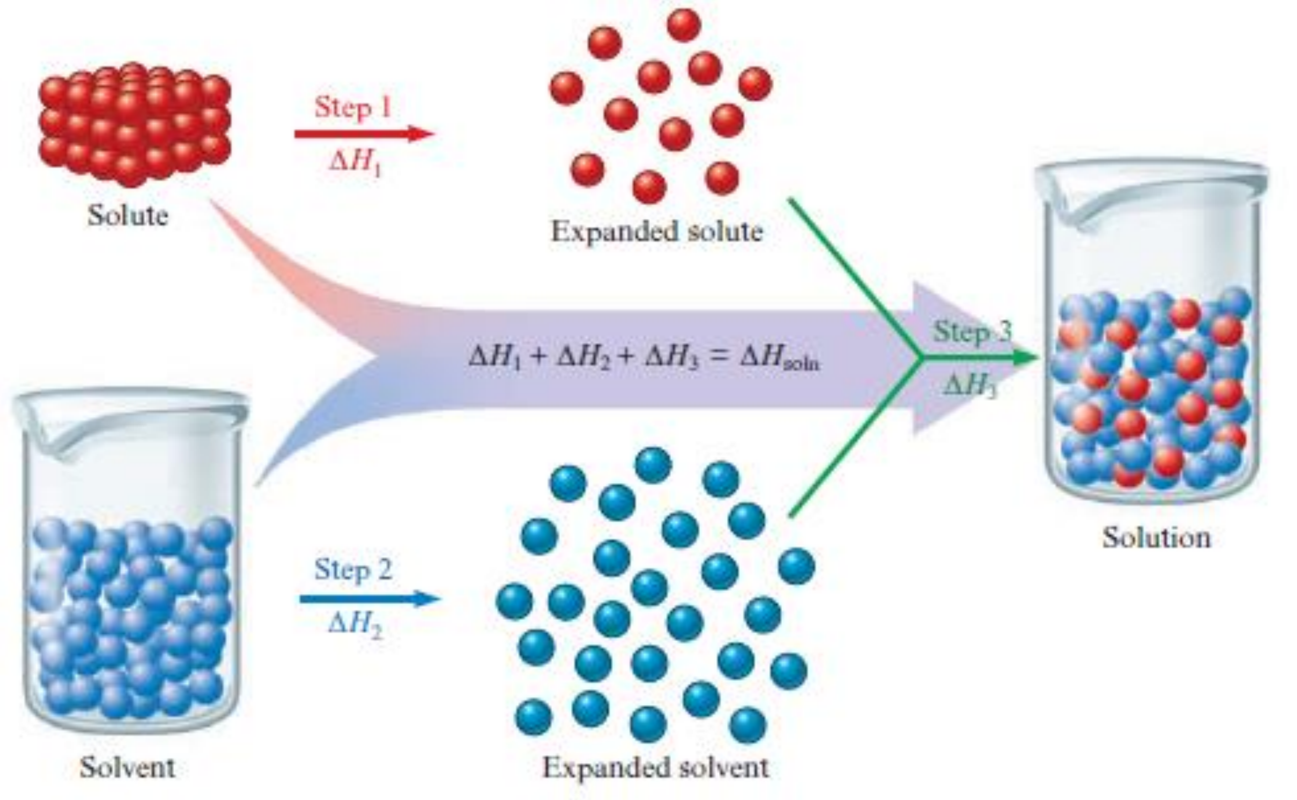
Solutions Review:

Solute:

- The substance **BEING DISSOLVED**.

Solvent:

- The substance **DOING** the **DISSOLVING**.



https://lightcat-files.s3.amazonaws.com/ 1

Dissolving Molecular Compounds:

- A **MOLECULAR** (covalent) compound will dissolve as a **WHOLE**, **UNCHARGED** molecule.
- It gets **SURROUNDED** by **SOLVENT** molecules.
- Will not carry a **CURRENT** because molecules are **UNCHARGED**.
- This is why a **SUGAR** solution is not an **ELECTROLYTE**.

Example of dissolving a covalent compound...

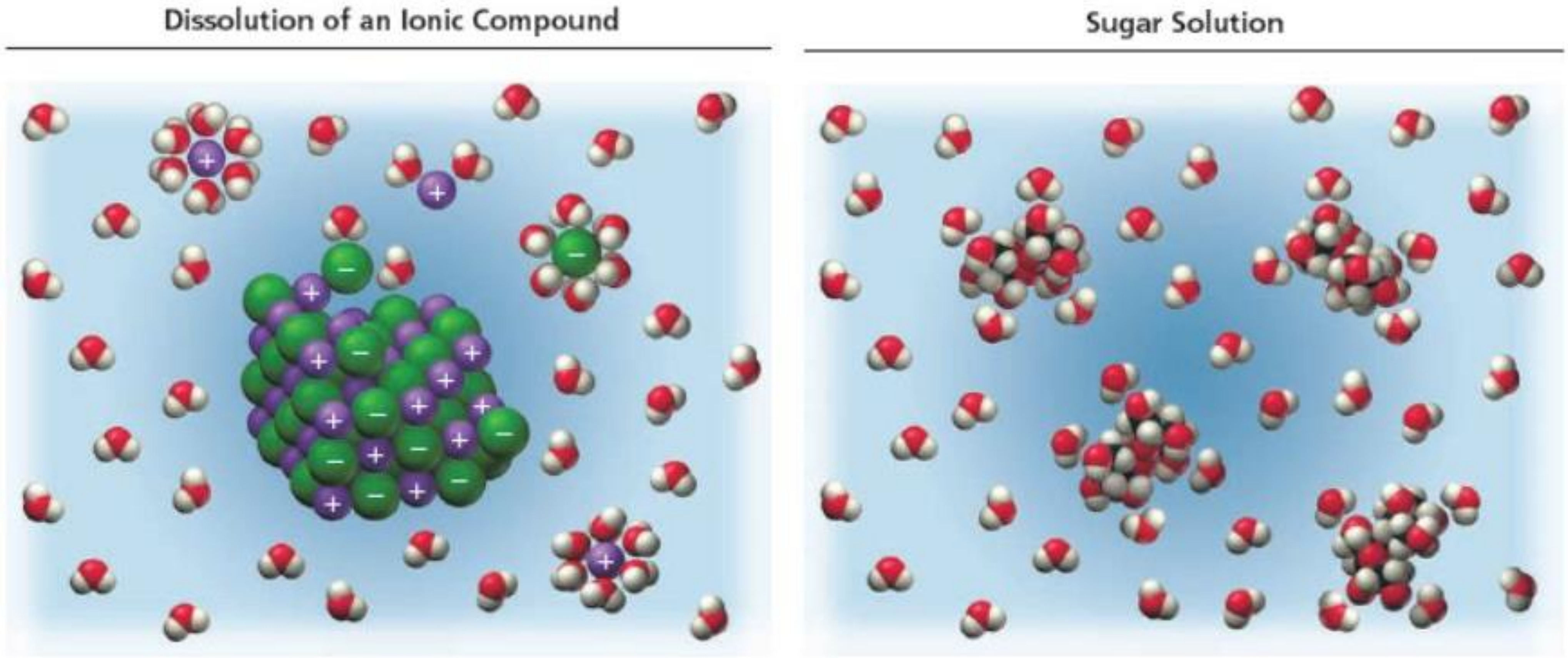
Dissolving Ionic Compounds:

- When **IONIC** compounds are dissolved, they **DISSOCIATE** (break up into **IONS**).
- These **IONS** are free to **MOVE** and **CARRY** **ELECTRIC** **CURRENT**.
- This is why a **SALT** solution is an **ELECTROLYTE**.

Example of dissolving an ionic compound…

Let's put it all together…

Dissolving Ionic vs. Molecular Compounds:



ionic compounds dissociate into ions when they dissolve

molecular compounds do not dissociate when they dissolve

http://slideplayer.com/slide/6218165/

Theory of Electrolytes:

https://www.nobelprize.org/images/arrhen 1

- Svante Arrhenius is credited with this theory explaining how different compounds dissolve.
- He stated that some solutions were able to conduct electricity because they formed ions, and he called these solutions **ELECTROLYTES**.
- He also discovered that **DIFFERENT COMPOUNDS** in solution conducted **DIFFERENT** amounts of **ELECTRICITY**
- He proposed that this was due to **DIFFERENT AMOUNTS** of **IONS** being produced during dissociation…

Example…

Theory of Electrolytes:

Arrhenius described the differences in conductivity as the **STRENGTH** of the electrolyte:

Weak Electrolytes:

- A substance that only **PARTIALLY DISSOCIATES** - Usually **POLAR COVALENT** molecules.
- Conduct **ELECTRICITY**, but **NOT** very **WELL**
- Ex. **VINEGAR** ($HC_2H_3O_2$)

Strong Electrolytes:

- Produces **MANY IONS** in solution (**DISSOCIATE COMPLETELY**) - Usually **IONIC** compounds.
- Conduct electricity **VERY WELL**.
- Ex. **$NaCl_{(aq)}$, HCl**

Non-Electrolytes:

- A substance that does not **DISSOCIATE** - Usually **PURE COVALENT** molecules.
- Are non-conductive.
- Ex. **SUGAR** ($C_6H_{12}O_6$)

Dissociation Equations:

We can write **DISSOCIATION** equations that show the **IONIZATION** of a substance in water.

Non-Electrolytes:

$C_{11}H_{22}O_{11(s)} \rightarrow C_{11}H_{22}O_{11(aq)}$

Strong Electrolytes:

$MgCl_{2(s)} \rightarrow Mg^{2+}_{(aq)} + 2Cl^{-}_{(aq)}$

Weak Electrolytes:

$Al(OH)_{3(s)} \leftrightarrow Al^{3+}_{(aq)} + 3OH^{-}_{(aq)}$

More on this "double arrow" later…For now we will assume that all compounds are strong electrolytes if they are soluble

Dissociation Equations & Stoich:

We can use the stoichiometry of the dissociation equation to determine the concentration of ions in a solution…this will be helpful when we deal with acids and bases.

Example:

Write the dissociation equation and determine the concentration of hydrogen ions in a 0.5mol/L solution of hydrochloric acid.

1:1 ratios

$$HCl_{(g)} \rightarrow H^{+}_{(aq)} + Cl^{-}_{(aq)}$$

$$0.5\,\frac{mol}{L} \rightarrow 0.5\,\frac{mol}{L} \quad 0.5\,\frac{mol}{L}$$

Dissociation Equations & Stoich:

Try this one…

Determine the concentration of chloride ions in a 0.3mol/L solution of $AlCl_3$.

$$AlCl_{3(s)} \longrightarrow Al^{3+}_{(aq)} + 3Cl^{-}_{(aq)}$$

$$0.3\,\frac{mol}{L} \longrightarrow 0.3\,\frac{mol}{L} \quad 0.9\,\frac{mol}{L}$$

$$[Al^{3+}] = 0.3\,\frac{mol}{L}$$

↑

"Concentration of" Al^{3+}

Cl^- Na^+

Cl Na

[ ]