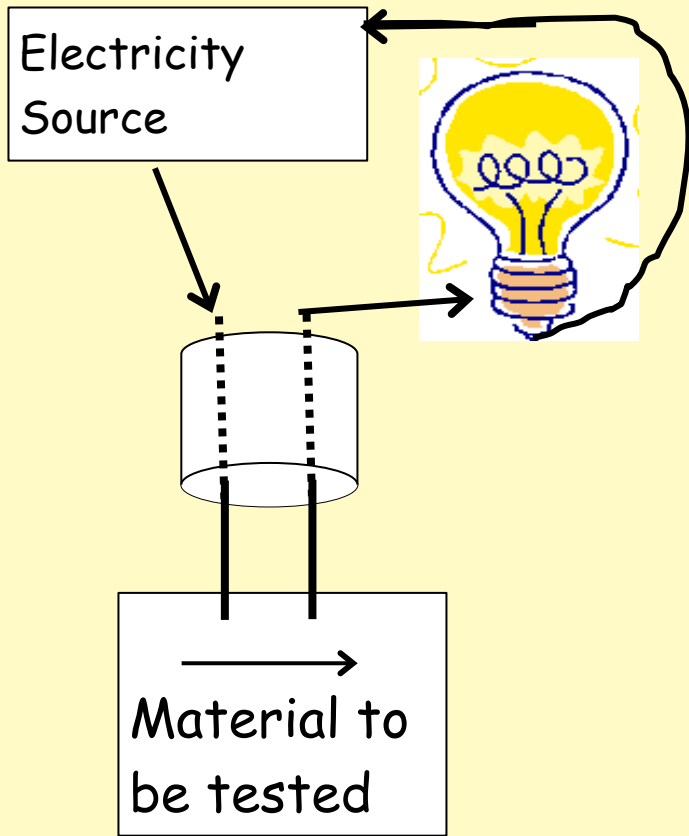


LAD 4.1



The arrows indicate the path of electrons

Electrolytes

Chemicals that dissolve in water that produce a solution that conducts electricity.

slide view

Solids in solid form are *not* electrolytes, but for perspective and comparison; Predict which of the following solids you think will conduct electricity? *Mark ALL that apply.*

1. metal
2. wood
3. plastic
4. graphite, carbon
5. glass

Solids: Which of the following will conduct electricity? *Mark ALL that apply.*

1. metal

2. wood

3. plastic

4. graphite, carbon

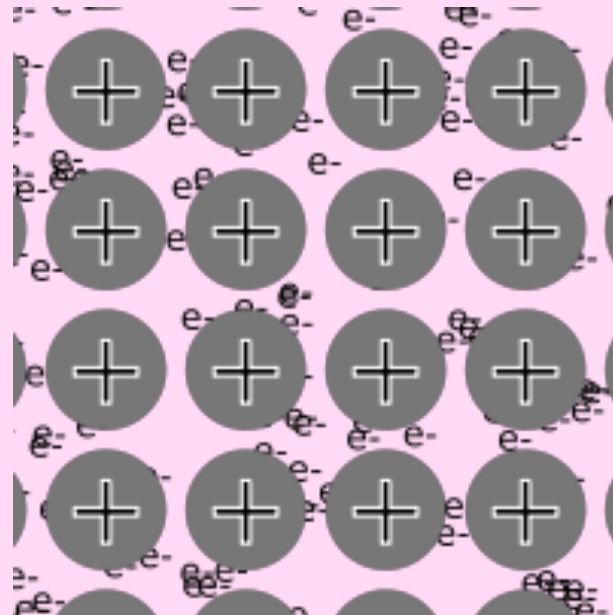
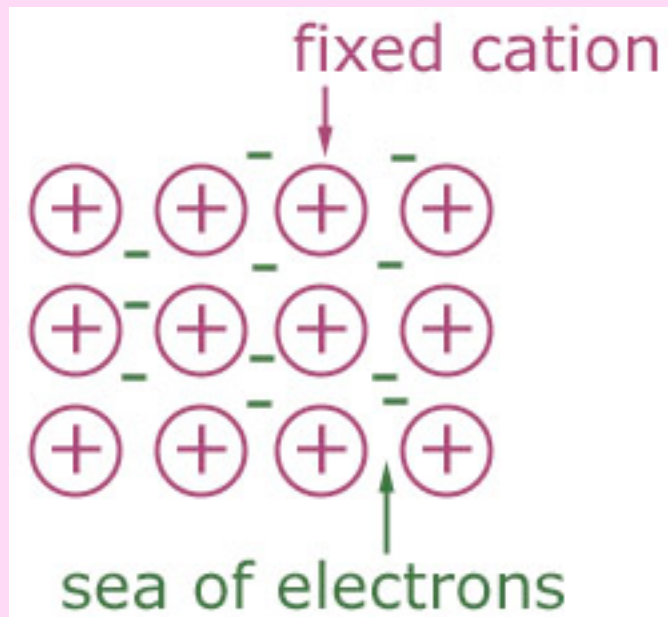
5. glass

- For electricity to conduct, electrons must be able to move.
- How is it that electrons move in metal and graphite?

slide show

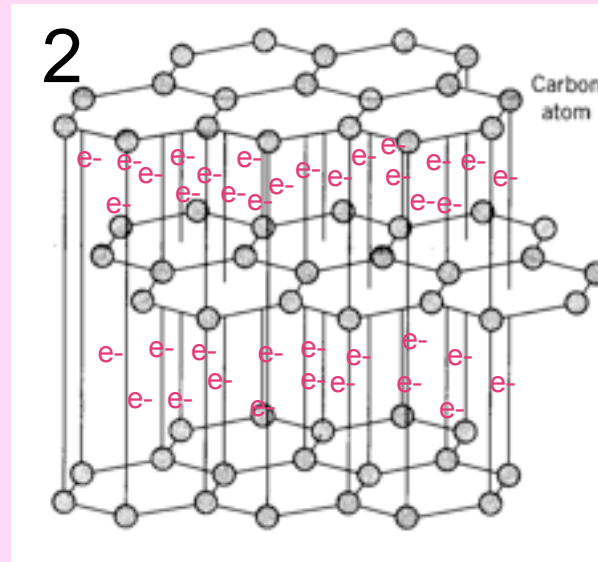
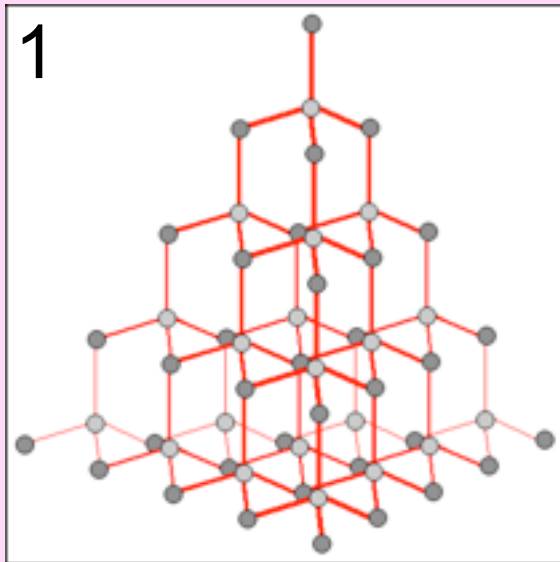
Metals - A Model to explain conductivity

1. Scientists need a model that will describe the fact that metals conduct electricity.
2. The current model is a “sea of electrons” swishing about a group of cations.
 - The cations are the nucleus surrounded by the *inner core* of electrons,
 - The valence electrons are “delocalized” and free to move.



Diamonds vs Graphite

1. In diamonds each C atom is bonded to four other atoms, holding the atoms substance very tightly.
 - This makes diamonds very hard, but not electrically conductive.
 - The electrons making up the bonds are very much “stuck in place.”
2. In graphite, each C atom is bonded to 3 other atoms and then the 4th bond holds the sheets together.
 - The electrons making up the bonds between the sheets are “delocalized” and able to move.
 - This makes the sheets of graphite able to slide, and electrically conductive.



What do we need for electricity to flow?

- The ability of electrons to move.
 - ✓ metals have mobile electrons
 - ✓ graphite has mobile electrons
- So, moving beyond solids, lets consider the conductivity of liquids and solutions.

Ice and liquid water. Which (or both) will conduct electricity? *Mark ALL that apply.*

1. Ice will conduct electricity.
2. Liquid water will conduct electricity.
3. Neither will conduct electricity.

Ice and liquid water. Which (or both) will conduct electricity? *Mark ALL that apply.*

1. Ice will conduct electricity.
2. Liquid water will conduct electricity.
3. Neither will conduct electricity
 - water will conduct ever so slightly....

Salt, will it conduct electricity?

Select ALL that apply.

1. Solid salt will conduct electricity.
2. Melted salt will conduct electricity.
3. Dissolved (in distilled water) salt will conduct electricity.
4. None of them will conduct electricity.

Salt, will it conduct electricity?

Mark ALL that apply.

1. Solid salt will conduct electricity.
2. Melted salt will conduct electricity.
3. Dissolved (in water) salt will conduct electricity.
4. None of them will conduct electricity.

Why doesn't water conduct electricity?

- No mobile electrons

Why does melted salt conduct?

Why does dissolved salt conduct?

- Melted salt



- The heat breaks the +/- crystal apart and the ions become free to move and “carry” the moving electrons (electricity).

- Dissolved salt



- The water breaks the +/- crystal apart and the ions become free to move and “carry” the moving electrons (electricity).

What do we need for electricity to be able to flow?

- In solids, we needed mobile electrons.
- In liquids/solutions, we need charged particles that are free to move.
- Electrolytes are solids when dissolved in water will produce a solution that conducts electricity

slide view

Sugar, will it conduct electricity?

Mark ALL that apply.

1. Solid sugar will conduct electricity.
2. Melted sugar will conduct electricity.
3. Dissolved sugar will conduct electricity.
4. None of them will conduct electricity.

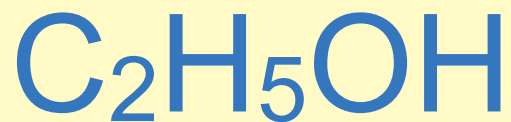
Sugar, will it conduct electricity?

Mark ALL that apply.

1. Solid sugar will conduct electricity.
2. Melted sugar will conduct electricity.
3. Dissolved sugar will conduct electricity.
4. None of them will conduct electricity.

Will alcohol conduct electricity?

1. Yes



2. No

3. I feel like I can't even begin to make a prediction.

Will alcohol conduct electricity?

1. Yes
2. No
3. I feel like I can't even begin to make a prediction.

Will salt in alcohol conduct electricity?

1. Yes
2. No
3. I feel like I can't even begin to make a prediction.

Will salt in alcohol conduct electricity?

1. Yes

2. No

- It would if the salt could dissolve and ionize, but salt doesn't dissolve in isopropyl alcohol.

3. I feel like I can't even begin to make a prediction.

So we need a model for why some substances conduct and others do not.

Remember that for electricity to conduct, electrons must be able to move.

- Ionic compounds will conduct, but only when they are melted or dissolved, not when they are solid.
- So what is it about being melted or dissolved that lets or helps electrons to move?
 - ✓ Unstuck (mobile) charged particles.
- Molecular compounds such as sugar or alcohol do not conduct electricity as a solid, melted (liquid) or dissolved
 - ✓ So it must be more than just being mobile.
 - ✓ Molecular compounds do NOT contain ions. Thus there is no vehicle for the electricity (electrons) to ride on.
- ☺ Check out the movie on the next slide for a visual representation.

A model to understand electrolytes.

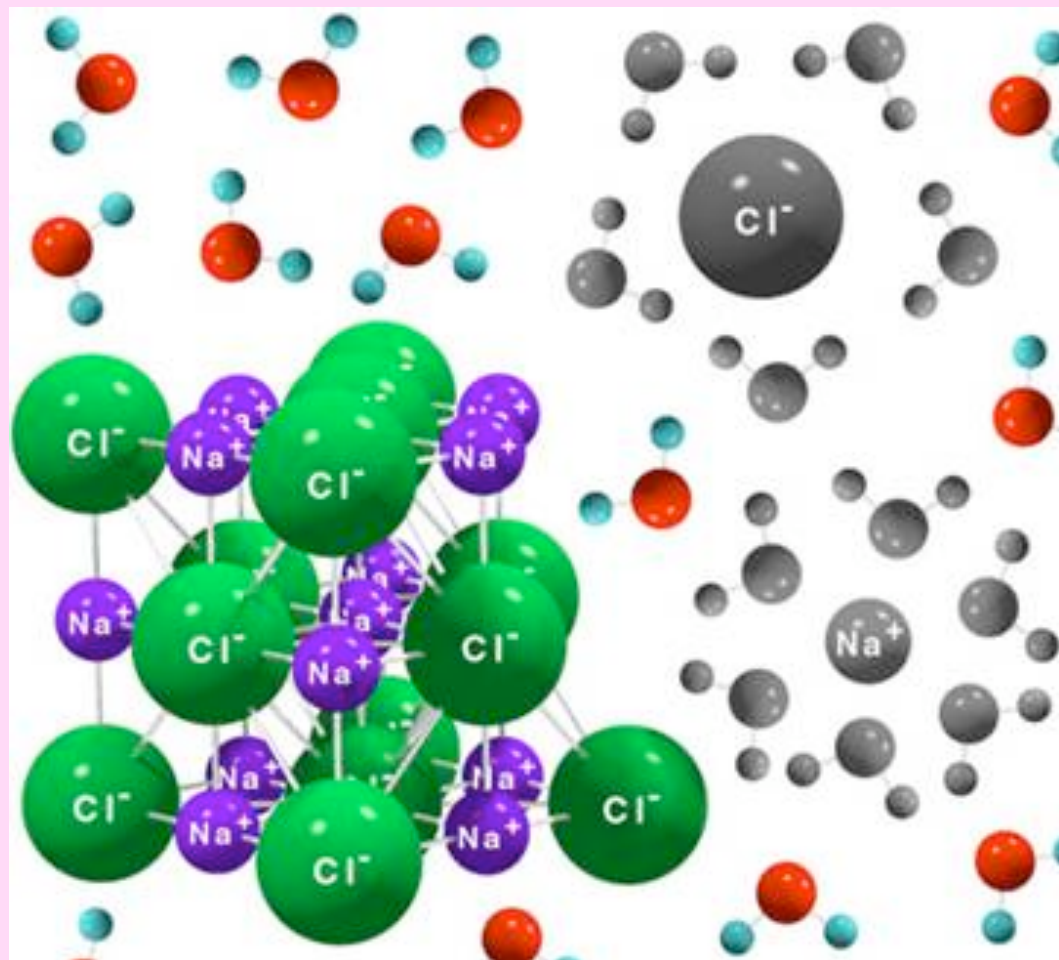
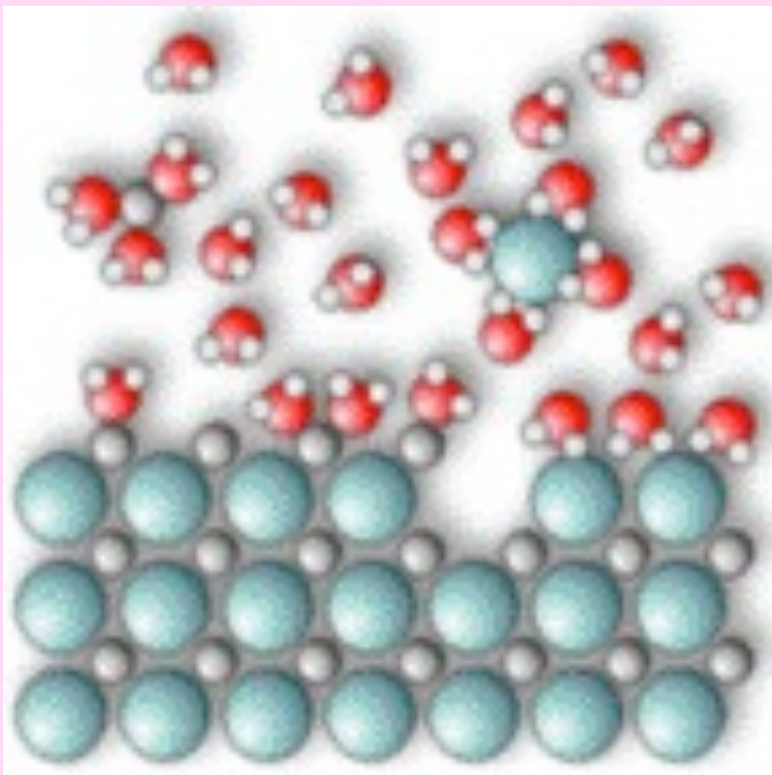
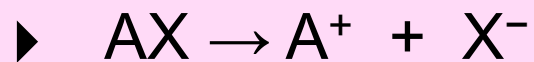
- The movie shows how ionic compounds produce mobile ions when dissolved in water.
- When melted, the ions are also separated and free to move.



Electrolytes and
Non-electrolytes

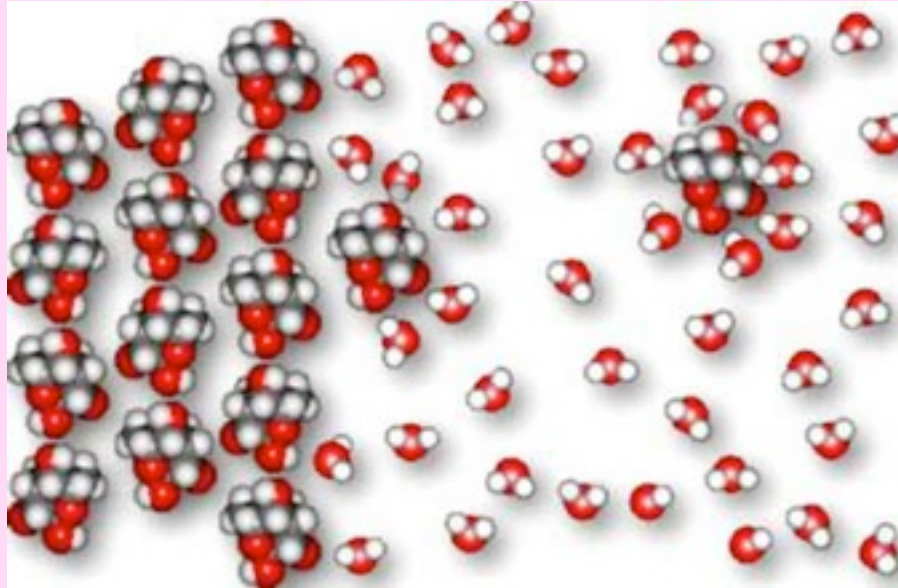
When ionic compounds dissolve, they dissociate into their charged particles that are able to carry electricity
Charged particles in solution = electrolyte.

- Generic Reaction for the dissolving of any ionic compound:

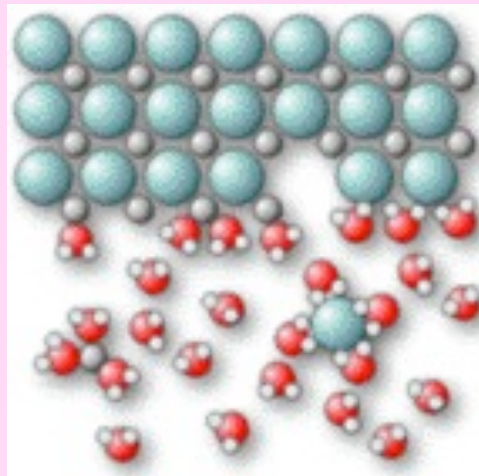


When sugar dissolves in water, the molecules do NOT dissociate into ions and can NOT carry electricity = Nonelectrolyte.

1. Sugar



2. Salt



Will acids conduct electricity?

hydrochloric acid HCl

acetic acid (vinegar) $\text{HC}_2\text{H}_3\text{O}_2$

1. Yes, vinegar will conduct
2. Yes, hydrochloric acid will conduct
3. Neither will conduct (because they are molecular compounds)
4. I can't even begin to make a prediction.

Will acids conduct electricity?

hydrochloric acid HCl

acetic acid (vinegar) $\text{HC}_2\text{H}_3\text{O}_2$

1. Yes, vinegar will conduct
2. Yes, hydrochloric acid will conduct
 - though we notice the HCl conducts better.
3. Neither will conduct (because they are molecular compounds)
4. I can't even begin to make a prediction.

concentrated vs dilute *and* strong vs weak

- Concentration refers to the amount of substance dissolved in a liquid to make a solution.
 - ✓ adding more or less salt, sugar, or acid would make a solution more or less concentrated.
- Strong/weak refers to the amount of the substance that actually ionized.
 - ✓ All salts that dissolve, completely ionize and are therefore strong electrolytes.
 - ✓ Molecular compounds such as sugar and alcohol do not ionize at all, and are therefore non-electrolytes.
 - ✓ Acids “straddle the line,” they are molecular compounds that do ionize and are therefore electrolytes.
 - ▶ Strong acids completely ionize and are strong electrolytes.
 - ▶ Weak acids, though they dissolve completely, do not completely ionize (dissociate) and are weak electrolytes.

concentrated vs dilute *and* strong vs weak

- You can have a concentrated strong acid
 - ✓ good at conducting electricity
- You can have a dilute strong acid
 - ✓ not as good at conducting electricity
- You can have a concentrated weak acid
 - ✓ not so good at conducting electricity (although might be better than a really dilute strong acid)
- You can have a dilute weak acid
 - ✓ very poor conducting solution, but better than a molecular compound such as pure water or alcohol.

So, to recap....

- What is an electrolyte?
 - ✓ *A chemical that dissolves in water that produce a solution that conducts electricity.*