Electrical Conductivity of Aqueous Solutions

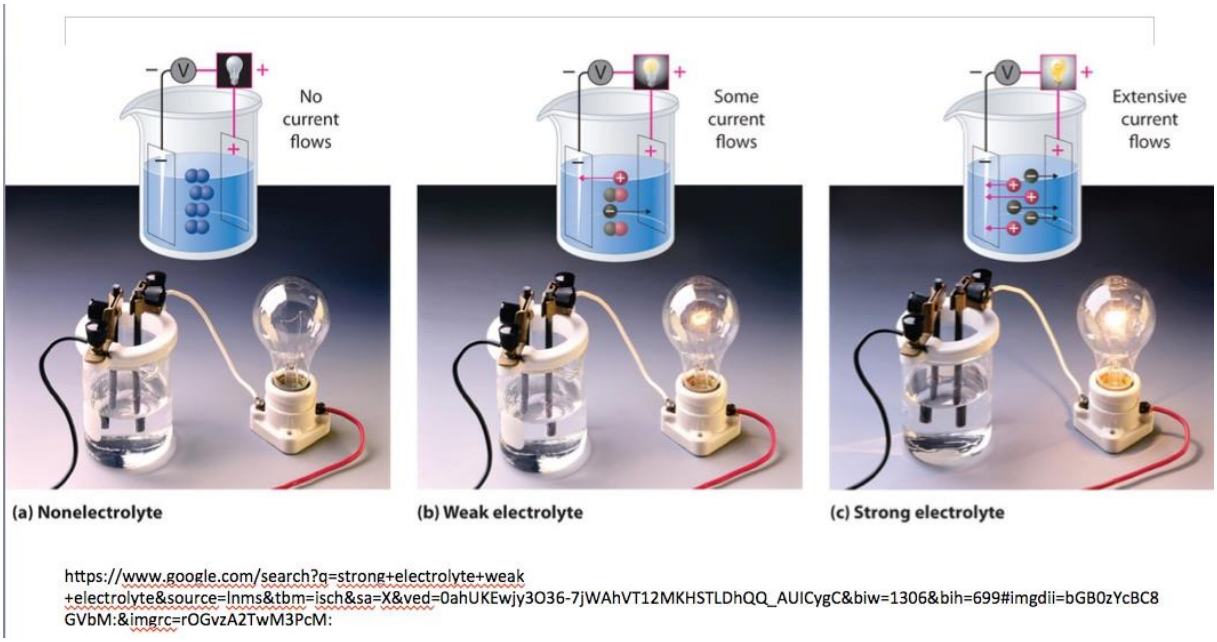
Objectives

The objectives of this laboratory are:

a) To observe electrical conductivity of substances in various aqueous solutions
b) To determine of the solution is a strong or weak electrolyte
c) To interpret a chemical reaction by observing aqueous solution conductivity.

Background

Electrical conductivity is based on the flow of electrons. Metals are good conductors of electricity because they allow electrons to flow through the entire piece of material. Thus, electrons flow like a "sea of electrons" through metals. In comparison, distilled water is a very poor conductor of electricity since very little electricity flows through water. Highly ionized substances are **strong electrolytes**. Strong acids and salts are strong electrolytes because they completely ionize (dissociate or separate) in solution. The ions carry the electric charge through the solution thus creating an electric current. When connected to a power source, a strong electrolyte solution can conduct enough electricity to light a bulb, as shown in the figure below.



https://www.google.com/search?q=strong+electrolyte+weak+electrolyte&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjy3O36-7jWAhVT12MKHSTLDhQQ_AUICygC&biw=1306&bih=699#imgdii=bGB0zYcBC8GVbM:&imgrc=rOGvzA2TwM3PcM:

Slightly ionized substances are **weak electrolytes**. Weak acids and bases would be categorized as weak electrolytes because they do not completely dissociate in solution. Weak electrolyte solutions would cause the bulb to light, but not as brightly.

Substances that do not conduct an electric current are called **non-electrolytes**. Non-electrolytes do not ionize; they do not contain moveable ions. The lightbulb will not turn on because there are no ions to carry the electric current. The table below lists examples of strong, weak and non-electrolytes.

Strong Electrolytes	**Weak Electrolytes**	**Non-Electrolytes**
Strong Acids (e.g. HCl)	Weak Acids (e.g. HCl)	Molecular compounds (e.g. $C_6H_{12}O_6$
Strong Bases (e.g. NaOH)	Weak Bases (e.g. NaOH)	
Soluble Salts (e.g. NaCl)	Slightly Soluble Salts (e.g. NaCl)	

Procedure

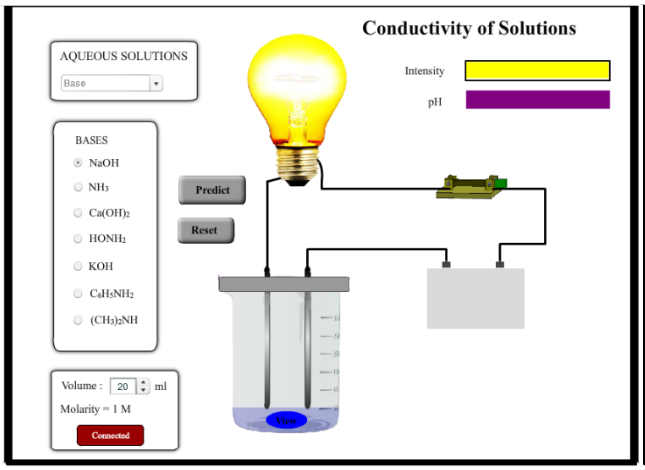
For this virtual experiment, you will use a computer simulation representing the conductivity of solutions experiment with a light bulb. You can directly access the simulation at: https://chemdemos.uoregon.edu/sites/chemdemos1.uoregon.edu/files/Conductivity%20of%20acid%20base%20salt%20and%20unknown-karthik.swf

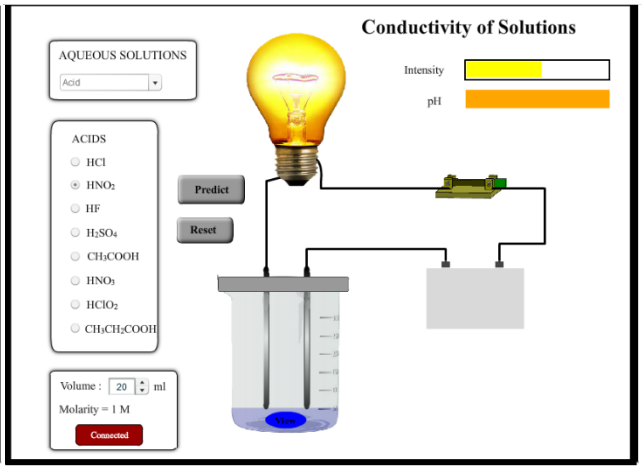
Or go to https://chemdemos.uoregon.edu/demos/Conductivity-Testing-of-Electrolytes-Computer-Simulation and click on Conductivity of acid base salt and unknown-karthik.swf

Examples

- From the drop-down menu under AQUEOUS SOLUTIONS, select Base. Then select NaOH from the list of bases. Click the "Predict" button, select one of the choices, then click "Submit". You should see that the light bulb has turned bright yellow, and the Intensity bar is completely yellow (bottom left image). Look at the lab report sheet to see how that example was entered.

- Click "Reset", then select HNO_2 from the list of acids. Click the "Predict" button, select one of the choices, then click "Submit". You should see that the light bulb has turned a dim orange, and the Intensity bar is completely only half yellow (bottom right image). Look at the lab report sheet to see how that example was entered.





Conductivity Testing – Evidence for Ions in Aqueous Solution

- Click "Reset", then select De-ionized Water from the drop-down menu under AQUEOUS SOLUTIONS.
    1. Click the "Predict" button, select one of the choices, and record your prediction on your lab report sheet.
    2. Click "Submit", then record the observed light intensity on your report sheet.
    3. Use the observed light intensity to determine the level of conductivity (high, medium, or low), the type of aqueous solution (strong electrolyte, weak electrolyte, or non-electrolyte), and whether the species in solution are fully ionized, partially ionized, or not ionized.
- Repeat the process for each compound listed on your report sheet. Remember to click "Reset", before selecting the next compound.