

## Deducing the energetic of dissolution.

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For each of the substances: Urea –  $\text{H}_2\text{NC}(=\text{O})\text{NH}_2$   
 $\text{NH}_4\text{Cl}$   
 $\text{CaCl}_2$   
 $\text{NaCl}$   
Ethanol,  $\text{C}_2\text{H}_5\text{OH}$

you will do the following:

- mix each with water
- observe any energy (heat) changes
- test the conductivity,
- make a plot of energy changes for the process
- draw the hydration of the solute.
- suggest which step makes the most important contribution to the **observed energy change**.

At the end of class I will ask each group to put one energy diagram on board and describe it.

### Instructions:

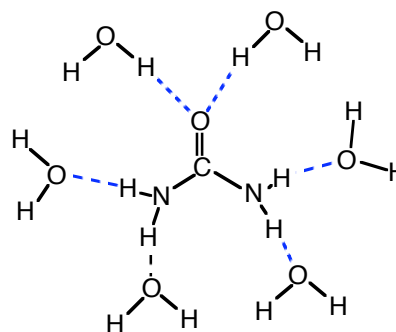
- Mixing:** To the urea and ethanol vials, add ~ 1/3 of a pipetteful of water  
To the  $\text{NH}_4\text{Cl}$ ,  $\text{CaCl}_2$ ,  $\text{NaCl}$  solids add water using the pipette to almost fill the vial.
- Heat changes:** Ask a group member to hold the vial as you are adding water, to immediately sense any changes in temperature. Make a note on your sheet (see next page)
- Conductivity:** Connect the conductivity meter to the battery and insert the copper leads into the vials, **BEING CAREFUL NOT TO GET THE WOOD STICK WET!!!** Does anything happen? Rinse the copper leads with distilled water from the wash bottle, collecting washing in plastic cup.
- Make Graphics:** Draw an energy plot showing how the energy changes as the pure solute dissolves in water to form a solution. Draw a picture illustrating the hydration of the solute at the molecular level. Which part of the energy diagram accounts for the observed heat change?

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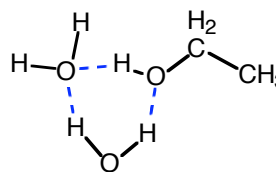
### Possibly Useful Vocabulary:

Solvent	Hydrated ion
Solute	Ion-dipole interactions
Dissolution	Ionic solid
Homogeneous vs heterogeneous solutions	Anion
Endothermic	Cation
Exothermic	Lattice energy
Solvation	Hydration (or solvation) energy
Hydration	

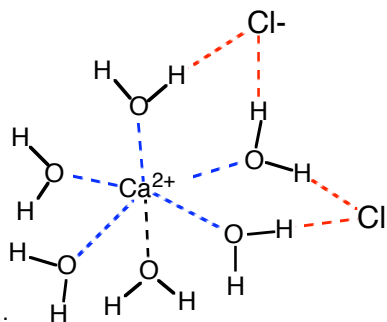
Urea

 $\Delta E_{\text{loss}}$   
interactions $\Delta E_{\text{solvation}}$  $\Delta E_{\text{total}} > 0$ , heat was added for dissolution,  
solution cooled

Ethanol

 $\Delta E_{\text{loss}}$   
interactions $\Delta E_{\text{solvation}}$  $\Delta E_{\text{total}} < 0$ , heat was released on dissolution,  
solution warmed

CaCl2

 $\Delta E_{\text{loss}}$   
interactions $\Delta E_{\text{solvation}}$  $\Delta E_{\text{total}} < 0$ , heat was released on dissolution,  
solution very warm

NH4Cl

 $\Delta E_{\text{loss}}$   
interactions $\Delta E_{\text{solvation}}$  $\Delta E_{\text{total}} > 0$ , heat was added for dissolution,  
solution very cool