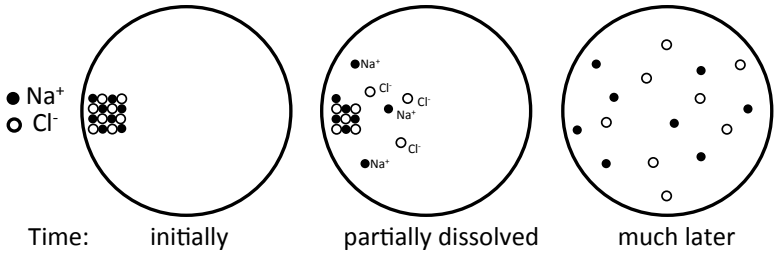
Puddle Chemistry: Ionic Substances Dissolving in Water and the Formation of a Precipitate

In this set of experiments, we will explore how ionic substances dissolve, how fast ions move through water and how precipitation reactions occur. All of this will be done on a miniature scale. In this first experiment, we will work through the experiment step-by-step and try to capture with sketches what is occurring along the way.

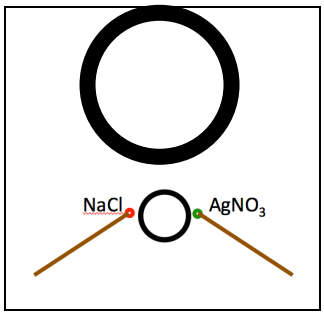
Ionic Salts Dissolving in Water. Before we begin, watch the YouTube video on NaCl dissolving in water. Link to this video from our lab web page. After viewing the video, copy the sketch shown here **into your laboratory notebook**. The sequence summarizes the dissolving process. The large circles represents a blob of water and the checkerboard pattern is a crystal of NaCl. The leftmost picture shows such a crystal just added to a blob of water. In the middle picture (again in your laboratory notebook), sketch some NaCl as a solid along with some $Na^+(aq)$ and $Cl^-(aq)$. You can represent these ions by writing their formulas (Na^+ and Cl^-) in the water or by using the circles shown by the key. Both are acceptable. The rightmost sketch shows the situation after all of the NaCl(s) has dissolved. Sketch a similar sequence for $AgNO_3(s)$ dissolving in water to form $Ag^+(aq) + NO_3^-(aq)$. The chemical equation that summarizes the dissolving process for NaCl is:



$$NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)$$

Precipitation. Start by watching the second YouTube video at our lab website. You will see this experiment being performed – it takes a minute to watch. Now we can try it ourselves using the copy of this page protected by a plastic sleeve. Add ten drops of distilled water to the large circle provided to the right. Crystals as few as one at a time (or small amounts of powder) can be transported by a toothpick moistened with distilled water.

Experiment 1. Read this paragraph through first. Stick the tip of the toothpick in a beaker of distilled water and then touch it to the solid to be moved. Crystals will stick to the toothpick. You may have to tap the toothpick to the inside of the glass bottle to remove excess solid. The figure at right shows the toothpicks (brown) transporting the solids when the experiment is ready to performed. Holding a toothpick in each hand, simultaneously touch the toothpicks to the water on opposite sides. Immediately pull the toothpicks out – the crystals should drop off on opposite sides of the water blob. Observe the blob of water over the next two minutes.



Record your observations in your laboratory notebook. Use three drawings: (1) Show the two solids on opposite sides of the water blob starting to dissolve. If you use symbols for the ions, you will need four symbols. This sketch may be similar to the middle one above. (2) Sketch the formation of the precipitate, AgCl(s). You may indicate the precipitate by writing AgCl(s) where you saw it forming along with a sketch of the precipitated material (perhaps using shading to indicate the area and shape of the precipitate). (3) A sketch of ions and precipitate after you think net ion movement has stopped. Are the aqueous ions distributed throughout the solution? The precipitate may be settling out because it is more dense than water. The reactions:

Balanced: $NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$

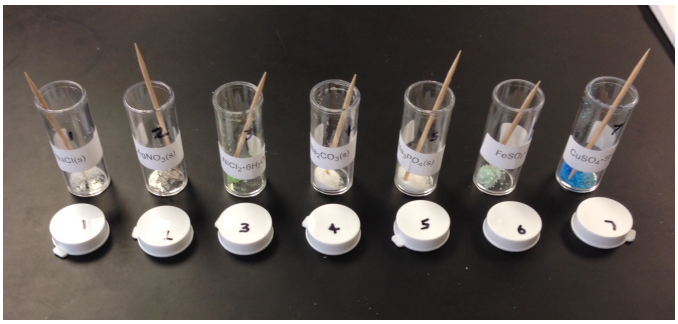
Ionic: $Na^+(aq) + Cl^-(aq) + Ag^+(aq) + NO_3^-(aq) \rightarrow AgCl(s) + Na^+(aq) + NO_3^-(aq)$

Net ionic: $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

Wipe off plastic sheet with a paper towel and discard in the trash. Ag^+ may leave a black stain on your fingers: You may use a disposable glove if you wish – or enough paper towel so your fingers do not contact the solution.

Ask your TA to check your sketches before continuing.

Remove the caps from the rest of the vials and arrange them in numerical order as shown at right: each vial has a corresponding numbered cap – do not switch caps. Place a toothpick in each vial and store it there when not being used to prevent cross-contamination. Repeat the same experiment with six other combinations of ionic solids. Use 10 drops of distilled water for each experiment. Each reaction takes less than 3 minutes to occur. In each case, record all observations and make three sketches in your laboratory notebook:



1. Ions dissolving and colors of the solution made – in most cases, one side of the puddle has the color and the other is colorless. Clearly identifying the ions with formula and charge.
2. Precipitate forming – sketch shape and record the color.
3. The situation after 5 minutes.

Next, write the balanced equation, the ionic equation and the net ionic equation for each.

Experiment 2. $NiCl_2 \cdot 6H_2O(s) + Na_2CO_3(s)$	**Experiment 3. $NiCl_2 \cdot 6H_2O(s) + Na_3PO_4(s)$**
Experiment 4. $FeSO_4 \cdot 7H_2O(s) + Na_2CO_3(s)$	**Experiment 5. $FeSO_4 \cdot 7H_2O(s) + Na_3PO_4(s)$**
Experiment 6. $CuSO_4 \cdot 5H_2O(s) + Na_2CO_3(s)$	**Experiment 7. $CuSO_4 \cdot 5H_2O(s) + Na_3PO_4(s)$**

Wipe off plastic sheet with a paper towel and discard in the trash. Discard toothpicks. Replace caps.

Credit for this experiment goes to Bob Worley of CLEAPSS, (UK).