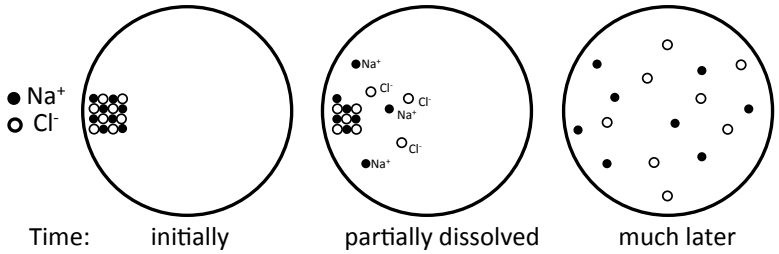
Microscale Precipitation Chemistry

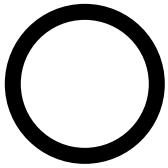
In this set of experiments, we will explore how ionic substances dissolve, move through the water and how precipitation reactions occur. All of this will be done on a miniature scale – chemistry instructors call it ***microscale***. Before we begin, watch the two YouTube videos linked from our lab website for this experiment. In the second one, you will see this experiment being performed – it takes a minute to watch.

Ionic Salts Dissolving in Water. After viewing the video, copy the sketch shown here **into your laboratory notebook**. The sequence summarizes the dissolving process. The large circles represent a 10-drop blob of water and the checkerboard pattern is a crystal of NaCl. The leftmost picture shows such a crystal just added to the 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. The chemical equation that summarizes the dissolving process for NaCl is shown here. Complete the analogous reaction for $AgNO_3(s)$.

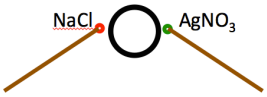


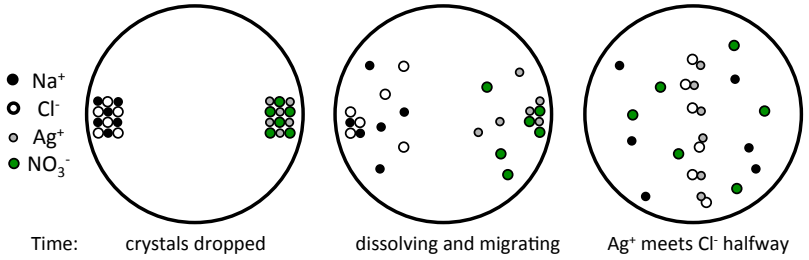
1. Dissolving: $NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)$ **Now you do:** $AgNO_3(s) \rightarrow$

Precipitation. 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.



Experiment 1. **Read this paragraph through first.** Remove the lid to Vials 1 (NaCl) and 2 ($AgNO_3$). Wet the tip of two toothpicks in a beaker of distilled water and then touch one toothpick to the NaCl and the other to the $AgNO_3$. Crystals should 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 blob on opposite sides. Immediately pull the toothpicks out – the crystals should drop off on opposite sides of the water puddle. Observe the blob of water over the next two minutes. Record your observations in your laboratory notebook. Use three drawings as shown at right: (1) Show the two solids on opposite sides of the water blob starting to dissolve. (2) Sketch the ions moving towards each other, and (3) the formation of the precipitate, AgCl(s) somewhere in the middle. After dissolving, the ions migrate across the blob of water. Where the two ion fronts collide, precipitation occurs for silver ion and chloride, while the other two ions continue to migrate:





2. Overall: $NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$

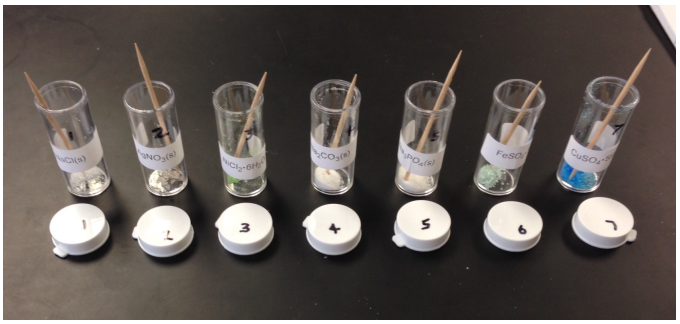
3. Ionic: $Na^+(aq) + Cl^-(aq) + Ag^+(aq) + NO_3^-(aq) \rightarrow AgCl(s) + Na^+(aq) + NO_3^-(aq)$

4. 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. (Doing these sketches once for Experiment 1 is enough – the other experiments would look very similar.)

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 in your laboratory notebook:



1. Thorough observations during the reaction. How long did it take until the precipitate appeared? What color was the precipitate? Did the color of the solution change or continue to migrate.
2. A sketch of the puddle after the precipitate is formed. (Use shading to catch the shape and location.)
3. The balanced overall reaction and the net ionic equation, both with states of matter. (Ok to skip ionic eqn)
4. The three pertinent solubility rules: One for each reactant (Why do they dissolve?) and one for the formation of the precipitate.

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).