

**Non-obvious controls:**

- Be sure to try all the different tabs at the top of the simulation. The model increases in difficulty as you go from **Table Salt** to the right.
- You can **Pause** the sim and then use **Step** to incrementally analyze.

**Important modeling notes / simplifications:**

- Water is not shown to help the students focus on the ion dissociation and crystal formation.
- The models are all qualitative interpretations of the three dimensional world. The crystal structures vary and the ion sizes vary to help the students build the concept that there are variations in the natural world, but to keep the simulation easy for students to develop their ideas, the models are oversimplified. The ion sizes are not to scale because the particle model wouldn't be visible in a reasonable size container. It might be good to show students tables with the correct sizes.
- Notice that the volume is much smaller in the **Table Salt** tab because it is so much more soluble.
- The solubility of salts often varies in references. We chose values that enabled modeling in a  $1 \times 10^{-16}$  L container. The sim is meant to be a useful tool for understanding  $K_{sp}$  and to enable students to see a wide variety of types of salts.
- To use the sim for problems where students are testing their predictions about what will happen relating Q&K, they will need to enter amounts in the ion **Total** space on the right.
- In the activity lesson plan by Trish Loeblein available from the **Teaching Ideas and Activities** link, there is a data table of results from multiple tests using the sim.

**Insights into student use / thinking:**

- $Tl_2S$  has such a small solubility (8/4) that the number of dissolved particles varies significantly, so it would not be a good one to use for calculating  $K_{sp}$  (Solubility Product Constant). It is a good situation to talk about sample size.
- My students were asked to explain how they know that a solution is saturated. A common misconception was that if there are no changes occurring that the solution is saturated. This misconception meant that several students were doing calculations for solubility and  $K_{sp}$  when the solution was actually unsaturated
- My students did sometimes guess that the container size was being adjusted because the particles sizes were different; so I had to help them understand the simplifications mentioned in the modeling notes.

**Suggestions for sim use:**

- For tips on using PhET sims with your students see: [Guidelines for Inquiry Contributions](#) and [Using PhET Sims](#)
- The simulations have been used successfully with homework, lectures, in-class activities, or lab activities. Use them for introduction to concepts, learning new concepts, reinforcement of concepts, as visual aids for interactive demonstrations, or with in-class clicker questions. To read more, see [Teaching Physics using PhET Simulations](#)
- For activities and lesson plans written by the PhET team and other teachers, see: [Teacher Ideas & Activities](#)