

**Non-obvious controls:**

- Be sure to try all the different tabs at the top of the simulation. The concepts increase in difficulty as you move to the right tabs.
- You can **Pause** the sim and then use **Step** to incrementally analyze.
- If you are doing a lecture demonstration, set your screen resolution to 1024x768 so the simulation will fill the screen and be seen easily.

**Important modeling notes / simplifications:**

- This simulation is designed to help students visualize reversible reactions, but the number of particles is small, so quantitative data is not a reasonable expectation.
- When you use the launcher in the straight shot mode, only the shot is straight on. The particles do not follow a linear path strictly.
- The total energy displayed represents the sum of kinetic + potential. If two particles collide, but at grazing angles or one from behind the other, not all of the kinetic energy is available to go into the reaction so there may not be enough for a reaction even though the total energy is greater than the barrier height.
- The collision model is simplified to be a basic elastic collision with the change in potential energy accounted for immediately after collision by appropriately adjusting the kinetic energy.
- When you add/remove energy using the PhET heater/cooler, the energy change is instantaneously seen in the particles. In real-life, the container would change temperature and then the particles would change energy through collisions, radiation, and convection. In this simulation, the simplification is made because the learning goals are focused on reactions and rates and not on energy transfer.
- The particle size is not part of the calculations. Different colors and sizes were used to help student's visualization.
- If you want to have students use a molecular model to calculate equilibrium constants, use *Salts and Solubility* where the data is more consistent and the values can be verified using a literature search,

**Insights into student use / thinking:**

- There is a comprehensive list of learning goals from the design team published in the Teaching Ideas and Activities <http://phet.colorado.edu/en/contributions/view/2980>

**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](#)