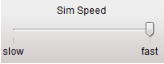**PhET Tips for Teachers       Atomic Interactions**

**Tips for controls:**
- This sim is like the **Interaction Potential** tab in States of Matter with the addition of providing diatomic molecules whose atoms are different.
- The sim needs to be in the **Play** mode to see the effects of changes. (the button will look            like
- The *Adjustable Attraction* is designed to help students construct their own understanding of the effects of *Atomic Diameter* and *Interaction Strength*.
- You can **Pause**          and then            use **Step** to incrementally analyze
- Try changing the sim speed            to help see changes
- The atom that is not pinned down can be dragged.

**Important modeling notes / simplifications:**

- The interaction between the two atoms is modeled using the Lennard-Jones potential.
- The atomic radius, which corresponds to σ (sigma), is the Van der Waals radius.
- When selecting pairs of atoms, the Oxygen-Oxygen selection is the only one in which the atoms bond.  When the bond forms, the shaking of the left atom is meant to represent the energy transferred away from the bonded pair.

**Insights into student use / thinking:**
- The force arrows were initially overwhelming to students; their first instinct was always to turn the feature off.  However, they did eventually use the arrows to make sense of the potential energy curve.
- Students had some problems with Potential energy, PE. They tried to connect PE with kinetic energy and/or difficulty with why PE can be below under the gray line.
- After students clicked on the "adjustable attraction" button in the control panel, they used the "atom diameter" slider to change the size of the atoms.  As they increased the atom diameter, they saw the atoms grow but did not notice that the distance between the atoms stayed the same, nor did they notice that the blue circle was no longer on the potential energy curve.  After they moved the slider to the far right, they let go and saw the unpinned atom fly off the play area.  Almost all students concluded that *the larger the atom diameter, the larger the repulsive force*.  When students clicked on the "return atom" button, they failed to notice that the distance between atoms was now larger.

**Suggestions for sim use**
- States of Matter might be used before this sim to help students understand atomic interactions on macroscopic relationships – molecular forces, phase, and temperature.
- 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**

Written by Loeblein, Lancaster last updated June, 2011