

In the **Atomic Interactions** simulation, students investigate how the relationship between attractive and repulsive forces govern the interaction between atoms.

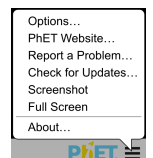
The screenshot shows the PhET Atomic Interactions simulation interface. It features a central graph of Potential Energy vs. Distance Between Atoms, a 3D visualization of two atoms, and a control panel on the right. Callout boxes provide instructions:

- SCALE** the graph: Points to the zoom-in (+) and zoom-out (-) icons.
- VIEW** the interaction between atoms: Points to the 3D atom visualization.
- DRAG** the unpinned atom or the dot on the graph: Points to the atom in the 3D view and the corresponding dot on the graph.
- CHOOSE** pairs of atoms to investigate or create a custom set: Points to the atom selection menu.
- HIDE or SHOW** forces between atoms: Points to the force display options (Attractive, Repulsive).

At the bottom of the simulation, there are controls for 'Slow Motion' and 'Normal' playback, and a PhET logo with a menu icon.

## Complex Controls

- The background of the simulation can be changed for easier projection by going to the PhET menu bar, selecting Options, and checking Projector mode.



## Insights into Student Use

- The force arrows are off by default as students initially found them overwhelming in interviews.
- Student interviews also indicated that students found the force arrows helpful for making sense of the potential energy graph.

## Model Simplifications

- The interaction between the two atoms is modeled using the Lennard-Jones potential.
- The atomic radius, which corresponds to  $\sigma$  (sigma), is the Van der Waals radius.
- For the oxygen-oxygen, epsilon ( $\epsilon$ ) roughly corresponds to the average bond energy. Sigma ( $\sigma$ ) was calculated based on the average bond length as the bottom of the potential energy well is located at the equilibrium bond distance.
- The bonding behavior for oxygen-oxygen is not explicitly shown in this simulation, as it would require a third atom to carry off excess energy. However, the well depth and forces between the oxygen atoms are much larger, consistent with a bonding pair.

## Suggestions for Use

### Sample Challenge Prompts

- Describe how attractive and repulsive forces influence the attraction between two atoms.
- Explain the relationship between the attractive forces between atoms and the potential energy graph for the atom pair.
- Compare and contrast the behavior and potential energy graph for all atom pairs.
- Describe what would need to happen for oxygen to form a diatomic bond.
- Define the values of  $\sigma$  and  $\epsilon$ .

See all published activities for Atomic Interactions [here](#).

For more tips on using PhET sims with your students, see [Tips for Using PhET](#).