

Non-obvious controls:

- You can grab the **dopants** and move them into the circuit.
- You can type in a value for the **battery voltage** or use the arrows to change it. The value can be positive or negative.
- 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:

- The internal force arrow indicates the force that electrons feel due to electric charge buildup in the circuit.
- The battery force arrow indicates the force that electrons feel due to the battery.

Insights into student use / thinking:

- Students may think that electrons in a circuit are created by the voltage. This sim helps them see that electrons are always in the circuit and the voltage just makes them move.
- Some students may think that the energy diagrams represent physical objects rather than graphs, so you may need to explicitly point out that this is not the case.

Suggestions for sim use (NOT an exhaustive list!):

- 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](#)
- Use this sim to illustrate how a diode works.
- Encourage students to observe the behavior with different combinations of dopants. Then have them go back and decide why current does or doesn't flow in each case, and whether light will be given off if current is flowing across the junction in each case.