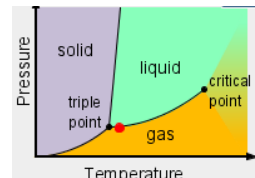


**Tips for controls:**

- Try all the different tabs at the top of the simulation. The tabs are designed to help teachers scaffold lessons or make lessons age appropriate by using only some tabs.
- On the first tab, as you toggle between chemicals, the phase will stay the same and the temperature will adjust realistically. So if you want to compare solids to solids it is very easy.
- On the second tab, as you toggle between chemicals, the material will be displayed with some liquid and some gas. The phase diagram starts in the same position.
- The “Adjustable Attraction” is designed to help students get a qualitative idea about how attraction effects phase. They will need to allow the simulation a few seconds to react. The change is not instantaneous.
- 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.
- In the 2<sup>nd</sup> tab, the lid can be moved up and down by grabbing the handle or finger.



- If you want to keep heating or cooling without holding the slider in the "Heat Control" with the mouse: click once on the slider and then use the up/ down arrow keys to set the slider where you want the arrow to stay.

**Important modeling notes / simplifications:**

- For solid water, the sim simplifies the model emphasizing that there is space between the molecules. A resource for the most common visual for ice structure is <http://www.lsbu.ac.uk/water/ice1h.html>
- The phase diagrams are shown qualitatively in the sim, to help students get a general understanding of phase diagrams. Quantitative phase diagrams are shown for water, neon, argon and oxygen on page 2 of these Tips.
- The sim is not designed to be used as a comprehensive tool for learning about phase diagrams, instead the focus is on phases of matter. The small number of particles shown and the simplicity of the underlying models makes it difficult to map accurately the exact phase to the correct regions of the phase diagram. However, we felt there would be some benefit to students being exposed to a simplified phase diagram. In the sim, the diagram marker remains on the coexistence line between liquid/gas or solid/gas (and is extrapolated into the critical region). If this approximation does not fit your specific learning goals, and you are concerned this might cause confusion, you can encourage your students to keep the phase diagram closed.

**Insights into student use / thinking:**

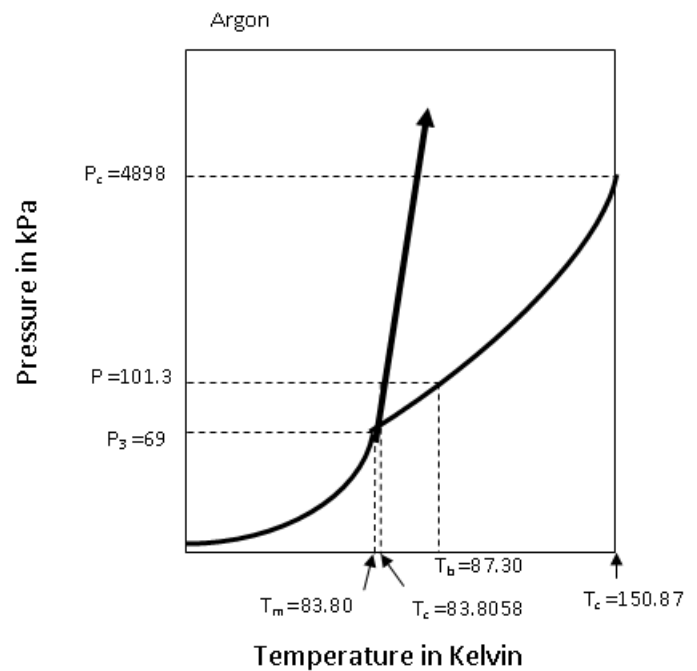
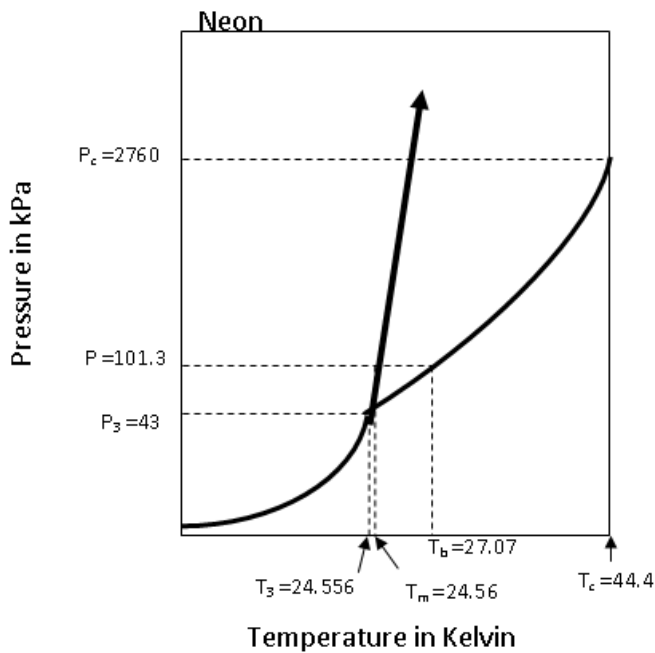
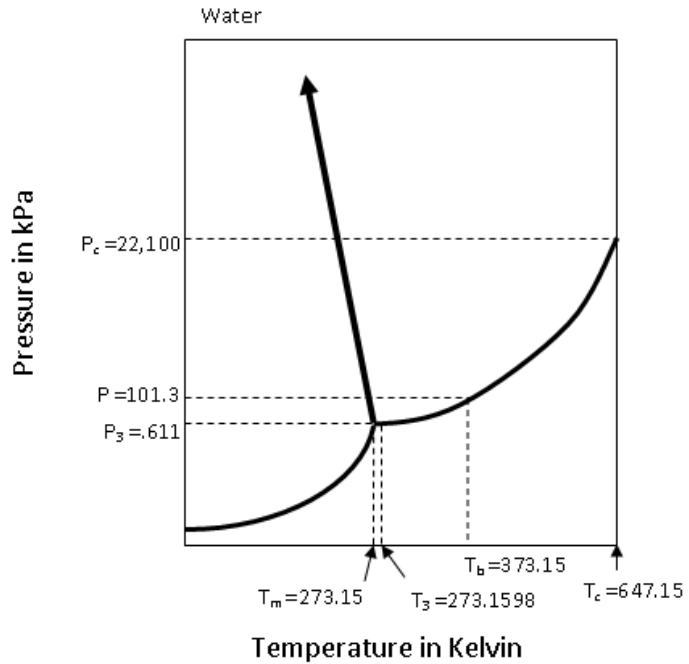
- Students can learn quite a bit about the basics of states of matter by just playing around with this sim.
- Advanced ideas, such as gas laws, may require a slightly more guided activity.

**Suggestions for sim use**

- There is a new simulation called *Atomic Interactions* that is like the third tab but has advanced features
- 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](#)

**Legend**

$T_m$  = melting point  
 $T_b$  = boiling point  
 $T_3$  = triple point  
 $T_c$  = critical point  
 $P_3$  = triple point  
 $P_c$  = critical point



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