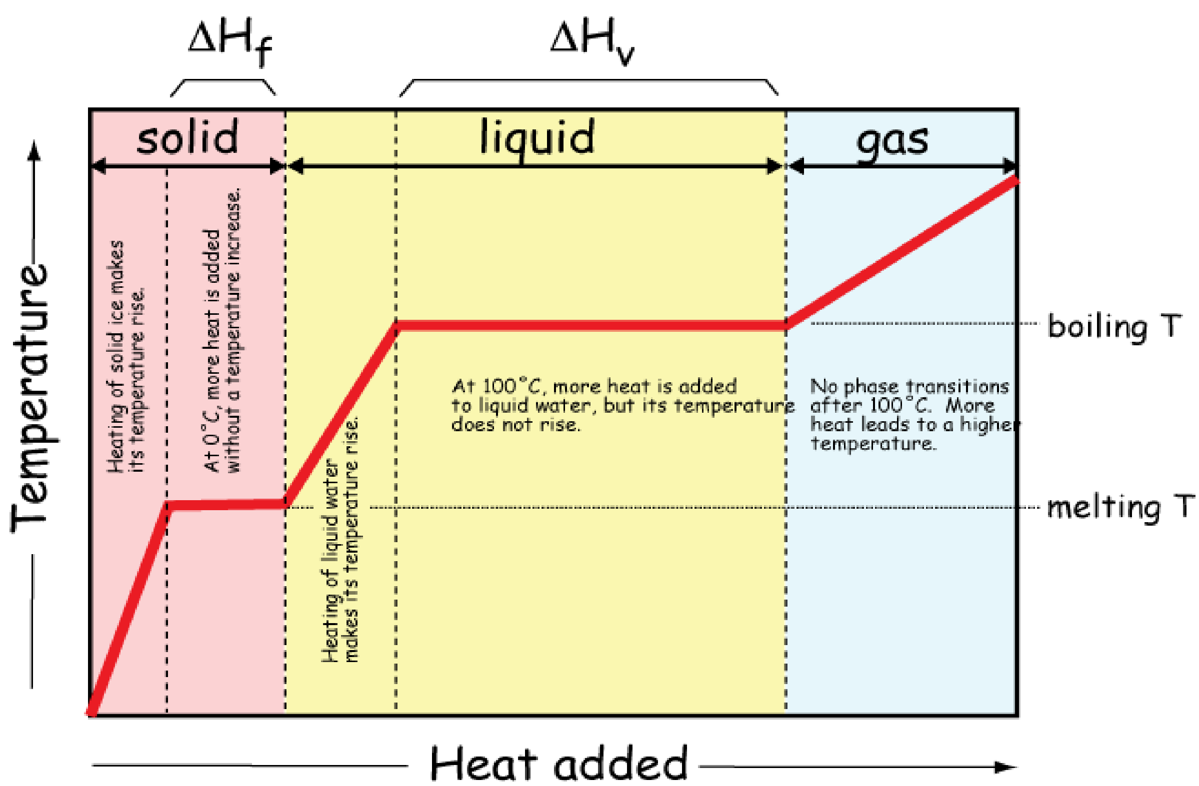
THE HEATING CURVE OF WATER

Now let's look at a schematic diagram of continuous heating of water from a temperature well below the freezing point to one well above the vaporization point. Temperature of a sample of water is plotted vs. heat added at a **constant rate**. This is an amazing curve and one worth staring at for a while.



Let's trace that curve from left to right across five regions. Note that on the bottom axis we're just adding heat to the sample at a steady rate, but what is happening to the temperature is anything but steady.

(1) Heating the solid

As we add heat to ice, its temperature rises. That's no big surprise. It rises at a linear rate that is governed by the heat capacity of ice, something that can be looked up in a table.

(2) 0˚C

What happens at 0˚C is really remarkable. We add heat but the temperature does not increase, even after a substantial amount of heat is added. That's a very strange result. Imagine if you were the first to discover it. People might not believe you!

What is happening, of course, is that ice is undergoing a **phase transition**: ice → liquid. It turns out that this phase transition alone, without rise in temperature, requires an *extra* amount of heat that we call the **latent heat of fusion**, ΔH_f. Mathematically, the heat capacity of water at this temperature (and at 100˚C) is infinite.

(3) 0˚C - 100˚C Heating the liquid

After the solid **melts** to liquid, the liquid reflects added heat as a rise in its temperature. The slope of the rise isn't quite the same as that of the solid because the heat capacity of water is a little different that that of ice (see table underHeat).

(4) 100˚C

At 100˚C we observe another phase transition: Liquid → gas (steam). Look at the (relatively speaking) immense amount of heat it takes to convert liquid water to steam. It's huge. That's why sweating is such an efficient cooling mechanism. Sweat requires a tremendous amount of heat energy (taken from the body) in order to evaporate into the gas phase. We call this extra energy the **latent heat of vaporization**, ΔH_v.

(5) > 100˚C Heating steam

Finally, we can heat steam almost arbitrarily. Again, the rise in temperature has a slope that is determined by the heat capacity of steam, which is quite different from those of liquid water and ice. At some very high temperature, of course, the O—H bonds of water will break and there won't be any more water, just H and O.

Because water has nine degrees of freedom of movement, it has a high heat capacity for a triatomic molecule.

Because water is polar and forms hydrogen bonds, it has large latent heats of fusion and vaporization, and its solid form is less dense than its liquid form.

Source: http://www.drcruzan.com/Water.html