Fresh water from the salty sea?

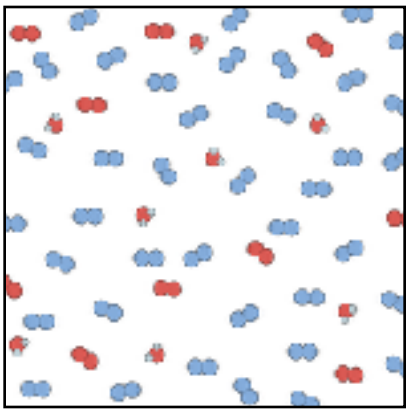
Water, water, every where,
Nor any drop to drink.

—Samuel Taylor Coleridge, *The Rime of the Ancient Mariner*

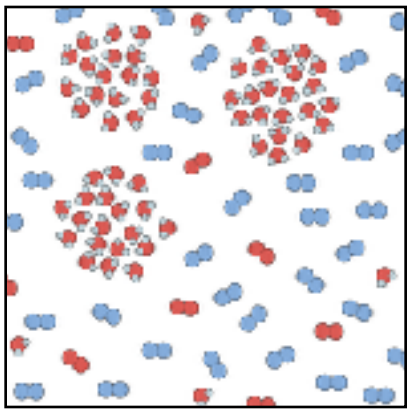
You can get salt out of seawater through evaporation. But what if what you really want is the *water* without the salt? The world has oceans full of salt water, but salt water isn't much use for drinking or agriculture. People need fresh water (that is, non-salty water), but fresh water is in short supply in many places. One possible solution is to get fresh water from seawater, leaving behind the salt. There are several ways to do this, one of which is a process called distillation.

Distilling seawater starts with the same process used for getting solid salt out of seawater: evaporation. Evaporation separates the water from the salt. But you can't drink water vapor directly out of the air. You also need to get the molecules of the water vapor to join back together into their drinkable, closely-packed liquid form, a process called condensation:

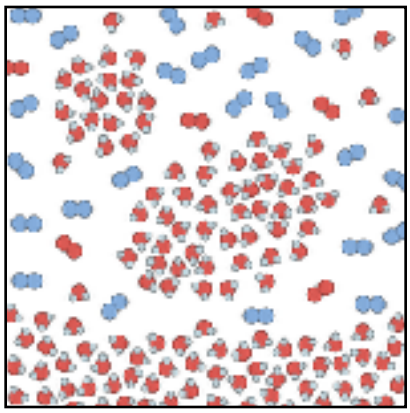
1 Water vapor in air...



2 condenses into cloud droplets...



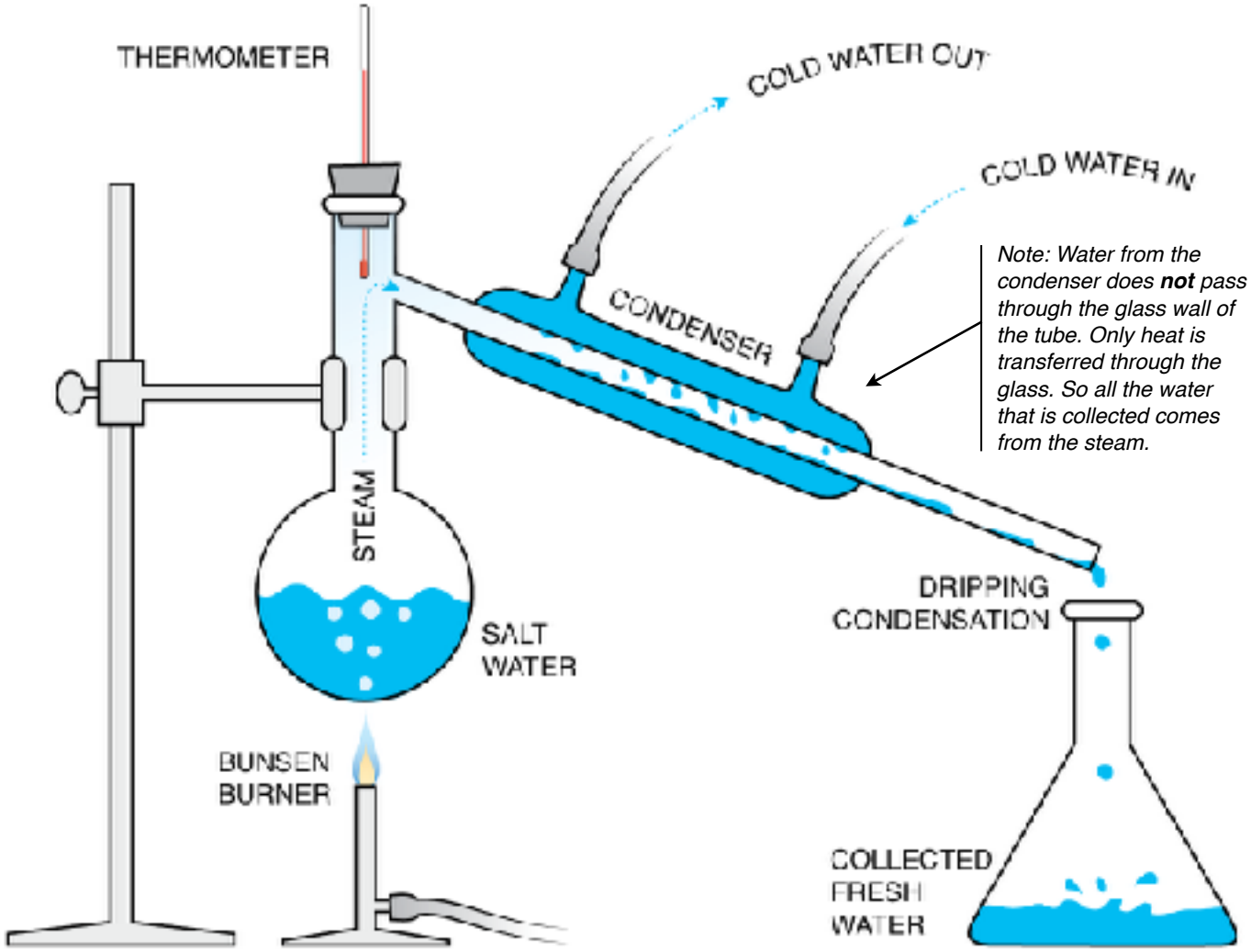
3 and falls down.



The higher the concentration of water vapor in the air, and the colder the air is, the easier it is for water molecules to clump together into a more dense liquid form. That's what puts the density in condensation!

So you get the salt water to evaporate by heating it, and then you get the water vapor to condense into liquid fresh water by cooling it. Nature runs this kind of distillation process all the time on a huge scale. The sun causes water to evaporate from the ocean, and then fresh water condenses into clouds and falls as rain or snow. That's where all the fresh water in rivers, lakes, and underground aquifers ultimately comes from.

On a much smaller scale, a simpler distillation apparatus can be set up in a lab. The illustration below shows a beaker of salt water being heated with a bunsen burner. Steam (pure H_2O) rises, leaving the salt behind. When the steam gets into the glass pipe that is angled downward, it transfers its heat through the glass to cold water circulating in the surrounding condenser. Only heat passes between the pipe and the condenser, not water. In effect, the condenser is just a cold sleeve wrapped around the angled glass pipe. The cooled steam inside the pipe condenses and drips into a collection flask.



How is the distillation apparatus illustrated above similar to the water cycle in nature? Specifically, which parts of the lab apparatus correspond to the sun, the ocean, cloud formation, rain, and rivers and lakes?