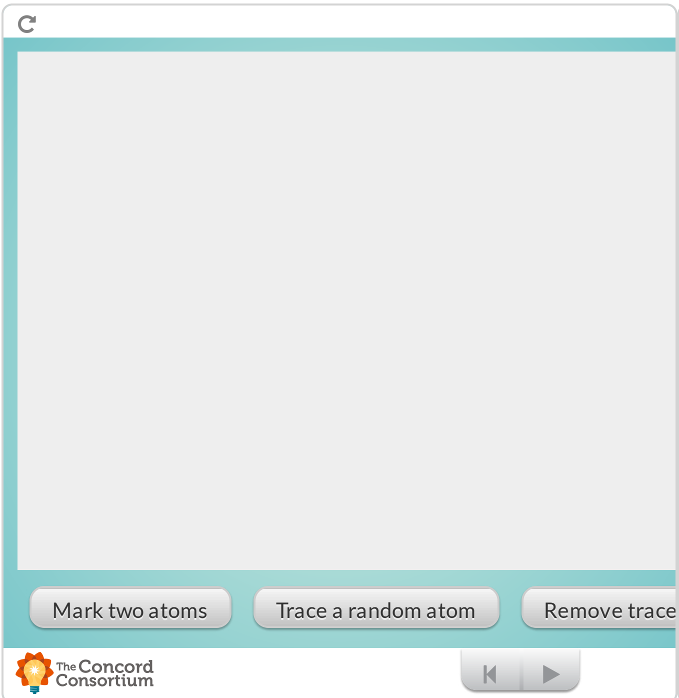
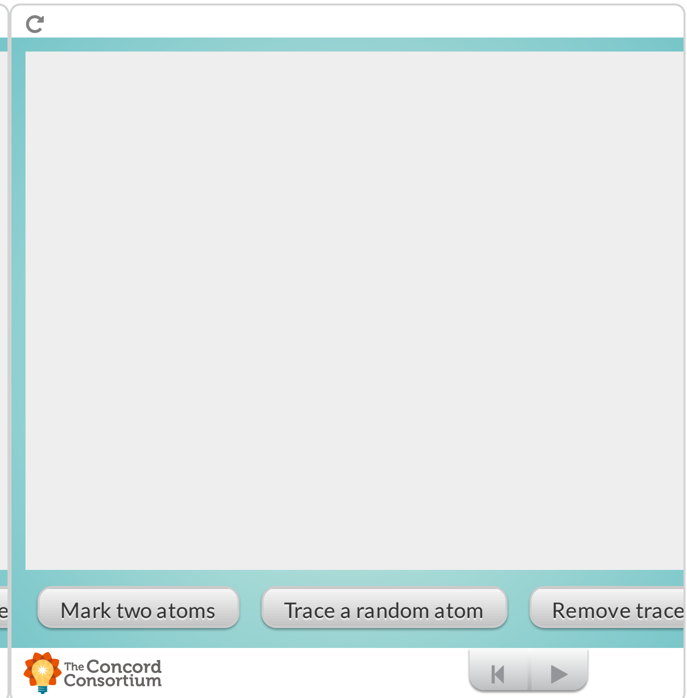
10.6: Liquids

When a crystalline solid melts, it loses its rigid form and adopts the shape of its container. At the same time there is usually an increase in volume of a few percent. On the molecular level we can interpret this as a breakdown in the regular structure of the solid. As temperature rises toward the melting point, the molecules vibrate more and more strongly. Above the melting point, these vibrations are so energetic that they overcome the forces holding the molecules in the crystal lattice.

In the two animations below from the Concord Consortium, one can compare solids and liquids. The animation on the left is that of a solid, compact and held tightly together by intermolecular forces. Pressing the play button on the bottom of the screen has little effect. On the other hand, pressing the play button on the liquid animation has a huge effect. The molecules in the liquid begin to move around rapidly, in stark contrast to the stability of the solid.





The molecules no longer vibrate around an average position but begin to slide past each other. The regular arrangement of the crystal disappears, but the molecules have not escaped each other's attractive influence (as can be seen by the dotted lines representing attractive forces in the animation).

The very small volume change which occurs on melting shows that the molecules have moved apart to only a very limited extent and that there can be only a few gaps caused by the less-regular packing. This view is confirmed by the experimental fact that liquids, as opposed to gases, are very difficult to compress. Even at the bottom of the deepest oceans, under pressures of thousands of atmospheres, the density of water is only minutely larger than at the surface.