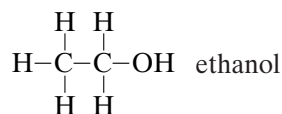


Liquid Solutes and Solvents

When you shake a bottle of salad dressing, oil droplets become dispersed in the water. As soon as you stop shaking the bottle, the strong attraction of hydrogen bonding between the water molecules squeezes out the oil droplets, forming separate layers. *Liquids that are not soluble in each other are immiscible.* Toluene and water, shown in **Figure 11**, are another example of immiscible substances.

Nonpolar substances, such as fats, oils, and greases, are generally quite soluble in nonpolar liquids, such as carbon tetrachloride, toluene, and gasoline. The only attractions between the nonpolar molecules are London forces, which are quite weak. The intermolecular forces existing in the solution are therefore very similar to those in pure substances. Thus, the molecules can mix freely with one another.

Liquids that dissolve freely in one another in any proportion are said to be miscible. Benzene and carbon tetrachloride are miscible. The nonpolar molecules of these substances exert no strong forces of attraction or repulsion, so the molecules mix freely. Ethanol and water, shown in **Figure 12**, also mix freely, but for a different reason. The —OH group on an ethanol molecule is somewhat polar. This group can form hydrogen bonds with water as well as with other ethanol molecules. The intermolecular forces in the mixture are so similar to those in the pure liquids that the liquids are mutually soluble in all proportions.



Gasoline is a solution composed mainly of nonpolar hydrocarbons and is also an excellent solvent for fats, oils, and greases. The major intermolecular forces acting between the nonpolar molecules are weak London forces.

Ethanol is intermediate in polarity between water and carbon tetrachloride. It is not as good a solvent for polar or ionic substances as water is. Sodium chloride is only slightly soluble in ethanol. On the other hand, ethanol is a better solvent than water is for less-polar substances because the molecule has a nonpolar region.

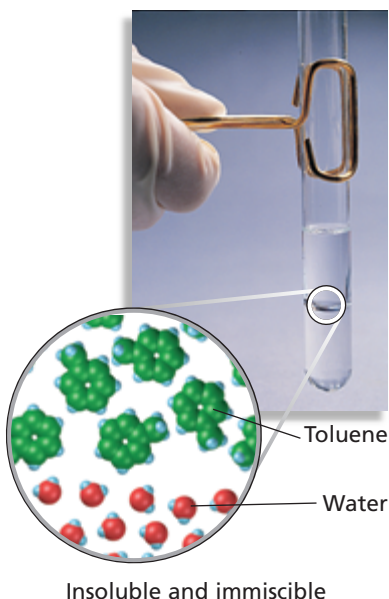
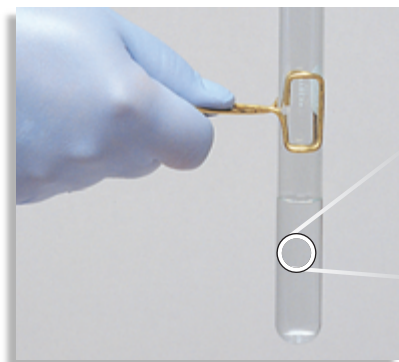


FIGURE 11 Toluene and water are immiscible. The components of this system exist in two distinct phases.

FIGURE 12 (a) Water and ethanol are miscible. The components of this system exist in a single phase with a uniform arrangement. (b) Hydrogen bonding between the solute and solvent enhances the solubility of ethanol in water.



(a) Miscible

