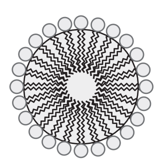
Emulsification

An Introduction to the

Emulsification

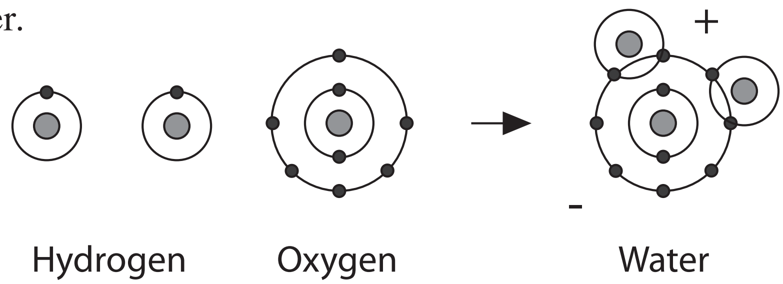
of

Lipids within a Watery Environment

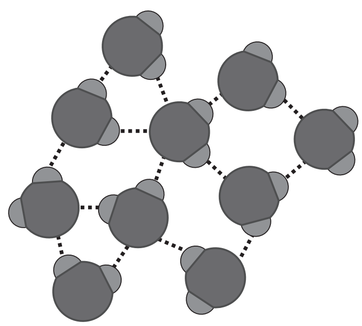


By Noel Ways

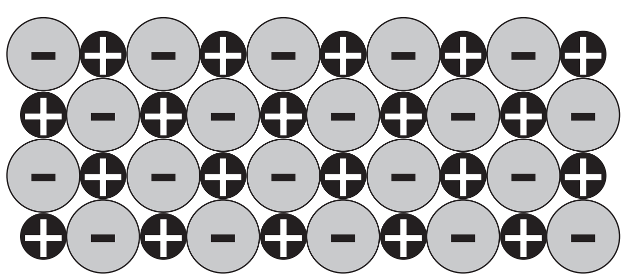
To begin the process of understanding emulsification, let's start with water. First, we note that water is a polar molecule due to it's molecular structure. This polarity is due to the hydrogen being found at one side of the molecule. There is now an unequal distribution of charge, with more positively charged protons and one side, and more negatively charged electrons at the other.



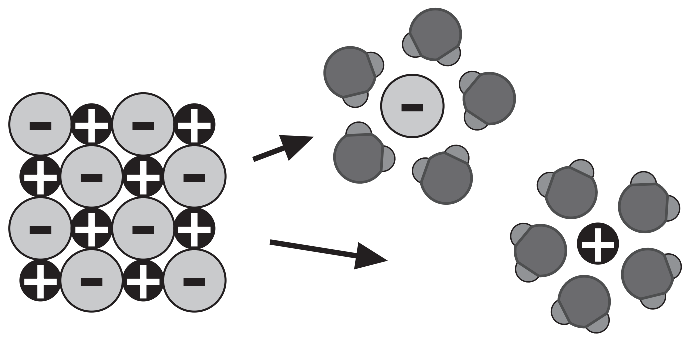
When water is in a liquid form, the polar characteristics of the water molecules will cause them to orient in such manner that the positively charged protons of the hydrogen will be attracted to the negatively charged oxygen. Such attractive forces create bonds called "hydrogen bonds".



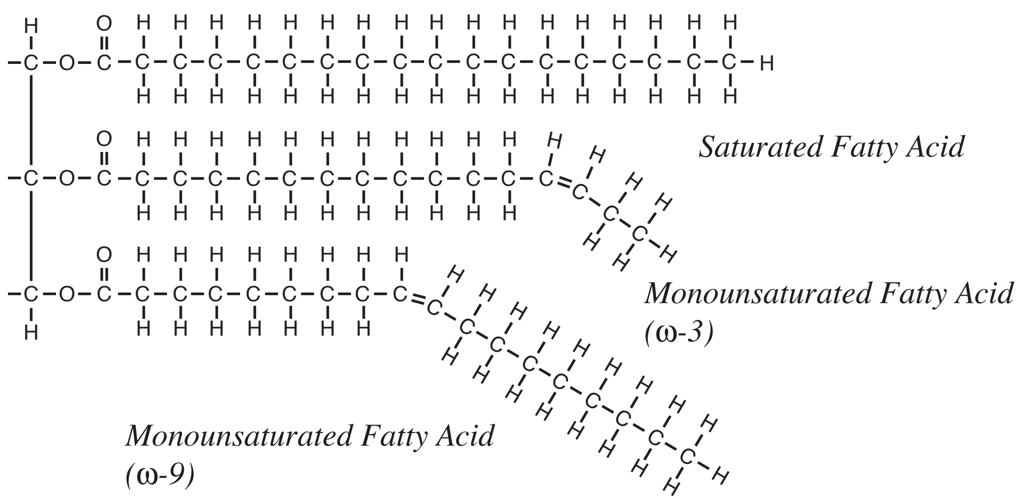
Now consider the molecular structure of a salt. Here, atoms or molecules that make up the salt will have charges, due to their receiving or losing electrons so that the outer most electron shell can be full in order to achieve stability. See you text or lecture notes for a further explanation. In the absence of water these charged particles will be arranged in an alternating fashion due to the fact that "opposites attract".



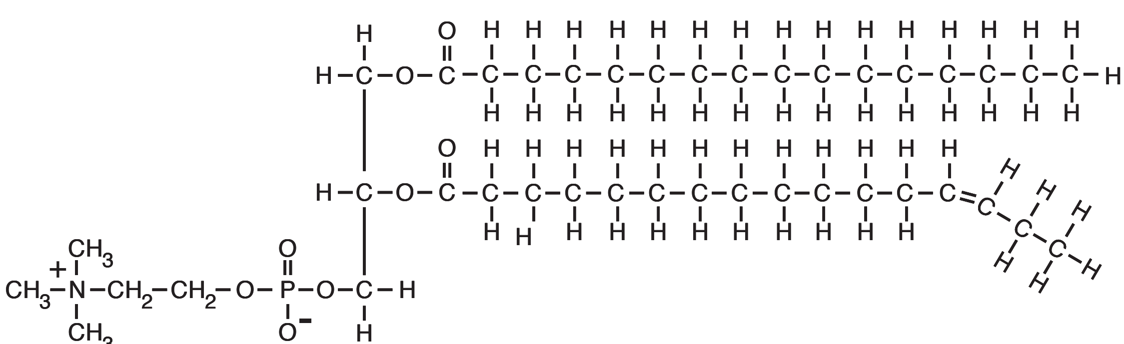
When a salt is put in water, the charges associated with the water will interact with the charges of the salt. As the attractive force of water is substantial, the water will act as a solvent and interfere with the attraction between the ions. The result is broken ionic bonds.



Turning our attention to lipids, a typical triglyceride is shown below. Note that there are no charges. Therefore, if lipids are put in water, there will be no part of the lipid that the water can be attracted to, consequently lipids will not and cannot dissolve in water.

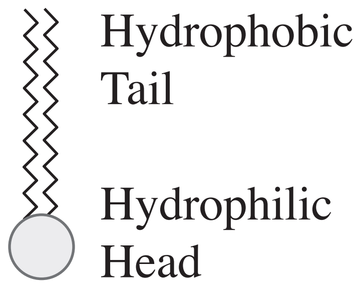


An interesting modification of the triglyceride occurs when one of the fatty acids is removed and replaced with a phosphate group, or another group that has charges associated with it. When this happens, the side of the molecule with the charges will interact with the water and is said to be "hydrophilic". The fatty acid "tails" will not dissolve in water and is said to be "hydrophobic"; again, due to the lack of charges.



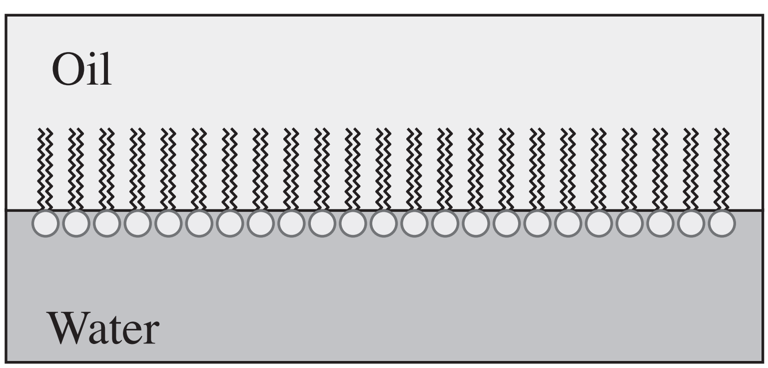
Note charges

We can redraw a phospholipid to look like:

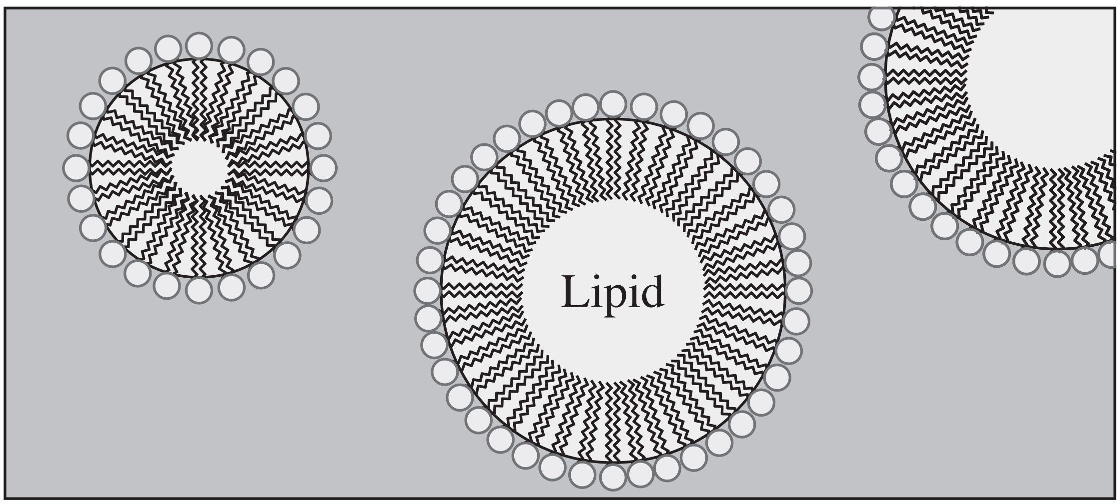


Turning our attention again to lipids, if we mix water and lipids together, they will separate, in part, due to the fact that lipids and water have no attraction toward each other.

Now, suppose we put phospholipids in the mixture illustrated above. We would find that the phospholipids would orient themselves in such manor that the charged ends (the hydrophilic heads) would be attracted to and in the water. The fatty acid hydrophobic ends, however, would be found in the oil as the fatty acids do not dissolve in water.



Suppose we take the oil/water mixture with phospholipids and shake it up. As expected, the oil would form droplets in the water. The phospholipids as shown on page 3 would orient themselves along the water/oil interface with the hydrophobic fatty acid tails in the oil and the charged hydrophilic heads in the water as the water being attracted to them.



Now, when the water "sees" the oil, it does not "see" the oil; but rather the charged heads of the phospholipids. The result is that the small droplets of oil now behaves like a salt. It does this because the phospholipids are acting like a "bridge" between the oil and the water. When this happens, the oil will remain suspended in the water, and we would say that the oil is emulsified.