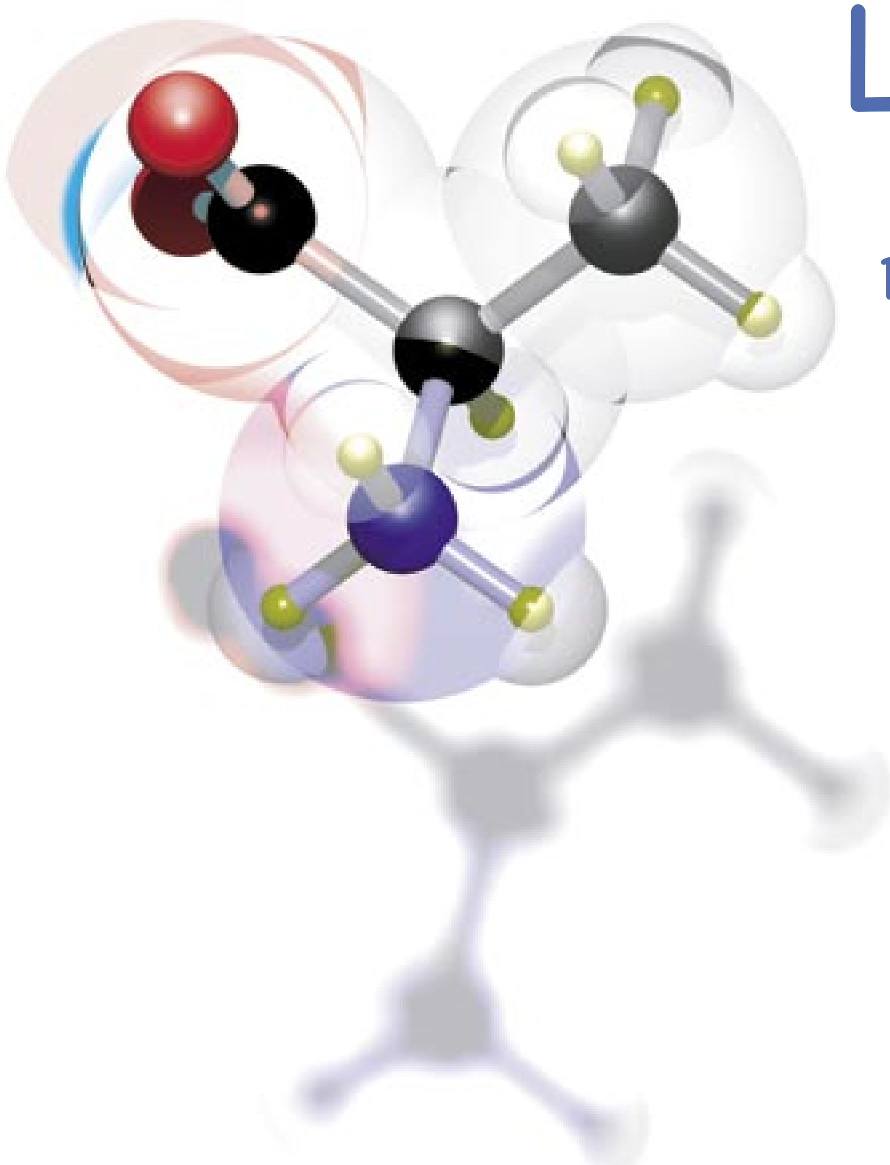
Real Science-4-Kids

Chemistry



Level I

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Front cover: water molecule showing both bonding of two hydrogens to one oxygen and the van der Waals radii of the atoms.
Back cover, inside title page: L-Alanine molecule, one of the amino acids

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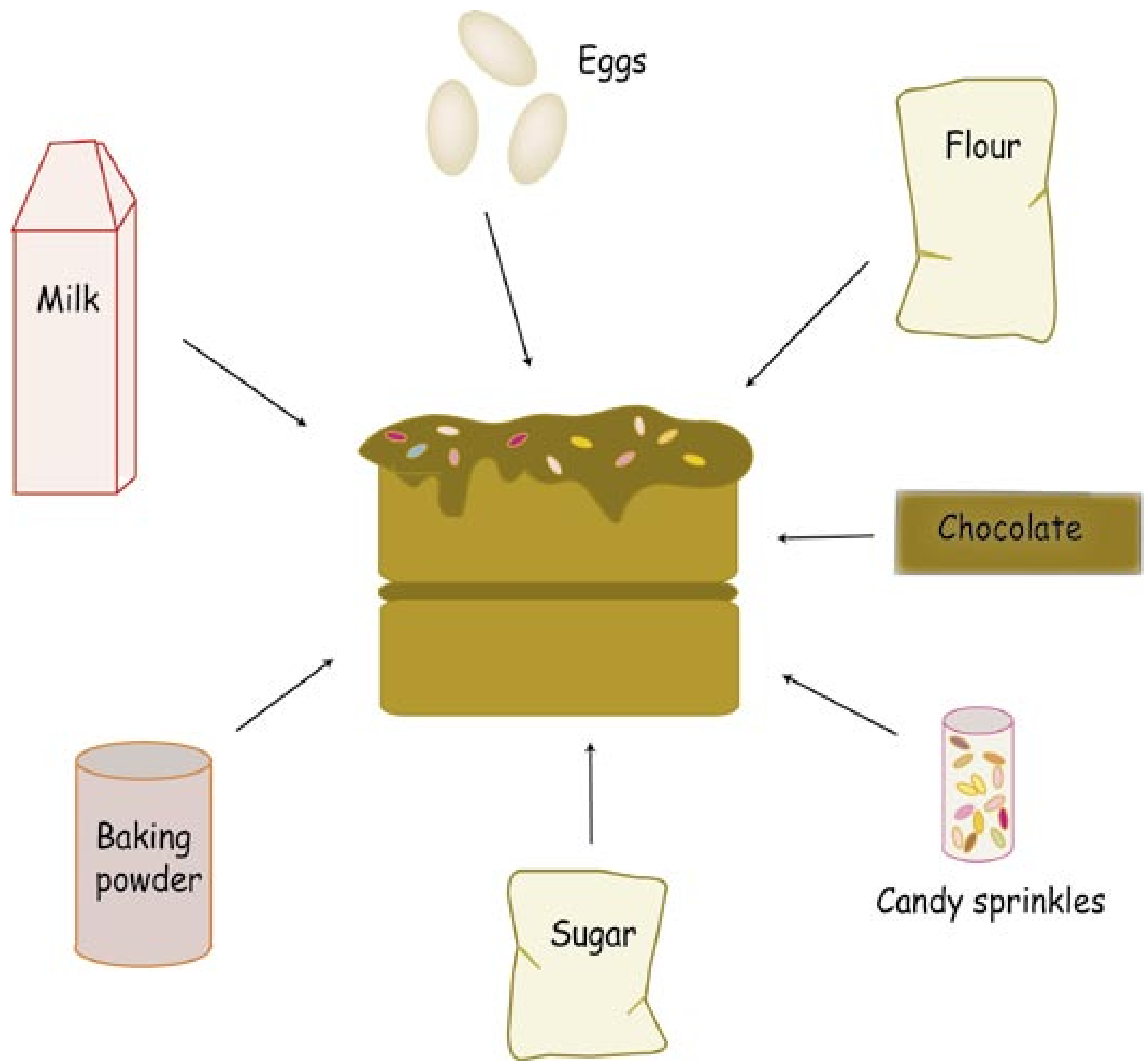
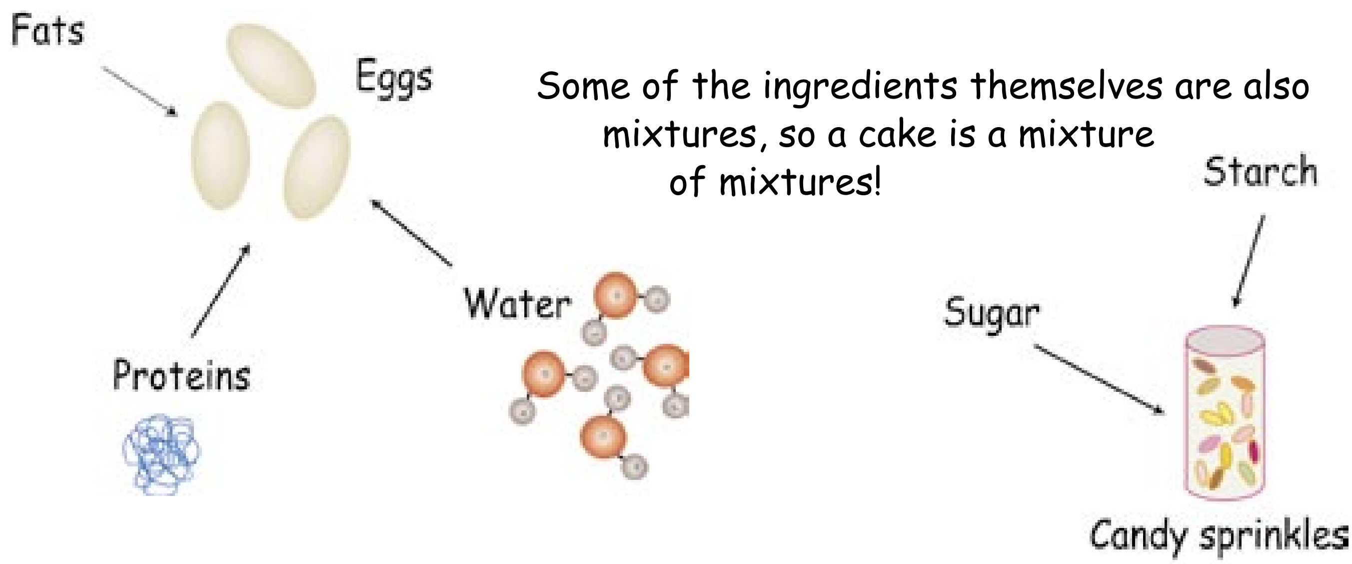
Chapter 6: Mixtures

6.1 Introduction

Sometimes things that look like they are made up of only one item are really made of many items. For example, when we eat cake we may think that we are eating only cake, but cake has many different ingredients in it. It has flour, eggs, butter, maybe some salt, water or milk, baking powder, and, hopefully chocolate.

Cake is really a mixture of many ingredients:





6.2 Types of mixtures

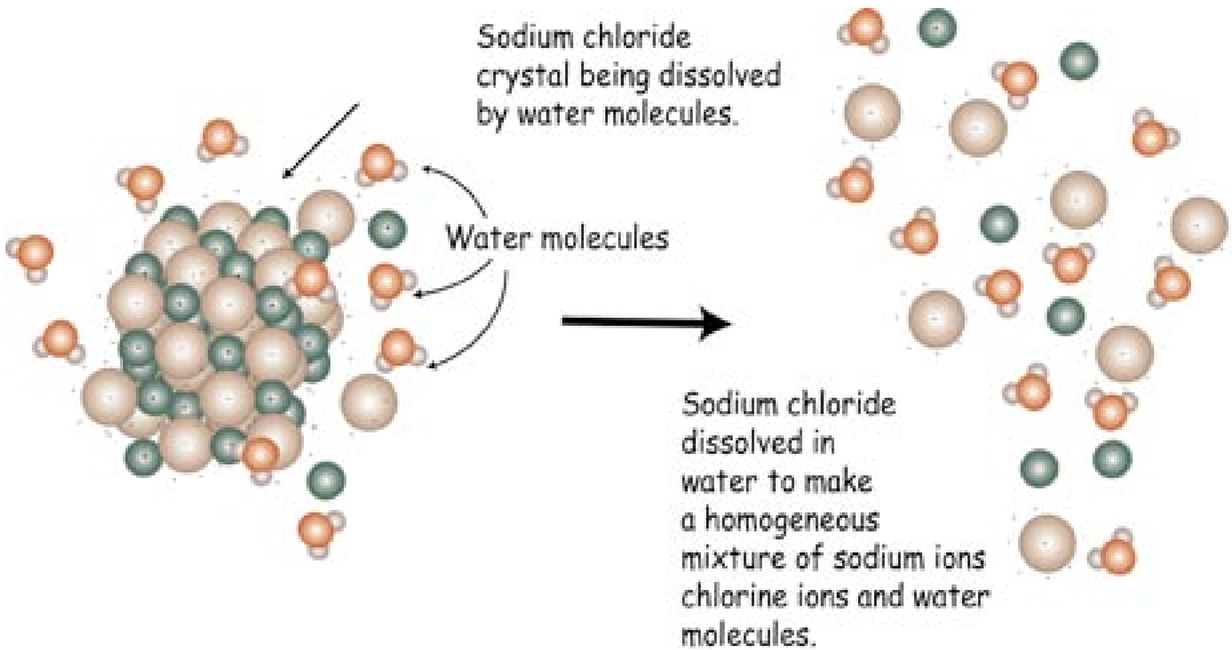
There are two main types of mixtures called homogeneous and heterogeneous mixtures.

Homo comes from the Greek word homos which means "the same," and geneous comes from the Greek word genos which means "kind." So a homogeneous mixture is a mixture of the "same kind." An example of a homogeneous mixture is salt water. In a glass of salt water, everywhere in the glass the salt water is the same. The top of the glass does not have different salt water than the bottom of the glass, so salt water is considered a *homogeneous mixture*.

Hetero comes from the Greek word heteros which means "other" so a heterogeneous mixture is a mixture of "other kind." An example of a heterogeneous mixture is ice water. Although ice and water are both water, ice has different properties than water. Ice floats in water. In a glass of ice water there will be more ice at the top of the glass than at the bottom of the glass. The mixture of ice and water is not the same throughout, so it is called a *heterogeneous mixture.*

6.3 Like dissolves like

Homogeneous mixtures are made of substances that like to mix. When salt is added to water, the water molecules break apart the salt crystals into sodium ions and chloride ions. The salt is said to dissolve or "loosen apart" in the water. When this happens a homogeneous saltwater mixture is created.



However, two substances that do not like to mix make heterogeneous mixtures. For example, when oil is added to water the oil stays in little droplets or floats to the top. No matter how hard these two are shaken they simply do not mix.

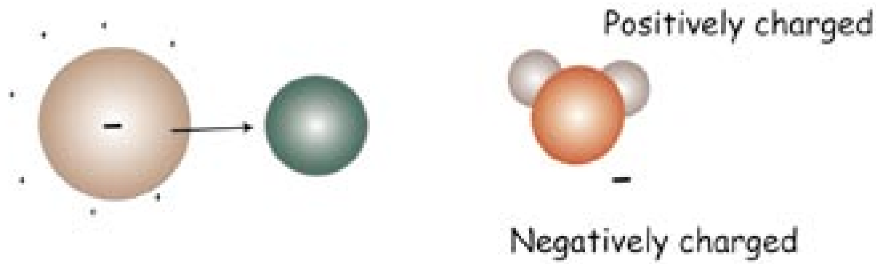
Why does salt dissolve in water and not oil? As it turns out, the properties of the individual molecules determine if something will dissolve or not. The rule is:

Like dissolves like.

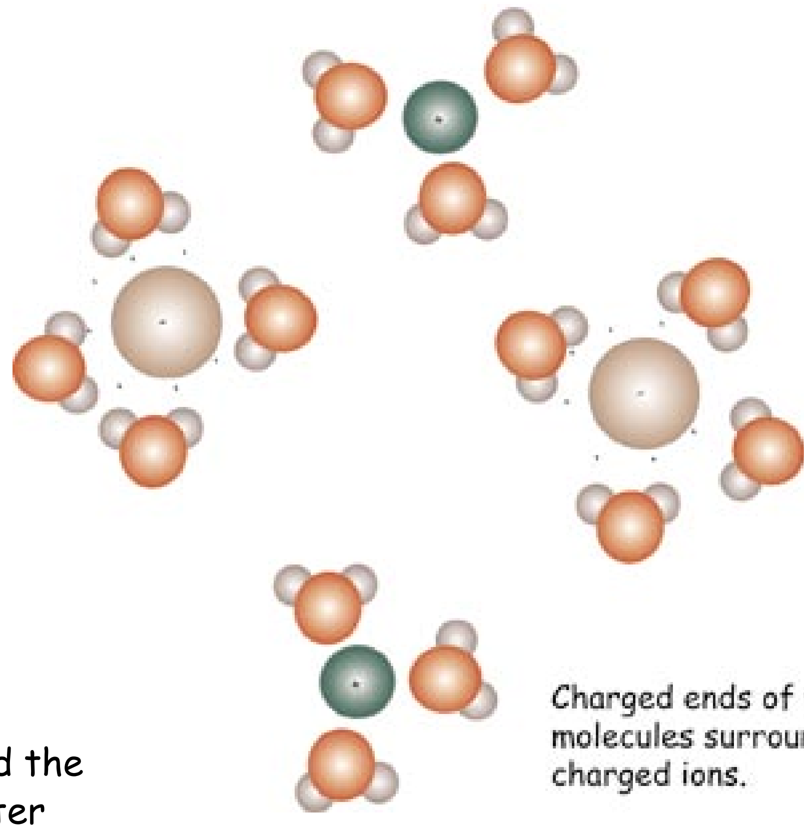
This simply means that molecules that are like each other will dissolve in each other, and molecules that are not alike will not dissolve in each other.

Salt and water are alike, in some ways, and oil and water are not.

Water molecules and salt molecules are alike in that they both are charged. Recall that the bond for a sodium chloride molecule is an ionic bond. Ionic bonds are easy to pull apart. The water molecules can easily pull apart the sodium and chloride bonds because water is charged.



The bonds holding the water molecules do not break apart because the bonds in a water molecule are not *ionic* bonds but are *covalent* bonds (see Chapter 2). Instead, the charged ends of the water molecules surround the free sodium and free chloride ions.

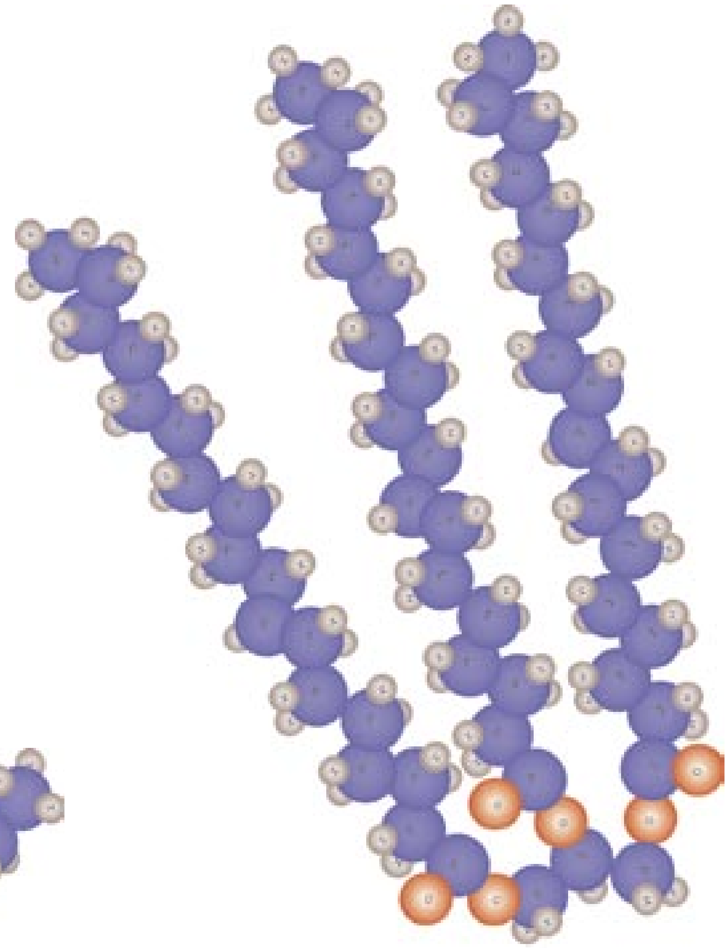


Charged ends of water molecules surrounding the charged ions.

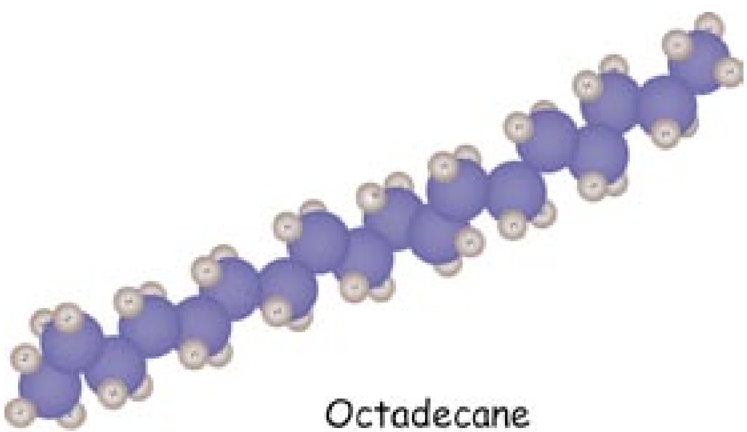
Note that the *negative* ends of the water molecules surround the *positive* sodium ions, and the *positive* ends of the water molecules surround the *negative* chloride ions. The fact that both the water molecules and the salt molecules are “alike” in certain chemical ways because they are both charged, means that one will *dissolve* in the other.

Oil molecules, on the other hand, are not charged. Oil molecules are long chains of hydrogen and carbon atoms hooked together and do not carry any effective charge.

The molecule that makes up olive oil, glycerol trioleate, is made of three long chains of carbons and hydrogens connected together on one end. This molecule is not charged and, therefore, it is not *like* water and cannot mix with or dissolve in water. However, it can be dissolved in other molecules that are also not charged, like mineral oil (octadecane) or even gasoline!



Glycerol trioleate
(vegetable oil)

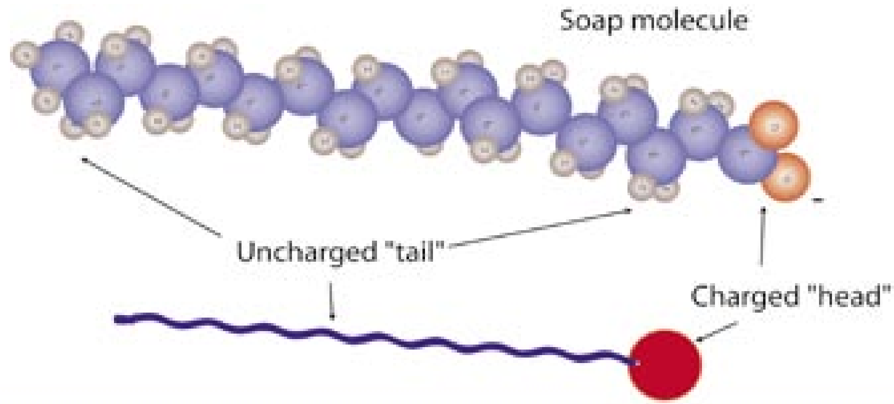


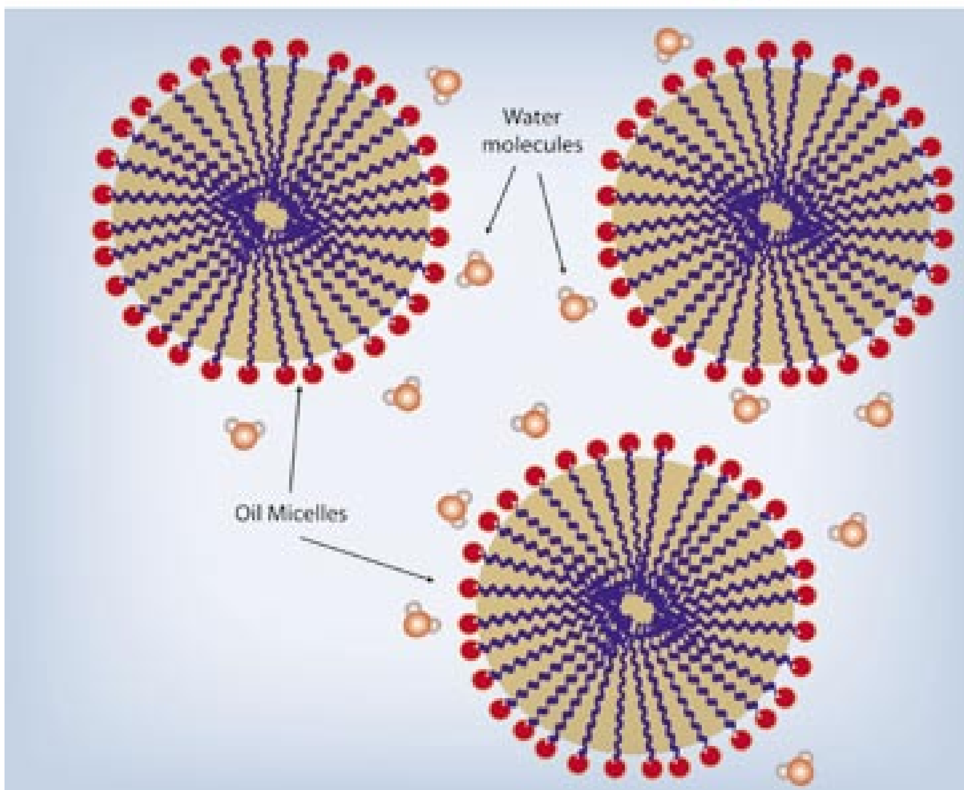
Octadecane
(mineral oil)

The principle that *like dissolves like* can be used to decide how something might be cleaned. For example, those things that dissolve in water, like ammonia, bleach, and water-based paints, can be cleaned with water. However, those things that do not dissolve in water, like grease and oil-based paints, cannot be cleaned with water. Many cleaning fluids, like mineral spirits, are made of molecules that are not charged and can, therefore, dissolve oil-based paints or grease.

6.4 Soap

Mineral spirits and gasoline, although effective on grease, are not very useful for washing away olive oil from your hands after preparing salad. Also, these solutions are very poisonous and can easily catch on fire. So what can be used instead?





Soap, of course! Soaps are molecules that have both a charged end *and* an uncharged end. These molecules are able to dissolve oil in water because they have an *uncharged* part (that likes oil) and a *charged* part (that likes water).

When soap comes into contact with an oil molecule, the uncharged part (or oily part) mixes with the oil. The charged part of the soap molecule does not want to mix with the oil, so it stays mixed with the water. This results in very tiny droplets called micelles (pronounced "my•cell"). Inside a micelle the greasy end of the soap is dissolved in the oil and the charged end is dissolved in the water on the outside. These tiny droplets can then be washed away with the water.

6.5 Summary

Here are the most important points to remember from this chapter:

- There are two types of mixtures: homogeneous and heterogeneous.
- Homogeneous mixtures are made by things that are "like" each other.
- Things that are "alike" dissolve in each other: *Like dissolves like.*
- Soap helps oil "dissolve" in water.