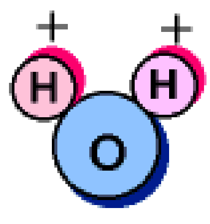
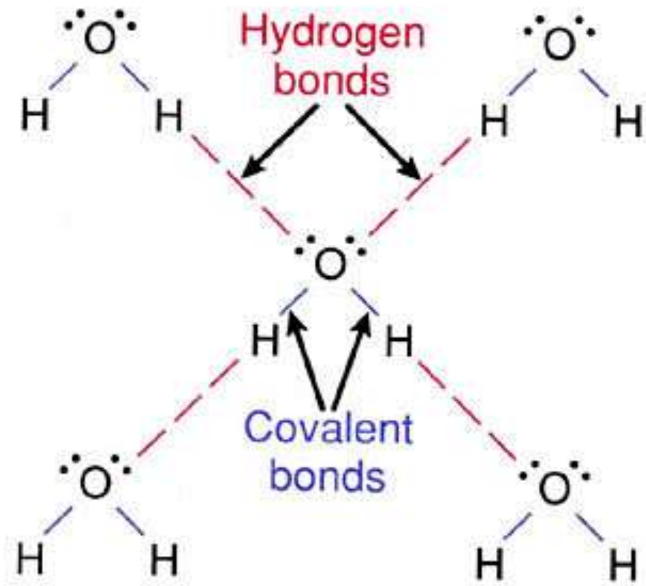
Milk Experiment Background and Procedure

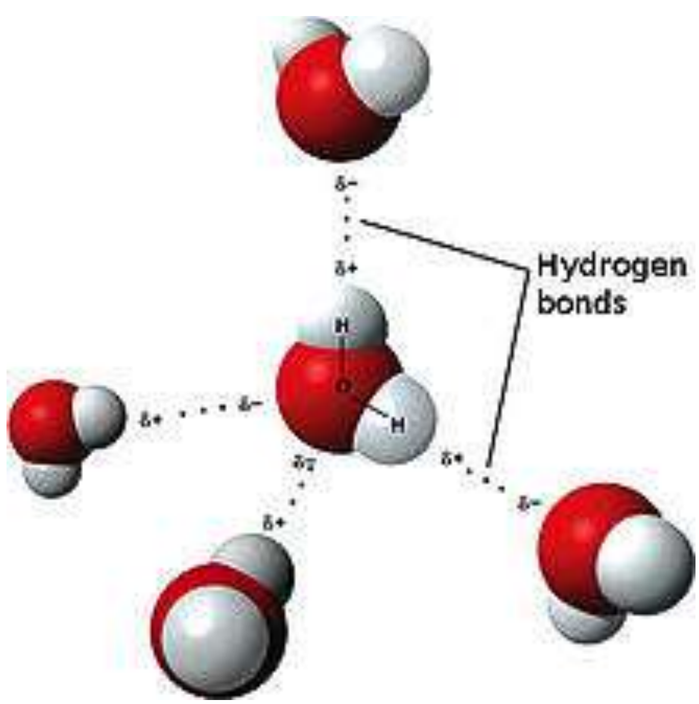
"Water may be one of the most familiar substances on the planet, but it certainly isn't ordinary. In fact, water's unique chemical properties make it so complicated that after decades of research, scientists still have much to learn about this remarkable and versatile substance."



Since hydrogen is more generous with its electrons and more likely to donate them to another element while oxygen is more selfish with electrons and more likely to hold onto them, when a molecule of water form the electrons spend more time around the oxygen and les around the hydrogen atoms. This creates what we call a POLAR molecule. Polar molecules have more of a negative charge at one end or "pole" of the molecule and more of a positive charge at the other end. Since water is a polar substance made up of polar molecules, it is a very good solvent for polar substances. Solvents are typically liquids in which other substances are easily dissolved. Table sugar is a polar molecule and dissolves easily in water. Polar molecules dissolve in polar solvents. We could give this the saying, "like dissolves like".



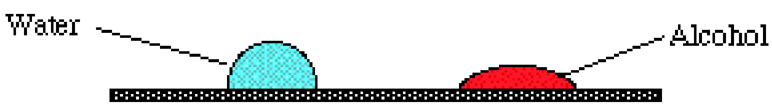
Hydrogen bonding in water.



Water is a polar molecule because the electrons in the atoms of the molecule spend more time around the oxygen than the hydrogens. Since opposite charges attract, the oxygen of one molecule of water is attracted to the hydrogen of the next water molecule. This makes water have unique properties. Three of them are:

1) It has a high boiling point for such a small molecule

2) It beads up on surfaces…high surface tension, and makes it so bugs can walk on water



3) It dissolves many polar substances (like dissolves like)

4 MAIN GROUPS OF BIOLOGICAL MOLECULES

1) LIPIDS (fats and oils…fats are solid at room temp. and oils are liquid)
2) PROTEINS (enzymes, structural support; transport of other substances and movement)
3) CARBOHYDRATES (energy and structural support)
4) NUCLEIC ACIDS (the famous DNA…information storage)

LIPIDS (FATS AND OILS)

There are many kinds of lipid molecules

BUT ALL LIPIDS:

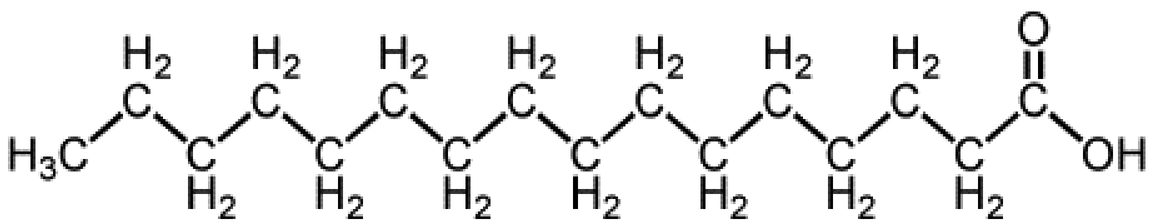
-DO NOT dissolve well in water but DO dissolve in oil

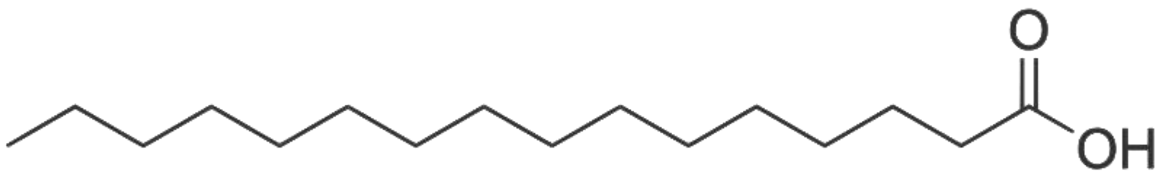
-They are mostly non-polar or uncharged molecules

(LIKE DISSOLVES LIKE !!! Birds of a feather flock together)

- are made of carbon atoms strung together often in long chains with an acid at the end so these very common lipids are called fatty acids. Palmitic acid is the most common fatty acid.

PALMITIC ACID $C_{16}H_{32}O_2$





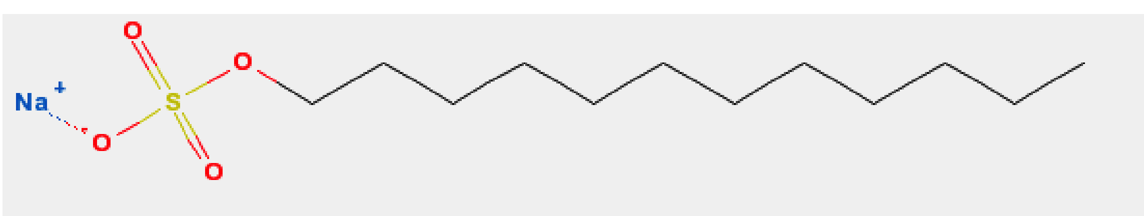
hydrocarbon tail HATES WATER
non-polar, hydrophobic, lipophilic

acid part LIKES WATER
polar and hydrophilic

SOME COMMON FATTY ACIDS

- Palmitic $C_{16}H_{32}O_2$ (very common in both animals and plants and is the most common lipid in milk)
- Oleic $C_{18}H_{34}O_2$ (common in both animals and plants) (*oleum* – Latin for ???)
- Linoleic $C_{18}H_{32}O_2$ (a fatty acid essential in the diet of humans for good health)
- Arachidonic $C_{20}H_{32}O_2$ (found in high amounts in meats and egg yolks)

Soap



polar end non-polar, hydrophobic, lipophilic tail

MILK (not all animal milks are created equal)

- Milk is mostly water with smaller amounts of lipids, proteins and sugars
- Milk is an emulsion of butterfat globules and protein globules in water.
- Milk also contains a sugar called lactose.
- An emulsion is a mixture of two liquids that don't like to mix together.
- After time many emulsions will separate.
- Emulsifiers help keep the liquids in the emulsion from separating.
- Whole milk is about 3.5% butterfat
- 2% milk is about…2% butterfat content
- In addition to lactose one liter of human breast milk contains 7-12g of human milk oligosaccharides…these oligosaccharides help the growth of beneficial bacteria in the infant's intestine and seem to help the immune system mature properly and function properly.

-Examples of emulsifiers are:

Egg yolk
Honey
Protein

-Emulsions scatter light…and that's why they appear_______?

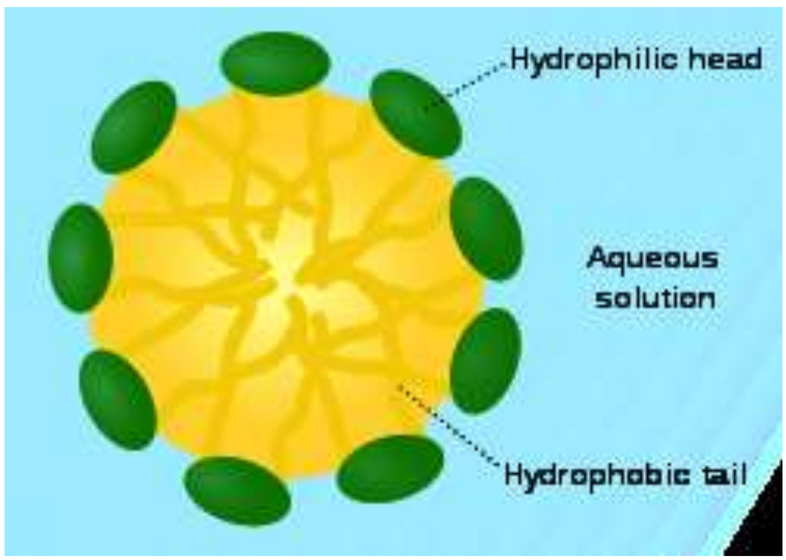
-Air bubbles in snow scatter light and that's why snow is ______?

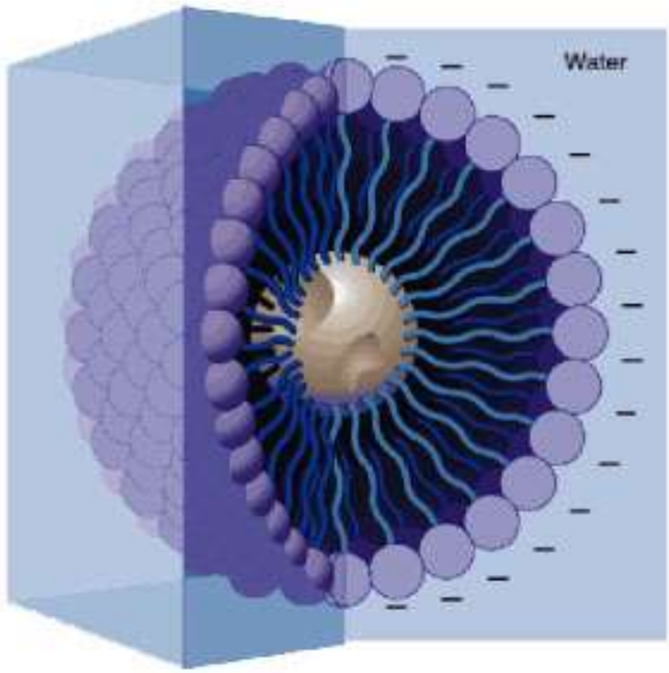
- Is ice that appears blue more or less dense than ice that appears white?

Name 5 animals that are farmed by humans for their milk.

1
2
3
4
5

Are all these animals' milks the same ? If not why?
Why did the experiment use a dry stick first?
If you put a drop of dye in water and repeated the experiment what would happen?
Can you propose any other experiments and predict what might happen?





EXPERIMENT PROCEDURE

Materials: Petri dish
test tube of whole milk
food dye
tooth picks
soap

Procedure:
1) Into a Petri dish pour enough to fill the dish with about 1 cm of whole milk.
2) Near the center of the dish, gently add one drop of food coloring to the surface of the milk.
3) Take a clean toothpick and slowly place it in the milk about 1 centimeter from the dye until the end of the toothpick is held firmly and vertically in place against the bottom of the dish. DO NOT AGITATE THE MILK
4) Record any change and then carefully remove the toothpick.
5) Place the opposite dry end of the toothpick into the test tube labeled soap.

6) Slowly place the end with the soap into the milk about 1 centimeter away
from the dye until the toothpick is held firmly and vertically in place against the bottom of the dish. Do not remove the toothpick.
7) Record what happens over the next two minutes.

Discussion:
Why did the experiment use a dry toothpick first?
If you put a drop of dye in water and repeated the experiment what would happen?