How Do Soaps Work?

- Soaps are the salts of long-chain fatty acids.

- Most dirt on clothing or skin adheres to a thin film of oil. If the oil film can be removed, the dirt particles can be washed away. A soap molecule consists of a long, hydrocarbon-like chain of carbon atoms with a highly polar or ionic group at one end. The carbon chain is lipophilic (attracted to or soluble in fats and oils), and the polar end is hydrophilic (attracted to or soluble in water).

- When soap is shaken with water, it forms a colloidal dispersion - not a true solution. These soap solutions contain aggregates of soap molecules called micelles. The nonpolar, or lipophilic, carbon chains are directed toward the center of the micelle. The polar, or hydrophilic, ends of the molecule form the "surface" of the micelle that is presented to the water. In ordinary soaps, the outer part of each micelle is negatively charged, and the positively charged sodium ions congregate near the periphery of each micelle.

- In acting to remove dirt, soap molecules surround and emulsify the droplets of oil or grease. The lipophilic "tails" of the soap molecules dissolve in the oil. The hydrophilic ends extend out of the oil droplet toward the water. In this way, the oil droplets are stabilized in water solution because the negative surface charge of the droplets prevents their coalescence.

- Another striking property of soap solutions is their unusually low surface tension, which gives a soap solution more "wetting" power than plain water. As a consequence, soaps belong to a class of substances called surfactants. A combination of the emulsifying power and the surface action of soap solutions enables them to detach dirt, grease and oil particles from the surface being cleaned and to emulsify them so that they can be washed away. These same principles of cleansing action apply to synthetic detergents.