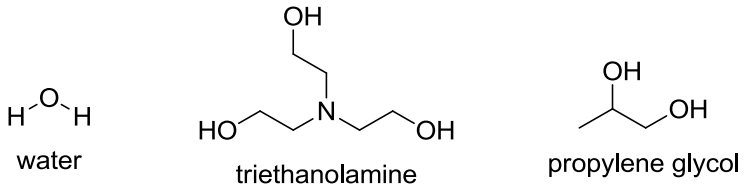
Synthesis of Hand Cream

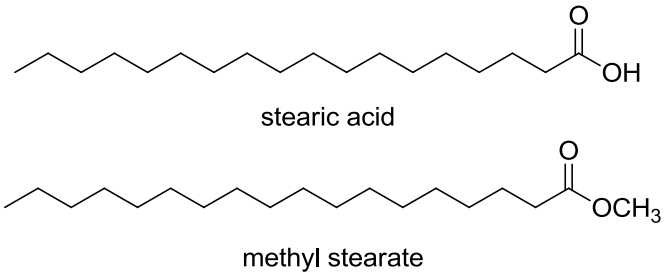
Introduction

The chemistry of the interaction between cosmetics and the skin is an area of much research. The sale of skin care products is a multi-million dollar industry. For the first quarter in 2005, Avon alone had a net income of $172 million. With these kinds of earnings it isn't surprising that considerable research is done in skin care. In this lab we will focus on the ingredients of a basic hand cream. This combination of ingredients achieves a hand-cream which has a number of useful functions including: softening of the skin, preventing dryness, elimination of natural waste products and cooling of the skin. Each of the ingredients within hand cream aid in at least one of these functions.

The hand cream that will be synthesized in this lab consists of three polar ingredients: water, triethanolamine, propylene glycol.



And four non polar ingredients: stearic acid, methyl stearate, lanolin and mineral oil.



Lanolin (also known as wool wax) is a yellow waxy substance secreted by glands in the skin of wool-bearing animals such as sheep. It is used widely in skin products. It has a complex and variable chemical composition containing thousands of unique (mainly non polar) organic molecules.

Mineral Oil: Is a byproduct of petroleum distillation. It is a clear, colourless oil containing mainly alkanes ($C_nH_{2n\_2,}$ typically with 15-40 carbons).

The purpose of the water in hand cream is to provide moisture to the skin. Lanolin is able to absorb water and aid in the moisturizing of the skin. Since the hand cream contains both water (polar) and oils (non-polar), an emulsifying agent is needed maintain an emulsion with a high degree of homogeneity. An emulsion is a mixture of finely divided particles suspended in a liquid. If no emulsifying agent was present, the mixture

would quickly separate. An emulsifying agent must have a polar and non-polar portion. Stearic acid (structure above) is an example of such a molecule. It has a long non-polar hydrocarbon chain (giving the compound an overall non-polar quality) but it also has a polar $–CO_2H$ group. The polar portion of the molecule is able to interact with the water. Whereas the non-polar portion is able in interact with the oil.

The four remaining ingredients: triethanolamine, propylene glycol, methyl stearate and mineral oil, each serve an important function in generating the desired properties of a hand cream. These properties include smoothness, homogeneity, appearance, and cooling effect. In this experiment we will try to determine the specific function these four ingredients by leaving each one of them out of a hand-cream recipe and characterizing the resulting products.

Procedure

The following table show the amount of each ingredient to mix for each sample.

Polar Ingredients					
	Sample #1	**Sample #2**	**Sample #3**	**Sample #4**	**Sample #5**
Deionized water	5 mL	5 mL	5 mL	5 mL	5 mL
Triethanolamine	0.25g	0.25g	0.25g	0.25g	0.0 g
Propylene glycol	0.10 g	0.10 g	0.10g	0.0 g	0.10 g
Non-polar Ingredients					
	Sample #1	**Sample #2**	**Sample #3**	**Sample #4**	**Sample #5**
Stearic acid	1.0 g	1.0 g	1.0 g	1.0 g	1.0 g
Methyl stearate	0.10 g	0.10 g	0.0 g	0.10 g	0.10 g
Lanolin	1.0 g	1.0 g	1.0 g	1.0 g	1.0 g
Mineral oil	1 mL	0 mL	1 mL	1 mL	1 mL

1. Measure 150 mL of deionized water into a 250 mL beaker and heat on a hot plate until boiling.
2. Add the polar ingredients for sample #1 to a large test tube. The most efficient way to do this is to add ingredients carefully and slowly directly into to a pre-weighed test tube the re-weigh (or re-tare) the test tube before adding each new ingredient.
3. Using a test tube holder, place the test tube in your boiling water bath.
4. Add the non-polar ingredients for sample #1 to another large test tube. Using a test tube holder, also place the test tube in your boiling water bath. Heat for 5 minutes.

5. Once your test tubes have heated for 5 minutes, pour the non-polar ingredients into the test tube containing the polar ingredients. Stir the mixture until a uniform paste is formed.
6. Test the pH of the paste using pH paper.
7. By rubbing the hand cream between your fingers, determine its physical properties.
8. Repeat step 1 through 6 with the four remaining samples.

Report Sheet

Sample #1

pH _____
Smoothness _____
Homogeneity _____
Appearance _____
Cooling effect _____

Sample #2

pH _____
Smoothness _____
Homogeneity _____
Appearance _____
Cooling effect _____
Missing ingredient _____
Explain purpose of
missing ingredient: _____
_____

Sample #3

pH _____
Smoothness _____
Homogeneity _____
Appearance _____
Cooling effect _____
Missing ingredient _____
Explain purpose of
missing ingredient: _____
_____

Sample #4

pH _____
Smoothness _____
Homogeneity _____
Appearance _____
Cooling effect _____
Missing ingredient _____
Explain purpose of
missing ingredient: _____
_____

Sample #5

pH _____
Smoothness _____
Homogeneity _____
Appearance _____
Cooling effect _____
Missing ingredient _____
Explain purpose of
missing ingredient: _____
_____

Good scientists must learn to explain their research results in accurate, clear, and concise language. Briefly summarize your main conclusions in a single paragraph below.