

Teacher's Preparatory Guide

Lesson #3 – Nanotechnology in Cosmetics

Purpose: The purpose of this lesson is to familiarize students with the chemistry of cosmetics.

Time required: 50 minute class period

Level: AP Chemistry, Honors Chemistry, and/or Human Anatomy

Teacher Background: Teacher will have to be familiar with polar and non-polar substances as well as the basic anatomy of the skin and emulsions. This information is provided in lessons 1 and 2.

Nanotechnology is the science of the very small where scientists and engineers manipulate materials at the nanoscale to create new materials and devices. Scientists have discovered that materials at the nanoscale can have very different properties than the same materials at the macro scale. The teacher may want to become familiar with basic information about nanotechnology by accessing materials on the internet such as:

NNIN's What is Nanotechnology? -- http://www.nnin.org/nnin_what.html

Earth and Sky's Top 10 things to know about nanotechnology -- <http://www.earthsky.org/blog/50688/top-10-things-to-know-about-nanotechnology>

Nanotechnology is expected to be a \$1.5 trillion industry by 2015. The cosmetics industry is a leader in using nanoparticles to enhance their products. The Project on Emerging Nanotechnologies' *Consumer Product Inventory* lists on its website numerous skin care products http://www.wilsoncenter.org/index.cfm?fuseaction=topics.home&topic_id=166192.

A Google search of cosmetics + nanotechnology will yield several articles on the topic.

Materials:

- L'Oreal Retivalift products (25mL each for testing)
- Assorted foundation make-up (25mL each for testing)
- Glass beakers or Petri dishes (100mL)
- Hot plate or hot water bath
- Insulated gloves or tongs

Advance Preparation:

1. Teacher will take small amounts of foundation and put them in beakers or glass Petri dishes and turn on hot plate or set up a hot water bath.

Safety Information:

1. If students are heating up the emulsions, the teacher must warn the students of the proper handling of hot glass (beaker, Petri dish, etc.).

Directions for the Activity:

1. Teacher will review the difference between polar and nonpolar molecules, intermolecular forces, and the anatomy of the skin from the previous days' lesson.
2. Teacher will introduce the different types of nanotechnology in cosmetics:
 - a. Nanoemulsions –
 - i. Emulsions are small droplets of oil dispersed in water or small droplets of water dispersed in oil
 - ii. These change the surface tension between water and oil = homogeneous product
 - b. Nanocapsules – used as delivery systems (200 nm). The capsules act like sponges that soak up and hold the product inside until the outer shell dissolves.
 - i. Lipid monolayer enclosing liquid or solid lipid core
 - ii. Allows for deeper penetration into the skin of active ingredients such as Vitamins A, C, and E, or pro-retinol A
 - iii. Allows for a light and sheer application without any residue
 - iv. Affects skin at the molecular level
 - c. Nanopigments – used in sunscreens and make-up
 - i. Filters UV rays
 - ii. Homogeneous color
3. Teacher will break the students up into small groups to complete the lab activity. Students will choose make-up products and slowly heat them up.
 - a. See student activity sheet below

Cleanup: students should wait until the make-up cools down and then dispose of the material either in the garbage can or down the sink with running water.

Assessment: Students will complete the lab activity sheet.

Resources:

To learn more about nanotechnology, here are some web sites with educational resources to go along with this lesson:

- <http://www.lignin.org/01novdialogue.html>
- http://www.smalltimes.com/Articles/Article_Display.cfm?ARTICLE_ID=269352&p=109
- <http://www.azonano.com/details.asp?ArticleID=1245>

National Science Education Standards

Content Standard B: Physical Science (grades 9 – 12)

- Structure of atoms
- Structure and properties of matter
- Chemical reactions

National Nanotechnology Infrastructure Network

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Student Lab Guide

Comparison of Emulsions

Materials

- 25 mL of several emulsion samples
- 100 mL beaker or similar container
- Hot plate or hot water bath
- Insulated gloves or tongs

Make a Prediction of what will happen when the emulsion is heated

When slowly heated, emulsions will separate into their components.

Conduct an Experiment

1. Obtain a beaker or a similar dish from your teacher.
2. Use a hot plate or a hot water bath to slowly heat your emulsion sample.
3. Make any observations.
4. Repeat with additional samples of different types of foundations.

Record your Observations

Emulsion Type	Amount of Time Heated	Observations

Analyze the Results

1. Did you observe what you predicted?

If not, how did your observation differ from your prediction?

2. Do your observations leave you with any more questions? Do they enable you to make more predictions? If so, what are they?

3. What other emulsions are there and would we see similar results with heating?

Examples: topical ointment such as BenGay, salad dressings, mayonnaise, margarine, cappuccino

Draw Conclusions

4. Based on your results, do you think that emulsions play an important role in commercial products? What do you think happens to the nanoparticles in the emulsions that contain them? Explain your answer.

Nanoparticles are so small they would stay within one or more of the separated components. They are too small to see.