

Teacher's Preparatory Guide

Lesson #2 – The Chemistry of the Skin

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

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. Most high school biology textbooks will have sections on skin anatomy and function. There is a discussion of this under “Directions for the Activity” section which is below. Internet resources are listed at the end of the unit.

Materials : Handouts and overhead of diagram of skin

Advance Preparation:

1. Teacher will white-out the names of the epidermis, dermis, and hypodermis. If this is for an anatomy class, the teacher may want to white-out more vocabulary words and use this diagram as a review of the anatomy of the skin.
2. Teachers will make copies of the anatomy of the skin handout and make a copy of the original diagram for use with an overhead projector.

Safety Information: None

Directions for the Activity:

1. Teacher will review the difference between polar and nonpolar molecules as well as intermolecular forces from the previous day's lesson.
2. Teacher will now discuss the anatomy of the skin concentrating on the depth of the different levels as well as the polarity of the components of the skin.
 - a. Epidermis – thin outer layer of the skin made up of 3 sub-layers
 - i. Stratus corneum (horny layer) – protect the other layers from desiccation. Achieved primarily by the intercellular lipid layers which provide a barrier to water diffusion.

- ii. Keratinocytes (squamous cells)
 - iii. Basal Layer
 - b. Dermis – middle layer of the skin made up of:
 - i. Blood vessels
 - ii. Lymph vessels
 - iii. Hair follicles
 - iv. Sweat glands
 - 1. held together by collagen (protein) made by fibroblasts which give the skin its strength and resilience. Changes in the dermis (organization and composition) play a significant role in altering the mechanical properties and appearance of the skin.
 - c. Subcutis (subcutaneous) – deepest layer of the skin consisting of a network of collagen and fat cells
 - i. Protects organs
 - ii. Conserves body heat
3. Teacher will discuss with students why skin wrinkles. Below is an article from Scientific American (September 2005) that might help begin a class discussion.

Why does skin wrinkle with age? What is the best way to slow or prevent this process?

Suzan Obagi, assistant professor in dermatology at the University of Pittsburgh and director of the Cosmetic Surgery and Skin Health Center, explains.

Normal healthy skin has a nice epidermis with a smooth cornified, or outer, layer that acts as a good barrier to water and environmental injury. Skin color and tone is even and unblemished. Components such as collagen (which provides skin firmness), elastin (which supplies skin elasticity and rebound) and glycosaminoglycans or GAGs (which keep the skin hydrated) are all abundant. It is interesting to note that under a microscope a biopsy of a wrinkle exhibits no telltale signs that reveal it to be a wrinkle. So what causes the skin to look wrinkled? It is probably a multi-factorial process of intrinsic aging and extrinsic aging.

Intrinsic aging is the natural aging process that takes place over the years regardless of outside influences. After the age of 20, a person produces about 1 percent less collagen in the skin each year. As a result, the skin becomes thinner and more fragile with age. There is also diminished functioning of the sweat and oil glands, less elastin production, and less GAG formation. Wrinkle formation as a result of intrinsic aging is inevitable, but it will always be slight.

Extrinsic aging occurs in addition to intrinsic aging as a result of sun and environmental damage (tobacco use and exposure to pollution, for example). Extrinsic aging shows up as thickening of the cornified layer, precancerous changes such as lesions called actinic keratosis, skin cancer (including basal cell carcinoma, squamous cell carcinoma, lentigo maligna melanoma), freckle and sun spot formation, and exaggerated loss of collagen, elastin, and GAGs. Alone or in concert, these processes give the skin the appearance of roughness, uneven tone, brown patches, thin skin and deep wrinkles.

Prevention is key to minimizing wrinkles. The most important thing is to take care of your skin before all these changes start to take place. Sun protection against both UVA and UVB rays is critical 365 days a year using an SPF of at least 35: I prefer zinc- or titanium-based products. After the age of 25 I recommend using Retin-A (a vitamin A derivative that uses the generic name tretinoin) as an antiaging cream. It is a prescription agent that has been used for more than 30 years with a safe track record and excellent results. In the first two or three months patients may experience redness, peeling and flaking, but should then noticed a marked improvement. Over time tretinoin improves fine lines, the appearance of pores, precancerous changes, and brown spots. If tretinoin treatment is not enough, then medium depth chemical peels and some non-invasive lasers can help build collagen and thus improve the skin's appearance.

4. Students will fill in the diagram of the skin with the appropriate terms.

Cleanup: none

Assessment:

There is no formal assessment for this lesson. Teachers will walk around the room checking on students as they are filling in the anatomy worksheet. Teachers will give the students the correct answers to the worksheet after the class has completed it ensuring that all students will leave the lesson with a correct diagram.

Resources:

To learn more about the make-up of the skin, here are some web sites with educational resources to go along with this lesson:

- <http://www.umm.edu/dermatology-info/anatomy.htm>
- <http://telemedicine.org/anatomy/anatomy.htm>
- <http://www.dermatologychannel.net/skinanatomy/index.shtml>

National Science Education Standards

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

- Structure of atoms
- Structure and properties of matter

References:

Dermatology - Anatomy of the Skin. Retrieved June 20, 2007, from University of Maryland Medical Center Web site: www.umm.edu/dermatology-info/anatomy.htm

Obagi, Suzan (2005, September 26). Why does skin wrinkle with age? What is the best way to slow or prevent this process?. *Scientific American, Ask the Expert*

Subramanyan, K., Misra, M., Mukherjee, S., & Ananthapadmanabhan, K.P. (2007). Advances in the materials science of skin: A composite structure with multiple functions. *MRS Bulletin*, 32, 770-778.

Worksheet: Anatomy of the Skin

Use the following to make an overhead for students to use as a guide as you are teaching about the functions of each layer. Make sure to white out chosen vocabulary words before making student copies.

Students: Label the diagram of the skin

