Name: _____
Date: _____ Hr: __

# Skin—Integumentary System

**Background:** The skin is often considered an organ system because of its extent and complexity. It does much more than just cover the body exterior. Architecturally, the skin is a wonder. It is touch yet pliable, a characteristic that enables it to withstand constant insult from outside agents.

*Objective 1: List several important functions of the integumentary system*

The skin has several functions, most concerned with protection. It insulates and cushions the underlying body tissues and protects the entire body from mechanical damage (bumps and cuts), chemical damage (acids, alkalis and the like), thermal damage (heat) and bacterial invasion. The hardened uppermost layer of the skin prevents water loss from the body surface.

Other skin functions include:

- Acting as a mini-excretory system; urea, salts, and water are lost when we sweat
- Performing important metabolic duties, such as producing proteins important to our immunity
- Acting as the site of vitamin D synthesis for the body
- Containing the cutaneous sense organs that allow us to sense and enjoy the external environment
- Playing an important role in regulating heat loss form the body surface

**Basic Structure of the Skin**

The skin has two distinct regions—the superficial epidermis composed of epithelium and an underlying connective tissue dermis. These layers are firmly cemented together along a wavy border. Immediately deep to the dermis is the subcutaneous tissue (hypodermis) which is not considered part of the skin. The main skin areas and structures are described below.

*Objective 2: To recognize and name the following skin structures: epidermal and dermal layers, hair follicles and hairs, sebaceous and sweat glands*

Using figure 6.1 and the skin model, identify the various skin structures as listed in your "To Know" sheet.

**Activity: Visualizing Changes in Skin Color due to Continuous External Pressure**

Go to the supply area and obtain a small glass plate. Press the heel of your hand firmly against the plate for a few seconds and then observe and record the color of your skin in the compressed area by looking through the glass.

Color of compressed skin: _____

What is the reason for this color change?

_____
_____
_____

What would happen if the pressure was continued for an extended period in this area?

_____

_____

There are several simple experiments you can conduct to investigate the location and physiology of cutaneous receptors. In each of the following activities, work in pairs with one person as the subject and the other as the experimenter. After you have completed an experiment, switch roles and go through the procedures again so that all class members obtain individual results. *Keep an accurate account of each test that you perform.*

**Activity: Determining the Two-Point Threshold**

The density of the touch receptors varies significantly in different areas of the body. In general, areas that have the greatest density of tactile receptors have a heightened ability to "feel." Let's check it out…

- Using a caliper test the ability of the subject to differentiate two distinct sensations when the skin is touched simultaneously at two pints. Beginning with the face, start with the caliper arms completely together. Gradually increase the distance between the arms, testing the subject's skin after each adjustment. Continue with this testing procedure until the subject reorts that *two points* of contact can be felt. This measurement, the smallest distance at which two points of contact can be felt, is the **two-point threshold**.
- Repeat this procedure on the back and palm of the hand, fingertips, lips, back of the nec, and ventral forearm. Record your results in the chart in the next column.
- Which area had the smallest two-point threshold?

| Determining Two-Point Threshold | |
|---|---|
| **Body Area Tested** | **Two-Point Threshold (millimeters)** |
| Face | |
| Back of hand | |
| Palm of hand | |
| Fingertip | |
| Lips | |
| Back of neck | |
| Ventral Forearm | |

**Activity: Testing Tactile Localization**

Tactile localization is the ability to determine which portion of the skin has been touched. The tactile receptor field of the body periphery has a corresponding "touch" field in the brain. Some body areas are well represented with touch receptors, and tactile stimuli can be localized with great accuracy, but density of touch receptors in other body areas allows only crude discrimination.

- The subject's eyes should be closed during the testing. The experimenter touches the palm of the subject's hand with a marker. The subject should then try to touch the exact point with his/her own marker (different color). Measure the error of localization in millimeters.
- Repeat the test in the same spot twice more, recording the error of localization for each test. Average the results of the three determinations and record it in the chart below.

| Testing Tactile Location | |
|---|---|
| **Body Area Tested** | **Average error of localization (millimeters)** |
| Palm of hand | |
| Fingertip | |
| Ventral Forearm | |
| Back of hand | |
| Back of neck | |

Does the ability to localize the stimulus improve the second time? _____ The third time? _____ Explain: ___
_____
_____
_____
_____
_____

- Repeat the above procedure on a fingertip, the ventral forearm, the back of a hand, and the back of the neck. Record the average results in the chart.
- Which area has the smallest error of localization (is most sensitive to touch)?

_____
_____

**Activity: Demonstrating Adaptation of Touch Receptors**

In many cases, when a stimulus is applied fro a prolonged period, the rate of receptor response slows and conscious awareness of the stimulus declines or is lost until some time of stimulus change occurs. This phenomenon is referred to as **adaptation**. The touch receptors adapt particularly rapidly, which is highly desirable. Who, for instance, would want to be continually aware of the pressure of clothing on their skin? Let's explore…

- The subject's eyes should be closed. Place a coin on the anterior surface of the subject's forearm, and determine how long the sensation persists for the subject. Duration of the sensation: _____ sec
- Repeat the test, placing the coin at a different forearm location. How long does the sensation persist at the second location? _____ sec
- After awareness of the sensation has been lost at the second site, stack three more coins atop the first one. Does the pressure sensation return? _____ If so, for how long is the subject aware of the pressure in this instance? _____sec
- Are the same receptors being stimulated when the four coins, rather than one coin, are used? _____ Explain: _____
_____
_____
_____
_____
_____

**Appendages of the Skin**

The appendages of the skin—hair, nails, and cutaneous glands—all derive from the epidermis, but they reside in the dermis.

*Objective 3: Describe the distribution and function of eccrine and apocrine sweat glands and sebaceous glands*

The cutaneous glands fall primarily into two categories: The sebaceous glands and the sweat glands. The **sebaceous (oil) glands** are found nearly all over the skin. Their ducts usually empty into a hair follicle, but some open directly onto the skin surface.

The product of the sebaceous glands, called sebum, is a mixture of oily substances and fragmented scells that acts a s natural skin cream that keeps the skin soft and moist. *Blackheads* are accumulations of dried sebum and bacteria. *Acne* is due to active infection of the sebaceous glands.

Epithelial openings, called *pores*, are outlets for the **sudoriferous (sweat) glands**. These exocrine glands are widely distributed in the skin. There are two types of sweat glands. The **eccrine** glands, which are distributed all over the body, produce clear perspiration, consisting primarily of water, salts (mostly NaCl), and urea. The **apocrine** glands found chiefly in the axillary and genital areas, secrete a milky protein- and fat-rich substance that is an excellent source of nutrients for the bacteria typically found on the skin.

The sweat glands are controlled by the nervous system, and are an important part of the body's heat-regulating apparatus. They secrete perspiration when the external or body temperature is too high. When this perspiration evaporates, it carries large amounts of body heat with it.

**Activity: Plotting the Distribution of Sweat Glands**

For this simple experiment you will need two squares of bond paper (each 1 cm x 1 cm), adhesive tape, and Lugol's iodine and a cotton-tipped swab.

- Using the iodine solution, paint an area of the medial aspect of your left palm (avoid the crease lines) and a region of your left forearm. Allow the iodine solution to dry thoroughly. The painted area in each case should be slightly larger than the paper squares to be used.
- Mark one piece of paper with an "H" (for hand) and the other with an "A" (for arm). Have your lab partner *securely* tape the appropriate square of bond paper over each iodine-painted area, and leave them in place for 10 minutes. While waiting to determine the results, continue with the sections on hair and nails.
- After 20 minutes, remove the paper squares and count the number of blue-black dots on each square. The appearance of a blue-black dot on the paper indicates an active sweat gland. (The iodine in the pore dissolves in the sweat and reacts with the starch in the paper to produce the color) Thus "sweat maps" have been produced for the two skin areas.

Which skin area tested has the most sweat glands? _____

**Hair**

*Objective 4: Identify the major regions of a hair and hair follicle*

Hairs are found over the entire body surface, except for the palms of the hands, the soles of the feet, parts of the external genitalia, the nipples and the lips. A hair, enclosed in a hair follicle, is also an epithelial structure. The part of the hair enclosed within the follicle is called the **root**.

The hair follicle is structured from both epidermal and dermal cells. If you look carefully at the structure of the hair follicle, you wll see that it generally is in a slanted position. Small bands of smooth muscle cells—**arrector pili—** connect each hair follicle to the dermis. When these muscles contract the hair follicle is pulled upright, dimpling the skin surface with "goose bumps".

**Nails**

*Objective 5: Identify the major regions of nails*

Nails, the hornlike derivatives of the epidermis are transparent and nearly colorless, but they appear pink because of the blood supply in the underlying dermis. The exception to this is the proximal region of the thickened nail matrix which appears as a white crescent called the lunula. When someone is cyanotic due to a lack of oxygen in the blood, the nail beds take on a blue cast.

Nails consist of a free edge, a body (visible attached portion), and a root (embedded in the skin and adhering to an epithelial nail bed). The borders of the nail are overlapped by skin folds called nail folds. The thick proximal nail fold is commonly called the cuticle.

**Activity: Identifying Nail Structures**

Identify the nail structures shown in Figure 6.4 on yourself or your lab partner.