

LAB: The Integumentary System

Background: The integumentary system is made up of the skin, hair, nails, sweat glands, and the sebaceous glands. The skin is the largest organ in the body. It makes up 12-15% of body and has an entire surface area between 1-2 meters. Our skin is our first barrier against infectious diseases and prevents fluid loss from our organs, which allows our body to maintain homeostasis. The skin is such an important organ that even moderate burns on more than 30% of the skin can be life threatening due to fluid loss and infection.

The primary function of the integumentary system includes

- Maintain internal temperature (e.g. sweating)
- Excrete excessive fluids and waste
- Receive pressure, pain, heat, and cold
- Produce and secrete melatonin and vitamin D
- Protect the body from infection
- Maintain fluid balance

The Layers of the Skin: The skin is separated into 3 main layers called the epidermis, dermis, and hypodermis.

The Epidermis

The epidermis is the outermost layer of the skin. There are 4 types of cells that make up the epidermis: melanocytes that produce melanin (influences skin color), keratinocytes that produce keratin, Merkel's cells that function in touch, and Langerhans' cells that function in immunity. There are a few layers, called strata, that make up the epidermis. The is avascular and all nutrients for the living cells of the epidermis diffuse from the basement membrane of the dermis below it. From the bottom layer to the outermost layer the strata include:

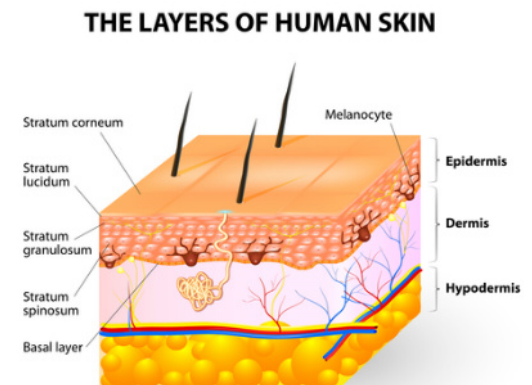
● **Stratum basale**- a layer of single cells that lays on the basement membrane of the dermis. These cells continuously divide and push up towards the surface of the skin.

● **Stratum spinosum** – These cells are “spiny” as the name denotes. They have been pushed out from the stratum basale and the spines interlock together to form a support layer.

● **Stratum granulosum** – The cells of this layer are still living, but none of the nutrients reach them. These cells begin producing keratin and the cell begin to die. Eventually, the keratin protein produced will make up the majority of the dead cells in the next two layers

● **Stratum lucidum** – This layer of dead keratinized cells is only found in areas where skin is thick, such as the soles of the feet, and is not found in thin skin areas, such as the forearms.

● **Stratum coreum** – This is the outer layer that we see and is made up layers of dead keratinized cells, This layer is tightly bound together, and the keratin protects the underlying cells from fluid loss while keeping the skin elastic. In a process called desquamation, cells of the stratum corneum are sloughed off. Cells from the epidermis are completely she every 35-45 days, so essentially you have a completely new skin every month and a half!



The Dermis

The dermis is the layer below the epidermis. The dermis is primarily made up of connective tissue layers and proteins including collagen, elastin, and reticular fibers. The arrangement of these fibers allow for the dermis to be extremely elastic and flexible. It also allows for blood vessels, glands, hair follicles, and nerves to be embedded in the dermis. The two main glands embedded in the skin include the sweat and sebaceous glands. The sweat glands assist the body in temperature control. The sebaceous glands produce oils that keep the outer layer of skin and hair moisturized. Hair and nail growth begin in the dermis. Highly keratinized epithelial cells are arranged to make up hair and nails.

The Hypodermis

The hypodermis is the bottommost layer of skin, located under the dermis. This layer is primarily made up of adipose tissue and functions in insulation and protection. The base of blood vessels, nerves, and some hair follicles also extend into the hypodermis.

Skin Disorders: There are more than 2000 diseases and disorders that can affect the integumentary system. The following table summarizes a few common skin disorders. The prevalence is within the United States only for the year 2004.

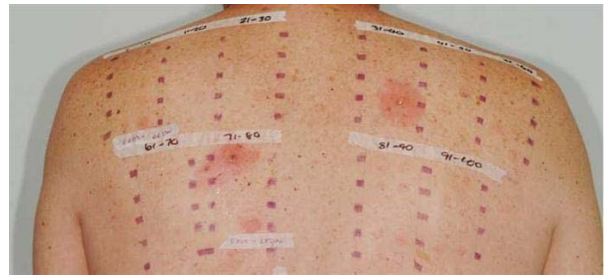
Skin Disorder	Description	Symptoms	Prevalence
<i>Herpes Simplex</i>	A virus that can cause blisters such as cold sores and fever blisters	Painful blisters, itching, burning, flu-like symptoms	165 million
<i>Dermatitis</i>	Inflammation of the dermis	Skin lesions, swelling, itching, redness	87.5 million
<i>Varicose Veins</i>	Swollen and clogged veins in the extremities	Limb pain, visible veins, skin ulcers, brown coloration in limbs, swelling	62.4 million
<i>Warts</i>	Growths caused by human papillomavirus (HPV), transmitted by contact	Growth with rough surface, may be itchy or painful	58.5 million
<i>Eczema</i>	Chronic skin condition that causes itchy, scaly rashes	Blisters, dry skin, discharge, bleeding, redness, inflammation	39.5 million
<i>Cellulitis</i>	Bacterial skin infection caused by Staphylococcus and Streptococcus	Fever, pain, inflammation, stretched skin, swelling, heat, sweating, fatigue	7.6 million
<i>Staph Infection</i>	Bacterial skin infection caused by Staphylococcus	Boils, impetigo, cellulitis, bacteremia, shock syndrome, septic arthritis	1.2 million

Diagnostic Tests for Skin Diseases

The branch of medicine that focuses on diseases of the integumentary system is called dermatology. A dermatologist is a board certified medical doctor with additional training in skin, hair, and nail disorders. There are many types of tests available to diagnose specific skin disorders. Three of the most common tests that are performed when a skin disorder is suspected include:

- Skin biopsy – When an abnormal growth appear on the skin that may be indicative of cancer, a skin biopsy may be performed. The suspect area of skin is removed and a pathology lab will prepare and examine the tissue microscopically to determine whether the skin may be cancerous.

●Patch test- These are used to detect whether an allergy may be causing the skin disorder. A variety of allergens such as pollen, animal dander, milk proteins, etc... can be applied to skin directly, or through subcutaneous injections. The skin is observed for a period of time for any redness, swelling, or itching that would indicate an allergic reaction to that allergen. The image to the right shows a common patch test.



●Skin culture – When a bacterial, fungal, or viral infection is suspected of causing a skin disorder, a skin culture can be taken. The culture may include samples of tissue or fluids present in the affected portion of the skin. The sample is then grown on different types of media in an attempt to identify the specific microorganism that may be causing the skin infection.

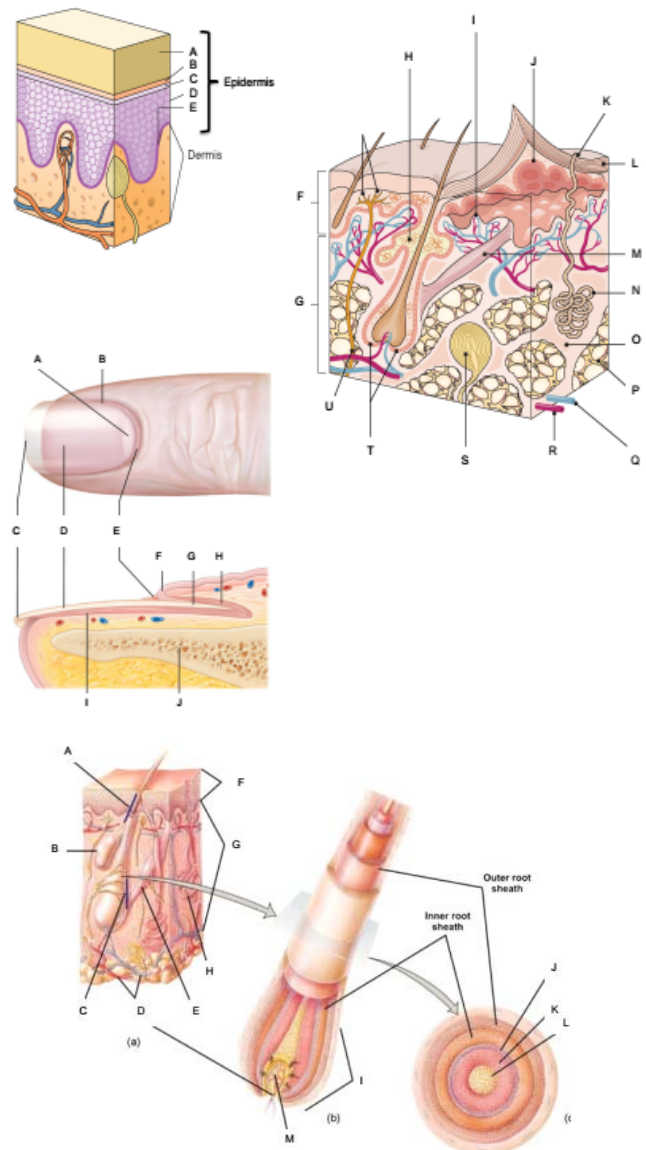
Station 1: The Integumentary System

Using the charts, tables, and diagrams on the lab table along with your text books or online resources, identify the following parts of the integumentary system.

Table 1: The Skin	
A.	L.
B.	M.
C.	N.
D.	O.
E.	P.
F.	Q.
G.	R.
H.	S.
I.	T.
J.	U.
K.	

Table 2: Nails	
A.	E.
B.	F.
C.	G.
D.	H.

Table 3: Hair	
A.	H.
B.	I.
C.	J.
D.	K.
E.	L.
F.	M.
G.	



Station 2: Integumentary System Histology

The cell and tissue structures of the integumentary system are suited for the function performed. Using the pictures on the lab table, draw and label the pictures in the space below.

Skin without hair

Using colored pencils, draw the histology Image B from the Skin without hair chart in the space below. Using image A as a reference, label the following: epidermis, dermis (papillary layer), blood vessels, and dermis (reticular layer)



Skin with hair

Using colored pencils, draw the histology Image B from the Skin with hair chart in the space below. Using image A as a reference, label the following: epidermis, dermis, hypodermis, hair follicle, and hair



Hair Follicle

Using colored pencils, draw the histology Image B from the Hair Follicle chart in the space below. Using image A as a reference, label the following: hair, dermal sheath, inner and outer root sheath, bulb, and dermal papilla



Nails

Using colored pencils, draw the histology Image B from the Nails chart in the space below. Using image A as a reference, label the following: nail plate, nail bed, cuticle, matrix, and proximal nail fold

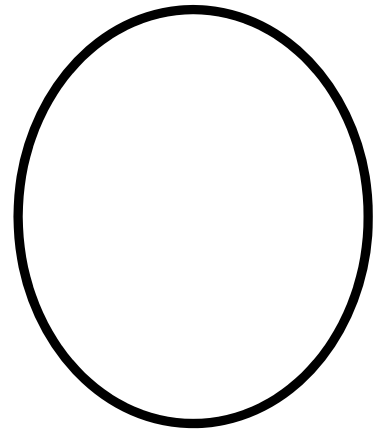


Station 3: Skin, Hair, and Nails

Examine the features of the integumentary system. You will collect skin, hair, and nail samples to observe under the microscope.

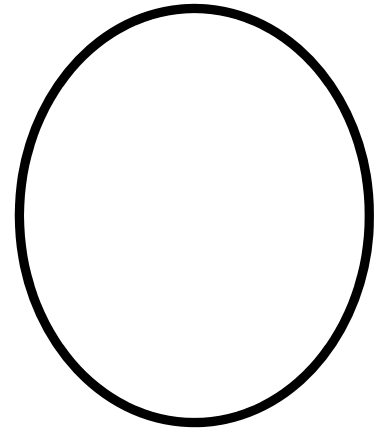
Skin

1. Use a Q-tip to gently swab the inside cheek of your mouth. Rub the Q-tip on the slide and discard the Q-tip in the designated beaker.
2. Add a drop of methylene blue to your slide and then place the cover slip on top. NOTE: You may need to add a drop of water to lighten up the methylene blue. Use a paper towel to wick off any excess liquid.
3. Examine the cheek cells under the microscope. You will need to work your way up the total magnification of 400x.
4. Draw what you see in the space to the right.
5. When finished, wash your slide and cover slip. Place on paper towel to dry.



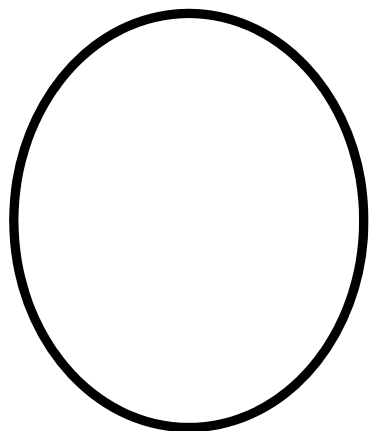
Hair Follicle

1. Remove a single hair from your head making sure you have a follicle attached.
2. Place your hair onto a slide and add a drop of water. Place cover slip on top.
3. Examine your hair follicle under the microscope (e.g. 400x) and draw your hair follicle in the space to the right.
4. When finished, wash your slide and cover slip. Place on paper towel to dry.



Nails

1. Using scissors or a nail clipper, remove a small piece of nail from the end of your fingernail.
2. Place clipping on slide and add water. Place cover slip on top. NOTE: You may need to cut the nail even smaller to examine underneath the microscope.
3. Examine the nail under 400x and draw what you see in the space to the right.
4. Rinse and clean off your slide.



Station 4: Skin Disease

Using the skin disease charts complete the following table. List ONLY THREE causes or Risk Factors, Symptoms and Treatment Options for each disease.

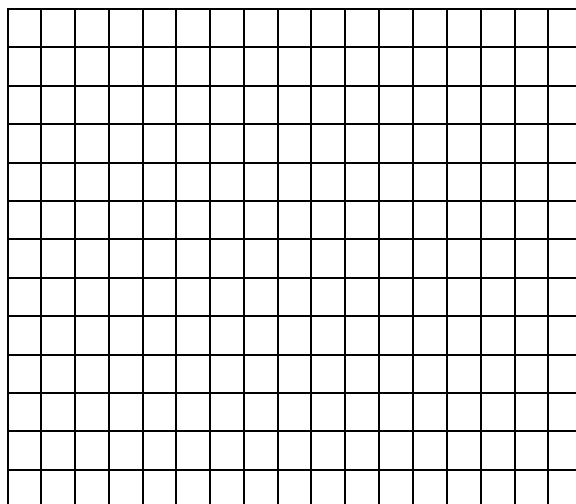
ACNE			
Description	Causes or Risk Factors	Symptoms	Treatment Options
What percent of people will experience acne at some point in their life?			
PSORIASIS			
Description	Causes or Risk Factors	Symptoms	Treatment Options
If a patient has 12% of their body covered with a psoriasis rash, what would be the severity?			
STAPH INFECTION			
Description	Causes or Risk Factors	Symptoms	Treatment Options
How many MORE staph infections occurred in 2007 than 1997?			
CHICKENPOX			
Description	Causes or Risk Factors	Symptoms	Treatment Options
What happened to the percent of children that had chickenpox once the percentage of children receiving the varicella increased?			
FUNGAL INFECTIONS			
Description	Causes or Risk Factors	Symptoms	Treatment Options
What part of the body has the highest percentage of fungal infections? Which part has the least?			

Station 5: Body Temperature

The skin is responsible for maintaining the internal temperature of the body regardless of the external temperature. At this station you will examine how changing the external temperature impacts the core temperature of the body.

1. Choose a group member to be the test subject. Record temperature of the water and record in the data table below in "Before Experiment". Next, place thermometer in the armpit as close to the skin as possible and record the temperature. Finally, place the thermometer on the skin of your forearm and record the temperature. Also observe and record the color of the skin of the forearm to be tested.
2. Submerge the forearm into the chilled water. Every minute for 5 minutes record the armpit temperature, dermal temperature, water temperature, and color of skin.
3. Once the 5 minutes is up, you will dry off the arm and continue to measure and record the armpit temperature, dermal temperature, water temperature, and color of skin every minute for 5 minutes.
4. Create a line graph of your results for the armpit temperature and the dermal temperature. **Make sure to give the graph a descriptive title, give a key/legend, use equal intervals, and title each axis with units.**

Body Temperature				
Time	Water Temp	Armpit Temp	Dermal Temp	Skin Color
Before Experiment (control)				
0 min				
Submerge Forearm				
1 min				
2 min				
3 min				
4 min				
5 min				
Post Submerge Forearm				
6 min				
7 min				
8 min				
9 min				
10 min				



Analysis Questions

Station 1

1. What are the 3 main layers of skin? _____
2. What protein makes up hair and nails? _____

Station 2

3. What type of tissue makes up the epidermis? Dermis?

Station 3

4. From what layer of the epidermis was your skin sample taken? _____

Station 4

5. What were the common causes and risk factors found between the majority of the skin disorders?

Station 5

6. Summarize how ice water affected the armpit temperature and dermal temperature.

7. Hypothesize what would happen to the armpit and dermal temperatures if the test subject was placed in a hot sauna.

Review Questions

1. What organs make up the integumentary system? _____

2. What percent of the body is skin? _____

3. Identify 2 functions of the skin. _____

4. What are 4 types of cells that make up the epidermis? What are their functions?

5. Since the epidermis is avascular, how does it get nutrients? _____

6. What types of proteins make up the dermis? _____

7. What structures are found embedded in the dermis layer? _____

8. What is the function of the sebaceous glands? _____

9. What is the function of the sweat glands? _____

10. According to the table in the background, what skin disorder was the most prevalent in the U.S. in 2004? _____ Least prevalent? _____

11. What is a skin biopsy? What is it used to diagnose?

12. What is a patch test? What is it used to diagnose?

13. What is a skin culture? What is it used to diagnose?