

# The Integumentary System

## HASPI Medical Anatomy & Physiology 07a

### Lab Activity

## Background



[http://www.earthtimes.org/newsimage/us-government-dedicates-day-skin-cancer-education\\_235.jpg](http://www.earthtimes.org/newsimage/us-government-dedicates-day-skin-cancer-education_235.jpg)

## The Integumentary System

The integumentary system is made up of the skin, hair, nails, sweat glands, and sebaceous glands. The skin is the largest organ in the body. It makes up 12-15% of body weight and has an entire surface area between 1-2 meters. Our skin is our first barrier against infectious disease 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 **functions** of the integumentary system include:

- Maintain internal temperature (sweating & shivering)
- Excrete excess fluids and waste
- Receive of pressure, pain, heat, and cold
- Produce and secrete melatonin & vitamin D
- Protect the body from infection
- Maintain fluid balance

## The Layers of the Skin

The skin is separated into three main layers called the epidermis, dermis, and hypodermis.

### The Epidermis

The epidermis is the outermost layer of the skin. There are four 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 epidermis 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 cells 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 forearm.
- **Stratum corneum** – This is the outer layer that we see and is made up of 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 shed every 35-45 days, so essentially you have completely new skin every month and a half!

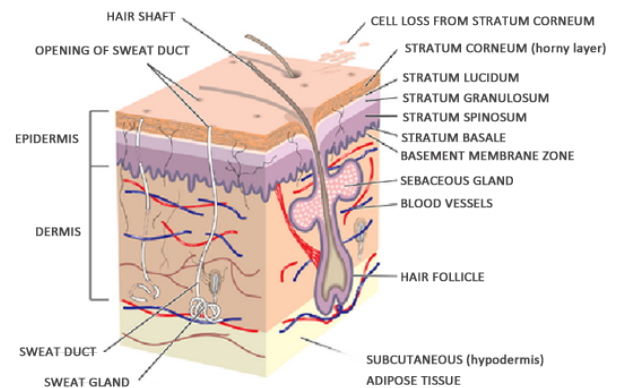
### The Dermis

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

Name(s): \_\_\_\_\_

Period: \_\_\_\_\_ Date: \_\_\_\_\_

### CROSS-SECTION OF SKIN



<http://media.mercola.com/assets/images/healthy-skin/skin-cross-section.png>

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 2,000 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
<b>Herpes simplex</b>	A virus that can cause blisters such as cold sores and fever blisters	Painful blisters, itching, burning, flu-like symptoms	165 million
<b>Dermatitis</b>	Inflammation of the dermis	Skin lesions, swelling, itching, redness	87.5 million
<b>Varicose veins</b>	Swollen and clogged veins in the extremities	Limb pain, visible veins, skin ulcers, brown coloration in limbs, swelling	62.4 million
<b>Warts</b>	Growths caused by human papillomavirus (HPV); transmitted by contact	Growth with rough surface, may be itchy or painful	58.5 million
<b>Eczema</b>	Chronic skin condition that causes itchy, scaly rashes	Blisters, dry skin, discharge, bleeding, redness, inflammation	39.5 million
<b>Cellulitis</b>	Bacterial skin infection caused by Staphylococcus and Streptococcus	Fever, pain, inflammation, stretched skin, swelling, heat, sweating, fatigue	7.6 million
<b>Staph infection</b>	Bacterial skin infection caused by Staphylococcus	Boils, impetigo, cellulitis, bacteremia, toxic shock syndrome, septic arthritis	1.2 million

### Diagnostic Tests for Skin Disorders

The branch of medicine that focuses specifically 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 abnormal growths 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 the 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.



[http://fromyourdoctor.com/ex/skin\\_allergy\\_test.jpg](http://fromyourdoctor.com/ex/skin_allergy_test.jpg)

Levine, N. 2012. Diagnosing Skin Problems, [www.webmd.com](http://www.webmd.com).

## Materials

Station 1: Anatomy posters (3)  
 Station 2: Eraser, timer, ruler  
 Station 3: Histology posters (4)

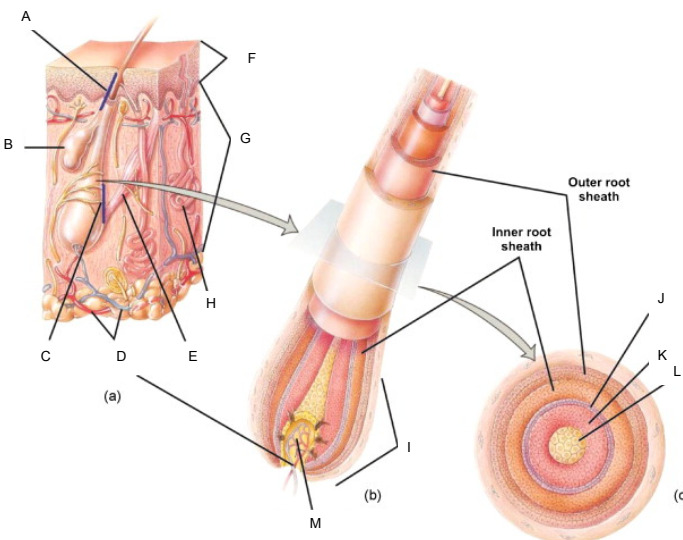
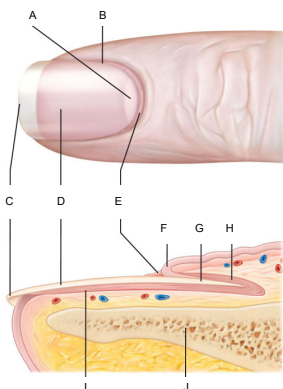
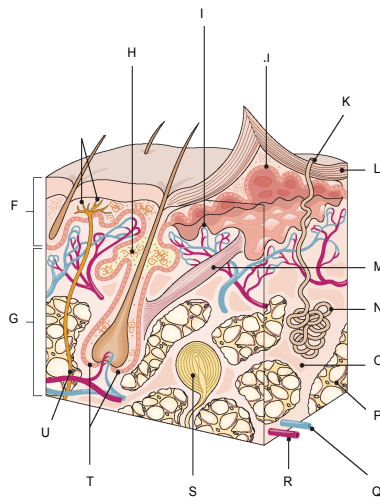
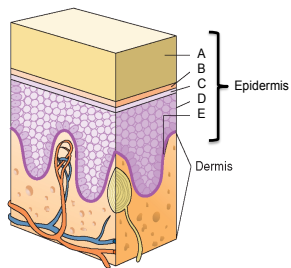
Station 4: Microscope, slide, coverslip, Q-tip, methylene blue  
 Station 5: Disease posters (5)  
 Station 6: Pan, ice water, thermometer/covers, paper towel

## Procedure

This is a station lab activity. There are 6 stations set up around the classroom. Each station will take approximately 10-15 minutes.

### Station 1: The Integumentary System

**Integumentary System Anatomy** – Using the “Skin”, “Nails”, and “Hair” charts identify the labeled organs or parts of the organs in **Tables 1-3** below. If there are any you cannot identify, use a textbook or online resource. A smaller version of the charts are included here for later review.



**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**

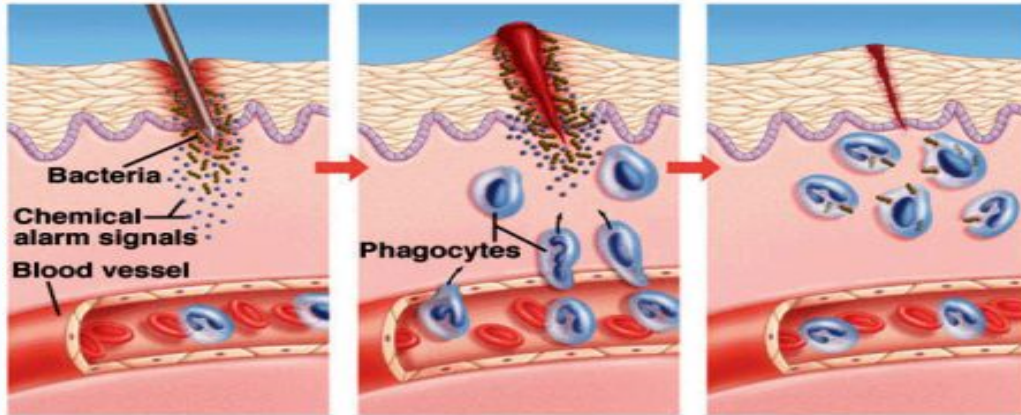
A	E
B	F
C	G
D	H

**Table 3: Hair**

A	H
B	I
C	J
D	K
E	L
F	M
G	

## Station 2: Inflammatory Response

The nervous and cardiovascular systems respond to certain stimuli by triggering an inflammatory response. The stimuli could be an infectious agent, foreign body like a splinter, burns, lacerations, toxins, or even chemicals. The inflammatory response is the body's attempt to remove the stimuli and protect the body. Depending on the severity, the inflammatory response can involve swelling, heat, redness, and pain. The blood vessels increase blood flow to the inflamed area, causing heat and redness. As the blood accumulates in the area, it also causes swelling.



[http://3.bp.blogspot.com/-wq\\_njyKVd0/UKEcLSJMjOI/AAAAAAAAABY8/QOpdgJbbwe4/s1600/Inflammation.jpg](http://3.bp.blogspot.com/-wq_njyKVd0/UKEcLSJMjOI/AAAAAAAAABY8/QOpdgJbbwe4/s1600/Inflammation.jpg)

### Directions

✓ when complete

**Step 1** Obtain a pencil with an eraser, a timer, and a ruler.

#### The White Reaction

**Step 2** Have the timer ready and drag the eraser lightly across the skin of the forearm. Start the timer.

**Step 3** Immediately observe the area that the eraser was dragged over. Watch for a white streak. Record the time it takes for the white streak to appear in Table 4 below. Continue timing.

**Step 4** Record the time it takes for color to return to the white area in Table 4.

**NOTE** The white reaction is caused by the displacement of blood from the small capillaries at the surface of the skin in response to the mechanical stimuli. Eventually blood will return to the area.

#### The Red Reaction

**Step 5** On the other forearm, drag the eraser firmly across the skin of the inner forearm. This should be slightly painful. Start the timer.

**Step 6** Immediately observe the area that the eraser was dragged over. Watch for a red streak with a white halo. Record the time it takes for the red streak to appear in Table 4.

**Step 7** Continue watching the streak for the next few minutes to determine if you have dermatographia. Some individuals will have a more severe allergic reaction caused by very sensitive skin that overproduces histamine in response to the stimuli.

**Step 8** Watch for a raised swollen welt where the eraser was dragged over. Record whether a welt appeared or not in Table 4. If the welt appeared, you have dermatographia.

Table 4	Time for white reaction to appear	Time for white reaction to disappear	Time for red reaction to appear	Do you have dermatographia?
Time in Seconds				



### Station 3: Integumentary System Histology

The cell and tissue structures of the integumentary system are suited for the functions performed. Redraw and label Image B below. Image A on each chart is for reference!

#### Skin w/o Hair

Using colored pens/pencils, draw the histology Image B from the “Skin w/o Hair” chart in the space below. Using Image A as a reference, label your drawing with the epidermis, dermis (papillary layer), blood vessels, and dermis (reticular layer).



#### Skin w/ Hair

Using colored pens/pencils, draw the histology Image B from the “Skin w/ Hair” chart in the space below. Using Image A as a reference, label your drawing with the epidermis, dermis, hypodermis, hair follicle, and hair.



#### Hair Follicle

Using colored pens/pencils, draw the histology Image B from the “Hair Follicle” chart in the space below. Using Image A as a reference, label your drawing with the hair, dermal sheath, inner and outer root sheath, bulb, and dermal papilla.



#### Nails

Using colored pens/pencils, draw the histology Image B from the “Nails” chart in the space below. Using Image A as a reference, label your drawing with the nail plate, nail bed, cuticle, matrix, and proximal nail fold.



## Station 4: Skin, Hair, & Nails

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

### Directions

✓ when complete

#### Skin

<b>Step 1</b>	Use a Q-tip to gently swab the inside cheek of your mouth.	
<b>Step 2</b>	Rub the Q-tip onto the slide. Discard the Q-tip.	
<b>Step 3</b>	Add one drop of methylene blue to your slide, where you rubbed the Q-tip, to stain the cheek cells. The cheek cells are clear, and the methylene blue will stain the cells to make them visible under the microscope.	
<b>Step 4</b>	Place the edge of a paper towel onto the corner of the slide touching the drop of methylene blue to wick off the methylene blue.	
<b>Step 5</b>	Add a drop of water to the slide and wick off any excess water. Repeat this process two more times.	
<b>Step 6</b>	Add a drop of water to the slide and place a coverslip.	
<b>Step 7</b>	View your cheek skin slide under the microscope. The cheek cells will appear blue, and the nucleus should be slightly darker.	
<b>Step 8</b>	Find at least one cell under high power (400x) and draw what you see in Diagram A below.	
<b>Step 9</b>	Rinse and use a paper towel to wipe off your slide and coverslip.	

#### Hair Follicle

<b>Step 1</b>	Grab a single hair from your head and pull. Make sure the follicle is attached.	
<b>Step 2</b>	Use scissors to cut the hair about an inch from the follicle so it will fit on the slide.	
<b>Step 3</b>	Place the hair follicle on the slide, add a drop of water, and cover with a coverslip.	
<b>Step 4</b>	View your hair follicle under the microscope.	
<b>Step 5</b>	Draw what you see under high power (400x) in Diagram B below.	
<b>Step 6</b>	Rinse your slide and coverslip, and use a paper towel to wipe dry.	

#### Nails

<b>Step 1</b>	Using the fingernail clippers, clip a very small piece of the end of your fingernail. (If you have fake nails, a section of toenail will also be adequate.)	
<b>Step 2</b>	Place the nail clipping on the slide, add a drop of water, and cover with a coverslip. If the coverslip is not sitting over the nail, remove the coverslip and cut the nail into a smaller piece.	
<b>Step 3</b>	View your nail under the microscope.	
<b>Step 4</b>	Draw what you see under high power (400x) in Diagram C below.	
<b>Step 5</b>	Rinse and use a paper towel to wipe off your slide and coverslip.	
<b>Step 6</b>	Clean off and return all of the materials.	

Diagram A

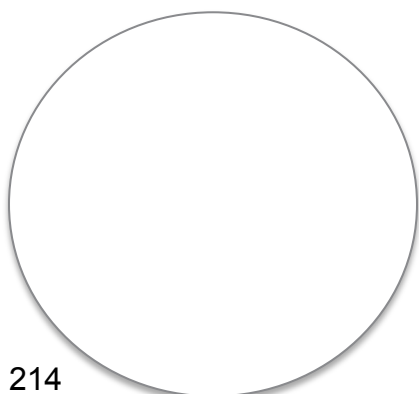


Diagram B

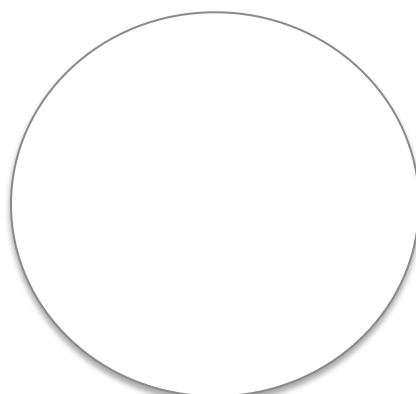
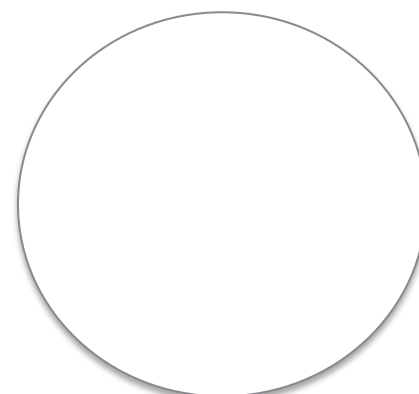


Diagram C



## Station 5: 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 (3)	Symptoms (3)	Treatment Options (3)
What percent of people will experience acne at some point in their life?			
Psoriasis			
Description	Causes or Risk Factors (3)	Symptoms (3)	Treatment Options (3)
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 (3)	Symptoms (3)	Treatment Options (3)
How many MORE staph infections occurred in 2007 than 1997?			
Chickenpox			
Description	Causes or Risk Factors (3)	Symptoms (3)	Treatment Options (3)
What happened to the percent of children that had chickenpox once the percentage of children receiving the varicella vaccine increased?			
Fungal Infections			
Description	Causes or Risk Factors (3)	Symptoms (3)	Treatment Options (3)
What part of the body has the highest percentage of fungal infections? Which part has the least?			

## Station 6: 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.

### Directions

✓ when complete

<b>Step 1</b>	Choose one member of your group to be the test subject. The test subject must be wearing short sleeves, or be able to roll up their sleeves.	
<b>Step 2</b>	A pan half-full of water is available at this station. Make sure there is some ice still floating in the pan. If there is not, add more ice. Using a thermometer, record the temperature of the water and record it in Table 5 below.	
<b>Step 3</b>	Place a thermometer probe cover over the end of the thermometer. Record the test subject's oral temperature and dermal temperature (forearm) using the thermometer. Observe the color of the forearm. Record in Table 5.	
<b>Step 4</b>	Have the test subject immerse his/her forearm into the water.	
<b>Step 5</b>	Record the oral temperature and the dermal temperatures of the submerged forearm every minute for 5 minutes. Note the skin color. Record in Table 5.	
<b>Step 6</b>	Have the test subject remove the arm and dry it off with paper towels. Clean up any water you have spilled around the pan.	
<b>Step 7</b>	Record the oral temperature, dermal temperature, and skin color every minute for 5 minutes after the arm has been removed from the pan. Record in Table 5.	
<b>Step 8</b>	Use the soap and/or alcohol pads to clean off the thermometers.	
<b>Step 9</b>	Create a line graph of your results for the oral and dermal temperatures on the graph provided. Label your graph!	

**Table 5. Body Temperature**

Time	Water Temp.	Oral Temp.	Dermal Temp.	Skin Color
<b>Before Experiment (control)</b>				
0 min				
<b>Submerged Forearm</b>				
1 min				
2 min				
3 min				
4 min				
5 min				
<b>Post Submerged Forearm</b>				
6 min				
7 min				
8 min				
9 min				
10 min				




## **Analysis Questions** - *on a separate sheet of paper complete the following*

### **Station 1**

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

### **Station 2**

3. What triggers an inflammatory response?
4. What are the symptoms of an inflammatory response?
5. What is the difference between a white and red reaction?
6. What is dermatographia? Do you have it?

### **Station 3**

7. What type of tissue makes up the epidermis?
8. What type of tissue makes up the dermis?
9. Are hair and nails living or non-living tissue? Explain your answer.

### **Station 4**

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

### **Station 5**

11. What were the common causes & risk factors found between the majority of the skin disorders?
12. What were the common symptoms found between the majority of the skin disorders?

### **Station 6**

13. How did the ice water affect the oral temperature?
14. How did the ice water affect the dermal temperature?
15. Hypothesize what would happen to the oral and dermal temperatures if the test subject was placed in a hot sauna.
16. **CONCLUSION:** In 1-2 paragraphs summarize the procedure and results of this lab.

## **Review Questions** - *on a separate sheet of paper complete the following*

1. What organs make up the integumentary system?
2. What percent of body weight is the skin?
3. What are the functions of the skin?
4. What are the three main layers of the skin?
5. What are the four types of cells that make up the epidermis, and what is the function of each of these cells?
6. Since the epidermis is avascular, how does it get nutrients?
7. Draw and label the 5 layers, or strata, of the epidermis. Write the function of each layer next to the label.
8. What is desquamation? How long does it take for a cell produced in the stratum basale to be sloughed off at the stratum corneum?
9. What types of proteins make up the dermis?
10. What structures can be found embedded in the dermis?
11. What is the function of sweat glands?
12. What is the function of sebaceous glands?
13. What are hair and nails made up of?
14. According to the table in the background, what skin disorder was most prevalent in the U.S. in 2004? What are the symptoms?
15. What is a skin biopsy and what is it used to diagnose?
16. What is a patch test and what is it used to diagnose?
17. What is a skin culture and what is it used to diagnose?

