Chapter 5
The Integumentary System
Integumentary System: Main Components

1. Skin
2. Hair
3. Oil and sweat glands
4. Nails
5. Sensory receptors
Integumentary System:
Skin and Body Membranes

Function of body membranes
1. Line or cover of body surfaces
2. Protect body surfaces
3. Lubricate body surfaces
Classification of Body Membranes

Two Types:

1. **Epithelial membranes**: contain both epithelial and connective tissue
   A. Cutaneous membrane
   B. Mucous membrane
   C. Serous membrane

2. **Connective tissue membranes**: just connective tissue
Skin Functions

Protects deeper tissues from:

- Mechanical damage (wear/tear or injury)
- Chemical damage (barrier to toxins)
- Bacterial damage (barrier to infection)
- Thermal damage (heat/cold)
- Ultraviolet radiation (sun!)
- Desiccation (extreme drying)
1A. Cutaneous Membrane (Skin)

- A dry membrane.
- Outermost protective boundary
- Largest organ in the body (~7% of body weight)
- Two main parts
  - Epidermis (superficial, thinner portion)
  - Dermis (deep, thicker connective tissue)
Skin Structure

Skin is made up of two types of tissue:

1. **Epidermis** – outer layer
   - Stratified squamous epithelium
   - Often keratinized (hardened by keratin)

2. **Dermis** – under layer
   - Dense connective tissue

These tissue are *firmly connected*, but can be “broken” by burns and friction (a.k.a blisters).
Friction Blister

Notice build up of interstitial fluid between epidermal and dermal layers.

Burn Blisters
Skin Structure

3. Subcutaneous Tissue (Hypodermis):
layer deep to the dermis

- Not part of the skin
- Anchors skin to underlying organs
- Composed mostly of adipose tissue
- Guards organs by providing cushioning and extreme temperature changes.
Skin Functions

1. Regulates blood temperature
   (dilating capillaries and sweating)

2. Stores blood

3. Protects from external environment

4. Detects cutaneous sensations
   (pressure, heat, texture, etc.)

5. Excretes and absorbs substances

6. Synthesizes vitamin D
Figure 4.4

Skin Structure

- Hair shaft
- Sweat pore
- Dermal papillae (papillary layer of dermis)
- Meissner's corpuscle
- Free nerve ending
- Reticular layer of dermis
- Sebaceous (oil) gland
- Arrector pili muscle
- Sensory nerve fiber
- Eccrine sweat gland
- Pacinian corpuscle
- Hypodermis (subcutaneous tissue)
- Hair root
- Hair follicle
- Eccrine sweat gland
- Artery
- Vein
- Adipose (fat) tissue
- Root hair plexus
Label Skin Diagram

Use the diagram in your textbook on p107.

1. Use the following terms:
   epidermis, dermis, subcutaneous layer, adipose tissue, hair shaft, blood vessels (use twice), sensory nerve, apocrine sweat gland, sebaceous (oil) gland, arrector pili muscle, free nerve ending

2. Copy the “Functions of the Skin” box onto the bottom left of the document.
Label Skin Diagram - Answers

1. Hair shaft tissue
2. Sebaceous (oil) gland
3. Free nerve ending muscle
4. Epidermis
5. Sensory nerve
6. Dermis
7. Subcutaneous layers
8. Blood vessels
9. Apocrine sweat gland
10. Adipose tissue
11. Blood vessels
12. Arrector pili
Label Skin Diagram #2

Use the diagram in your textbook on p107.

1. Use the following terms:
   epidermis, dermis, subcutaneous layer, adipose tissue,
   hair shaft, blood vessels (use twice), sensory nerve,
   apocrine sweat gland, sebaceous (oil) gland,
   arrector pili muscle, free nerve ending, tactile cell

2. Copy the “Functions of the Skin” box onto the bottom left of the document.
Label Skin Diagram - Answers

1. Hair shaft muscle
2. Epidermis gland
3. Free nerve ending
4. Dermis
5. Subcutaneous layer
6. Blood vessel
7. Adipose tissue
8. Apocrine sweat gland
9. Tactile cell
10. Arrector pili
11. Sebaceous (oil)
12. Blood vessels
Layer of Epidermis
Strata – layers

1. Stratum corneum and lucidum (dead)
1. Stratum granulosum
1. Stratum Spinosum
1. Stratum Basale
Layer of Epidermis

Epidermis is composed of stratified squamous and columnar epithelial cells.

Top layer (squamous only) is flattened, non-active cells, filled with keratin.
Layer of Epidermis

Superficial layer - Non-active cells:

NOT metabolically active, NOT undergoing mitosis
Skin: Epidermis and Dermis

Three major types of cell:

- keratinocytes
- melanocytes
- tactile cells

and free nerve endings

Superficial surface

[Image of skin layers with labels such as stratum corneum, stratum granulosum, stratum spinosum, stratum basale, dermis]
Layer of Epidermis
Superficial layer - Non-active cells:

NOT metabolically active, NOT undergoing mitosis
Layer of Epidermis
Superficial layer-
Composed of dead **keratinocytes**

Deep to that layer-
Filled with **keratinocytes**, cells that produce keratin.

Deep to that layer-
Contains **melanocytes**, cells that produce **melanin**, a pigment that contributes to skin color and absorbs damaging UV light.
Melanin is produced and “sent to” the keratinocytes to protect from sun damage.
Protective Proteins- Keratin

Keratinocytes make keratin, a type of protein that is insoluble.

This protein allows the epidermis to provide protection from water, abrasions, heat, microbes, and chemicals.

Keratin is found in

the hair, nails,

and other parts of epidermal tissues.
Keratin is a polymer.

This type of protein, is made up of ____?____ monomers.
Layer of Epidermis

Keratin is a polymer.

This type of protein, is made up of amino acid monomers.
Melanocytes produce melanin, a pigment that contributes to skin color and protects the skin from UV damage.

All humans have the same number of melanocytes, but the amount of melanin produced differs. Different amounts depends on genes and exposure to light.

Different amounts of melanin accounts for the different hues of skin color (shades of brown).
Layer of Epidermis - Tactile cells

Tactile cells in contact with the tactile disc (at the end of a sensory neuron in the dermis), sensations are received.

Receptors for such sensations (texture, heat, pain) are finest in the hands and lips.
Layer of Epidermis - Free Nerve Endings

Free nerve endings through dermis to epidermis

Receptors for such sensations (texture, heat, pain) are finest in the hands and lips.
(a) Somatosensory cortex in right cerebral hemisphere
(b) Motor cortex in right cerebral hemisphere
Highest concentrations of nerve endings exist in the fingertips, lips, tongue, and sexual organs.
Sensory nerves

- **Free nerve endings** detect sensations of:
  - pain
  - light touch (texture)
  - itch
  - temperature
  - and hair movement

- **Tactile cells** detect:
  - light and deep touch (pressure)
Tattoo Process
Tattoo Process
Permanent ink (foreign pigments) is deposited into the dermis, puncturing through the epidermis.

Associated problems:
- fade over time due to sunlight exposure
- improper healing
- picked-at scabs
- flushing away ink particles by immune system
- costly (time, $) and painful laser removal process
Body Piercing
Videos
Skin, cleaned with antiseptic, is punctured (through all or some layers) with a needle. Jewelry, attached to the needle, is pushed through the skin layer(s).

Associated problems:
- slowed healing time length
- infection
- allergic reactions
- nerve damage
- cartilage deformation
- interference with medical procedures
Client Problem Statement

Write a short story, describing a series of events in which a main character has decided to get a tattoo or a body piercing.

This character must experience one of the problems (listed in previous slides). Describe how the character feels and why.

Parters: 3 maximum
Length: 10 sentences minimum
Point of view: 1st or 3rd person
Temporal setting: unlimited

Must be read to the class before the end of the period
Skin Layers….Knowing your Parts
Appendages of the Skin

Skin has many appendages that are also included in the integumentary system.

1. Sebaceous Glands
2. Sweat Glands
3. Hair and Hair follicles
4. Nails
Appendages: Sebaceous Glands

Sebaceous (oil) glands (all over except palms and soles of feet)

Produce sebum: oily substance and cells
  • Lubricant for skin
  • Kills bacteria

Most with ducts that empty into hair follicles

Glands are activated at puberty

Acne – active infection of sebaceous glands
Sebaceous gland histology

Infected gland
Appendages:

Sudoriferous (sweat) glands

- Widely distributed in skin
- Important in thermal regulation
Sweat and Its Function

Composition of sweat:

• Mostly water
• Some metabolic waste

Function

• Helps dissipate excess heat (evaporation)
• Excretes waste products
• Acidic nature inhibits bacteria growth
• Odor is from associated bacteria
Appendages: Hair

- Functions of Hair
  - Still serves some protective purposes (eyelashes, respiratory)
  - Primarily needed for staying warm - we no longer need that!

Figure 4.7c
Appendages: Hair

Hair consists of hard keratinized epithelial cells

Melanocytes provide pigment for hair color

Figure 4.7c
Hair follicle

Dermal sheath

Epidermal sheath

Matrix (growth zone) in hair bulb

Melanocyte

Connective tissue papilla containing blood vessels (c)
Appendages: Hair

Arrector pilli

Smooth muscle that when contracts allows hairs to “stand on end”
Melanin and Skin Color

Skin color is determined by your genetics. This reflects evolutionary ancestry.

Why does skin get lighter the farther you get from the equator?
Vitamin D

Essential for health for many reasons:

- Calcium absorption in intestines
- Immune function
- Reduced rates of cancer, among others

Your body synthesizes vitamin D from a type of cholesterol when it is exposed to the UV rays in SUNLIGHT.

- If you block all of your UV….you don’t make vitamin D

Skin color is a reflection of balancing act of preventing overexposure and underexposure to UV.