CHAPTER OBJECTIVES

This chapter covers the integumentary system and the combining forms and abbreviations used in building the words that relate to it. Upon completion of this chapter, you should be able to:

• Name the parts of the integumentary system and discuss their functions
• Define combining forms used in building words that relate to the integumentary system
• Name the common diagnoses, laboratory tests, and clinical procedures used in treating the integumentary system
• Define the major pathological conditions, surgical terms and pharmacological agents related to the integumentary system
The organs of the integumentary system include the skin, hair, nails (both fingernails and toenails), sebaceous (pronounced seb-ACE-shuss) glands and sweat glands.

The integumentary system is an extremely large, flat, flexible body system that covers the entire surface of the body. The primary functions of the integumentary system are protection, temperature regulation, and secretion of fluids. The integumentary system also houses nerve receptors.

SKIN

The skin is a vital organ that covers the entire outside of the body, forming a protective barrier against pathogens and injuries from the environment. The skin serves as a protective membrane against invasion from bacteria and other potentially harmful organisms. It is the body's largest organ and contains millions of nerve receptors that detect pain, touch, heat, cold and pressure. The skin also contains thousands of sweat glands which assist in maintaining the body’s internal temperature by secreting sweat. Blood vessels located in the skin also help to regulate the body’s temperature by constricting and dilating as appropriate.
The skin is composed of three layers:

- **The epidermis** (pronounced: eppy-dermis) is the thin, outer membrane layer.
- **The dermis** is the middle, fibrous connective tissue layer.
- **The subcutaneous** (pronounced sub-cue-tane-ee-us) layer is the innermost layer that is composed of fatty tissue.
The epidermis is the outermost layer of the skin, and protects the body from the environment. The thickness of the epidermis varies in different types of skin; it is only .05 mm thick on the eyelids, and is 1.5 mm thick on the palms and the soles of the feet. The epidermis contains the melanocytes (the cells in which melanoma develops), the Langerhans' cells (involved in the immune system in the skin), Merkel cells and sensory nerves. The epidermis layer itself is made up of five sublayers that work together to continually rebuild the surface of the skin.

The epidermis of thick skin has five layers: stratum basale, stratum spinosum, stratum granulosum, stratum lucidum, and stratum corneum.

Image Source: OpenStax College, Anatomy & Physiology. OpenStax College. [http://cnx.org/content/col11496/latest/]
The Basal Cell Layer

The basal layer is the innermost layer of the epidermis, and contains small round cells called basal cells. The basal cells continually divide, and new cells constantly push older ones up toward the surface of the skin, where they are eventually shed. The basal cell layer is also known as the stratum germinativum due to the fact that it is constantly germinating (producing) new cells.

The basal cell layer contains cells called melanocytes. Melanocytes produce the skin coloring or pigment known as melanin, which gives skin its tan or brown color and helps protect the deeper layers of the skin from the harmful effects of the sun. Sun exposure causes melanocytes to increase production of melanin in order to protect the skin from damaging ultraviolet rays, producing a suntan. Patches of melanin in the skin cause birthmarks, freckles and age spots.

The Squamous Cell Layer

The squamous cell layer is located above the basal layer, and is also known as the stratum spinosum or "spiny layer" due to the fact that the cells are held together with spiny projections. Within this layer are the basal cells that have been pushed upward, however these maturing cells are now called squamous cells, or keratinocytes.
Keratinocytes produce keratin, a tough, protective protein that makes up the majority of the structure of the skin, hair, and nails.

The squamous cell layer is the thickest layer of the epidermis, and is involved in the transfer of certain substances in and out of the body. The squamous cell layer also contains cells called Langerhans cells. These cells attach themselves to antigens that invade damaged skin and alert the immune system to their presence.

**The Stratum Granulosum and the Stratum Lucidum**

The keratinocytes from the squamous layer are then pushed up through two thin epidermal layers called the stratum granulosum and the stratum lucidum. As these cells move further towards the surface of the skin, they get bigger and flatter and adhere together, and then eventually become dehydrated and die. This process results in the cells fusing together into layers of tough, durable material, which continue to migrate up to the surface of the skin.

**The Stratum Corneum**

The stratum corneum is the outermost layer of the epidermis, and is made up of 10 to 30 thin layers of
continually shedding, dead keratinocytes. As the outermost cells age and wear down, they are replaced by new layers of strong, long-wearing cells. The stratum corneum is sloughed off continually as new cells take its place, but this shedding process slows down with age. Complete cell turnover occurs every 28 to 30 days in young adults, while the same process takes 45 to 50 days in elderly adults.

THE DERMIS

The dermis is located beneath the epidermis and is the thickest of the three layers of the skin (1.5 to 4 mm thick), making up approximately 90 percent of the thickness of the skin. The main functions of the dermis are to regulate temperature and to supply the epidermis with nutrient-saturated blood. Much of the body's water supply is stored within the dermis.

The dermis layer is made up of two sublayers:

*The Reticular Layer*

The lower, reticular layer, is thicker and made of thick collagen fibers that are arranged parallel to the surface of the skin. The reticular layer is denser than the papillary dermis, and it strengthens the skin, providing structure and elasticity. It also supports other components of the skin, such as hair follicles, sweat glands, and sebaceous glands.
**The Papillary Layer**

The upper, papillary layer, contains a thin arrangement of collagen fibers. The papillary layer supplies nutrients to select layers of the epidermis and regulates temperature. Both of these functions are accomplished with a thin, extensive vascular system that operates similarly to other vascular systems in the body. Constriction and expansion control the amount of blood that flows through the skin and dictate whether body heat is dispelled when the skin is hot or conserved when it is cold.

**SUBCUTANEOUS**

The **hypodermis** (also called the subcutaneous layer or superficial fascia) is a layer directly below the dermis and serves to connect the skin to the underlying fascia (fibrous tissue) of the bones and muscles. It is not strictly a part of the skin, although the border between the hypodermis and dermis can be difficult to distinguish. The hypodermis consists of well vascularized, loose, areolar connective tissue and adipose tissue, which functions as a mode of fat storage and provides insulation and cushioning for the inner organs.
Hair is a keratinous filament growing out of the epidermis. It is primarily made of dead, keratinized cells. Strands of hair originate in an epidermal penetration of the dermis called the hair follicle. The hair shaft is the part of the hair not anchored to the follicle, and much of this is exposed at the skin’s surface. The rest of the hair, which is anchored in the follicle, lies below the surface of the skin and is referred to as the hair root. The hair root ends deep in the dermis at the hair bulb, and includes a layer of mitotically active basal cells called the hair matrix.

The hair bulb surrounds the hair papilla, which is made of connective tissue and contains blood capillaries and nerve endings from the dermis.
Hair texture (straight, curly) is determined by the shape and structure of the cortex, and to the extent that it is present, the medulla. The shape and structure of these layers are, in turn, determined by the shape of the hair follicle. Similar to the skin, hair gets its color from the pigment melanin, produced by melanocytes in the hair papilla. Different hair color results from differences in the type of melanin, which is genetically determined. As a person ages, the melanin production decreases, and hair tends to lose its color and becomes gray and/or white.

Hair serves a variety of functions, including protection, sensory input, thermoregulation, and communication. For example, hair on the head protects the skull from the sun. The hair in the nose and ears, and around the eyes (eyelashes) defends the body by trapping and excluding dust particles that may contain allergens and microbes. Hair of the eyebrows prevents sweat and other particles from dripping into and bothering the eyes.

**NAILS**

The nail bed is a specialized structure of the epidermis that is found at the tips of our fingers and toes. The nail body is formed on the nail bed, and protects the tips of our fingers and toes as they are the farthest extremities.
and the parts of the body that experience the maximum mechanical stress. In addition, the nail body forms a back-support for picking up small objects with the fingers.

The nail body is composed of densely packed dead keratinocytes. The nail body forms at the nail root, which has a matrix of proliferating cells from the stratum basale that enables the nail to grow continuously. The lateral nail fold overlaps the nail on the sides, helping to anchor the nail body. The nail fold that meets the proximal end of the nail body forms the nail cuticle, also called the eponychium. The nail bed is rich in blood vessels, making it appear pink, except at the base, where a thick layer of epithelium over the nail matrix forms a crescent-shaped region called the lunula (the “little moon”). The area beneath the free edge of the nail, furthest from the cuticle, is called the hyponychium. It consists of a thickened layer of stratum corneum.
GLANDS

SWEAT GLANDS

When the body becomes warm, **sudoriferous glands** produce sweat to cool the body. Sweat glands develop from epidermal projections into the dermis and are classified as merocrine glands; that is, the secretions are excreted by exocytosis through a duct without affecting the cells of the gland. There are two types of sweat glands, each secreting slightly different products.

1. **Apocrine glands** are specialized sweat glands that can be found only in the armpits and pubic region. Apocrine sweat glands are larger than eccrine sweat glands and lie deeper in the dermis, sometimes even reaching the hypodermis, with the duct normally emptying into the hair follicle. These glands secrete a milky sweat that encourages the growth of the bacteria responsible for body odor. The release of this sweat is under both nervous and hormonal control, and plays a role in the poorly understood human pheromone response.

2. **Eccrine glands** are the true sweat glands. Found over the entire body, these glands regulate body temperature by bringing water via the pores to the surface of the skin, where it evaporates and reduces skin temperature. They excrete a colorless fluid and are a primary component of thermoregulation in humans and thus help to maintain homeostasis.
SEBACEOUS GLAND

A sebaceous gland is a type of oil gland that is found all over the body and helps to lubricate and waterproof the skin and hair. Most sebaceous glands are associated with hair follicles and are therefore typically not found on the palms of the hands and soles of the feet. They generate and excrete sebum, a mixture of lipids, onto the skin surface, thereby naturally lubricating the dry and dead layer of keratinized cells of the stratum corneum, keeping it pliable. The fatty acids of sebum also have antibacterial properties, and prevent water loss from the skin in low-humidity environments. The secretion of sebum is stimulated by hormones, many of which do not become active until puberty. Thus, sebaceous glands are relatively inactive during childhood.

CERUMINOUS GLANDS:

Ceruminous glands are a specialized gland in the skin of the human external auditory canal. Together with sebaceous glands, they produce the cerumen, the ear wax. Cerumen plays an important role in the protection of the ear canal against physical damage and microbial invasion.

Link to Learning: Please watch the following video: MedlinePlus: Sweating.
<table>
<thead>
<tr>
<th>Combining Forms Relating to the Integumentary System</th>
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<tbody>
<tr>
<td><strong>aden/o</strong></td>
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<td><strong>adip/o</strong></td>
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<td><strong>blephar/o</strong></td>
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<td><strong>cry/o</strong></td>
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<td><strong>cyan/o</strong></td>
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<td><strong>derm/o, derm/a, dermat/o</strong></td>
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<td><strong>diaphor/o</strong></td>
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<td><strong>erythema/o</strong></td>
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<td><strong>ichthy/o</strong></td>
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<td><strong>kerat/o</strong></td>
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A dermatologist studies, diagnoses, and treats disorders of the skin. Many disorders of the skin can be identified by simply looking at the skin. Once this visual assessment has been made, the dermatologist can then determine which procedure and test will be most appropriate to determine the underlying problem. There are three main ways that a dermatologist may test the skin.

- **Scratch Test**: a potential allergen is scratched into the skin. Redness or swelling indicates a positive reaction.

- **Patch Test**: when a suspected allergen is placed onto a piece of paper and then applied to your skin. If a reaction occurs, the test is considered positive.

- **Intradermal test**: when a small amount of allergen is injected just under your skin.

Link to Learning: Please read: Merck Manuals: [Diagnosis of Skin Disorders](#).
The integumentary system is susceptible to a variety of diseases, disorders, and injuries. These range from annoying but relatively benign bacterial or fungal infections that are categorized as disorders, to skin cancer and severe burns, which can be fatal.

**LESIONS**

Specific terms are used to describe various types of marks and growths that can be found on the skin. **Lesions** can be described as any abnormal growth or area of skin that differs from the skin around it.

**Primary lesions** are physical changes in the skin considered to be caused directly by a disease.

- **Bulla**: a large fluid filled blister
- **Macule**: a change in the color of the skin that you cannot detect by touch
- **Patch**: a macule greater than 1 cm.
- **Nodule**: a raised solid lesion more than 1 cm. and may be in the epidermis, dermis, or subcutaneous tissue
• **Papule:** a solid raised lesion that has distinct borders and is less than 1 cm in diameter
  Example: pimple

• **Plaque:** a solid, raised, flat-topped lesion greater than 1 cm. in diameter

• **Pustule:** a small elevated lesion that contains pus

• **Telangiectasia:** an area with permanent dilation of superficial blood vessels in the skin

• **Tumor:** a solid mass of the skin or subcutaneous tissue; abnormal growth

• **Vesicle:** raised lesions less than 1 cm. in diameter that are filled with clear fluid

• **Wheal:** an area of edema in the upper epidermis; usually associated with allergic itching

**Secondary lesions** result from an outside force affecting the skin, such as scratching, trauma and infection, or a change in a primary lesion.

  • **Erosion:** slightly depressed areas of skin in which part or all of the epidermis has been lost
  • **Ulcer:** a wound with loss of tissue, often with inflammation
  • **Excoriation:** traumatized or roughened skin caused by scratching or rubbing
• **Fissure:** a linear crack in the skin’s surface
• **Scale:** an increase in the dead cells on the surface of the skin
• **Crust:** occurs when plasma exudes through an eroded epidermis; dried blood or crust on the skin’s surface
• **Keloid:** an exaggerated connective tissue response of injured skin that extend beyond the edges of the original wound – scar tissue

**Link to Learning:** Please read: Merck Manual: *Types of Skink Marks and Growths*

**SKIN INFECTIONS:**

Your skin helps protect you from germs, but sometimes it can get infected by them. Some common types of skin infections are: bacterial, viral, fungal and parasitic. Treatment of skin infections depends on the cause.

• **Bacterial:** Cellulitis and impetigo; staphylococcal infections can also affect the skin
• **Viral:** Shingles, warts, and herpes simplex
• **Fungal:** Athlete's foot, yeast infections and ringworm
• **Parasitic:** Body lice, head lice and scabies
CANCER

There are three primary types of skin cancer: basal cell, squamous cell, and melanoma. These cancers are derived from the epidermal layers with the same names. Melanomas are derived from the melanocytes, or pigment cells, in the deepest level of the epidermis.

Basal cell and squamous cell cancers usually occur on parts of the body exposed to the sun, such as the face, ears, and extremities. These cancers are highly curable, especially if detected and treated early. Melanomas, which form dark moles that spread over the surface of the skin, are more lethal because they metastasize very quickly.

INJURIES

Because the skin is the part of our bodies that meets the world most directly, it is especially vulnerable to injury. Injuries include burns and wounds, as well as scars and calluses. They can be caused by sharp objects, heat, or excessive pressure or friction to the skin.
Burns

Burns are often classified by the degree of their severity.

- A **first-degree burn** is a superficial burn that affects only the epidermis. Although the skin may be painful and swollen, these burns typically heal on their own within a few days. Mild sunburn fits into the category of a first-degree burn.

- A **second-degree burn** goes deeper and affects both the epidermis and a portion of the dermis. These burns result in swelling and a painful blistering of the skin. It is important to keep the burn site clean and sterile to prevent infection. If this is done, the burn will heal within several weeks.

- A **third-degree burn** fully extends into the epidermis and dermis, destroying the tissue and affecting the nerve endings and sensory function. These are serious burns that may appear white, red, or black; and require medical attention.
**Scars and Keloids**

Most cuts or wounds, with the exception of ones that only scratch the surface (the epidermis), lead to scar formation. A **scar** is collagen-rich skin formed after the process of wound healing that differs from normal skin. Scarring occurs in cases in which there is repair of skin damage, but the skin fails to regenerate the original skin structure.

Sometimes, there is an overproduction of scar tissue, because the process of collagen formation does not stop when the wound is healed; this results in the formation of a raised or hypertrophic scar called a **keloid**. In contrast, scars that result from acne and chickenpox have a sunken appearance and are called atrophic scars.

**SURGICAL TERMS**

Dermatologists and plastic surgeons, routinely perform skin surgery. Types of skin surgery include:

- **Biopsy**: the removal of a sample of skin for microscopic examination to identify the presence, cause, or extent of a disease or condition.

- **Cautery**: applying heat to the skin surface to cause coagulation and stop bleeding.
Chemotherapy: a cancer treatment that uses drugs to stop the growth of cancer cells, either by killing the cells or by stopping them from dividing.

Cryosurgery: the use of liquid nitrogen to remove skin growths, fade age spots and treat early stage basal and squamous cell carcinomas.

Curettage: removal of tissue from an area by scraping.

Dermabrasion: a procedure that removes the upper layer of skin allowing new skin to grow in its place. Often used for acne scars, age spots, scars, skin growth, skin lesions, sun damage and wrinkles.

Electrosurgery: an electrical current is used to stop bleeding or to destroy abnormal skin growths.

Excision: the removal of a skin lesion by completely cutting it out.

Flaps: when skin adjacent to the wound is moved to cover it.

Skin grafting: when skin is removed from one site on the body and used to patch the wound.

Laser Surgery: a surgical procedure that uses a laser beam as a knife to make bloodless cuts in tissue or to remove a surface lesion such as a tumor.

Radiation therapy: a cancer treatment that uses high-energy x-rays or other types of radiation to kill cancer cells or to keep them from growing.
• **Mohs’ microscopic surgery:** a surgical technique for the removal of certain skin cancers by taking special horizontal sections of skin tissue. The tumor is cut from the skin in thin layers and then each layer is viewed through a microscope to check for cancer cells.

**Link to Learning:** Please read: Merck Manual: *Treatment of Skin Disorders*.

**Word Building Examples**

**Derm/o ; Dermat/o = skin**
- Dermat/o + -logist = dermatologist
  One who studies the skin
- Derm/o + -plasty = dermoplasty
  Surgical repair to the skin
- Dermat + -itis = dermatitis
  Inflammation of the skin

**Melan/o = black**
- Melan/o + -cyte = melanocyte
  Special cells in the basal layer of the epidermis
- Melan/o + -oma = melanoma
  Skin cancer caused by overgrowth of melanin in a melanocyte
-derma = suffix for skin

- Scler/o + -derma = scleroderma
  Disorder in which skin becomes taut, thick and leather like
- Leuk/o + -derma = leukoderma
  Disappearance of skin pigment causing milk-white patches
- Ichthy/o + -derma = ichthyoderma
  Dry and scaly skin condition

Onych/o – refers to the nail

- Onych/o + ia = onychia
  Infected nail bed
- Onych/o + malacia = onychomalacia
  Softening of the nails
- Onych/o + phagia = onychophagia
  Nail biting

Lip/o = fat

- Lip/o + oma = lipoma
  Fatty mass
- Lip/o +ectomy = lipectomy
  Removal of fat

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>Bx, bx</td>
<td>Biopsy</td>
</tr>
<tr>
<td>BCC</td>
<td>Basal cell carcinoma</td>
</tr>
<tr>
<td>decub</td>
<td>Decubitus (ulcer)</td>
</tr>
<tr>
<td>derm</td>
<td>Dermatology</td>
</tr>
<tr>
<td>FS</td>
<td>Frozen section</td>
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<tr>
<td>ID</td>
<td>Intradermal</td>
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<tr>
<td>I&amp;D</td>
<td>Incision and Drainage</td>
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<tr>
<td>IV</td>
<td>Intravenous</td>
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<tr>
<td>Sub Q, subQ</td>
<td>Subcutaneous</td>
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<td>Ung</td>
<td>Ointment</td>
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## PRONUNCIATION

Practice pronouncing each term, then click the audio icon to hear it.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>Alopecia</strong></td>
<td>(al-o-PEE-she-a) Loss of hair in spots; baldness.</td>
</tr>
<tr>
<td><strong>Cellulitis</strong></td>
<td>(cell-u-LIE-tis) Diffuse and especially subcutaneous inflammation of connective tissue.</td>
</tr>
<tr>
<td><strong>Chloasma</strong></td>
<td>(klo-AZ-ma) Irregular brownish or blackish spots especially on the face that occur sometimes in pregnancy and in disorders of or functional changes in the uterus and ovaries.</td>
</tr>
<tr>
<td><strong>Dermabrasion</strong></td>
<td>Surgical removal of skin blemishes or imperfections (as scars or tattoos) by abrasion (as with sandpaper or wire brushes).</td>
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<tr>
<td><strong>Fissure</strong></td>
<td>(FISH-ur) A break or slit in tissue.</td>
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<tr>
<td><strong>Hidrosis</strong></td>
<td>(hi–DRO-sis) Excretion and production of sweat.</td>
</tr>
<tr>
<td><strong>Lesion</strong></td>
<td>(LEE-zhun) An abnormal change in structure of an organ or part due to injury or disease; wound damage or injury to the skin.</td>
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<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>Melanocyte (MEL-a-no-site)</td>
<td>An epidermal cell that produces melanin.</td>
</tr>
<tr>
<td>Macule (MAK-yule)</td>
<td>A patch of skin that is altered in color but usually not elevated and that is a characteristic feature of various diseases (as smallpox).</td>
</tr>
<tr>
<td>Nodule (NOD-yule)</td>
<td>A small mass of rounded or irregular shape.</td>
</tr>
<tr>
<td>Polyp (PAUL-ip)</td>
<td>A projecting mass of swollen tissue.</td>
</tr>
<tr>
<td>Pruritis (pru-RYE-tis)</td>
<td>Localized or generalized itching due to irritation of sensory nerve endings.</td>
</tr>
<tr>
<td>Psoriasis (so-RYE-a-sis)</td>
<td>A chronic skin disease characterized by circumscribed red patches covered with white scales.</td>
</tr>
<tr>
<td>Rosacea (ro-ZAY-she-a)</td>
<td>A chronic inflammatory disorder involving especially the skin of the nose, forehead, and cheeks that is characterized by congestion, flushing, and marked nodular swelling of tissues especially of the nose.</td>
</tr>
<tr>
<td>Sebaceous (se-BAY-shush)</td>
<td>Secreting sebum.</td>
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<tr>
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<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steatitis</strong></td>
<td>Inflammation of fatty tissue.</td>
</tr>
<tr>
<td><strong>Striae</strong></td>
<td>A narrow structural band especially of nerve fibers. Plural of <em>stria</em>.</td>
</tr>
<tr>
<td><strong>Tinea</strong></td>
<td>Any of several fungal diseases of the skin; ringworm.</td>
</tr>
<tr>
<td><strong>Varicella</strong></td>
<td>A contagious skin disease that usually occurs in childhood; chickenpox.</td>
</tr>
<tr>
<td><strong>Vitiligo</strong></td>
<td>A progressive skin disorder where white spots appear on otherwise normally pigmented skin.</td>
</tr>
<tr>
<td><strong>Xeroderma</strong></td>
<td>A disease of the skin characterized by dryness and roughness and a fine scaly desquamation; Excessive dryness of the skin</td>
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*You have now completed chapter 3. To navigate back to the main Moodle page, click the back button in your browser.*