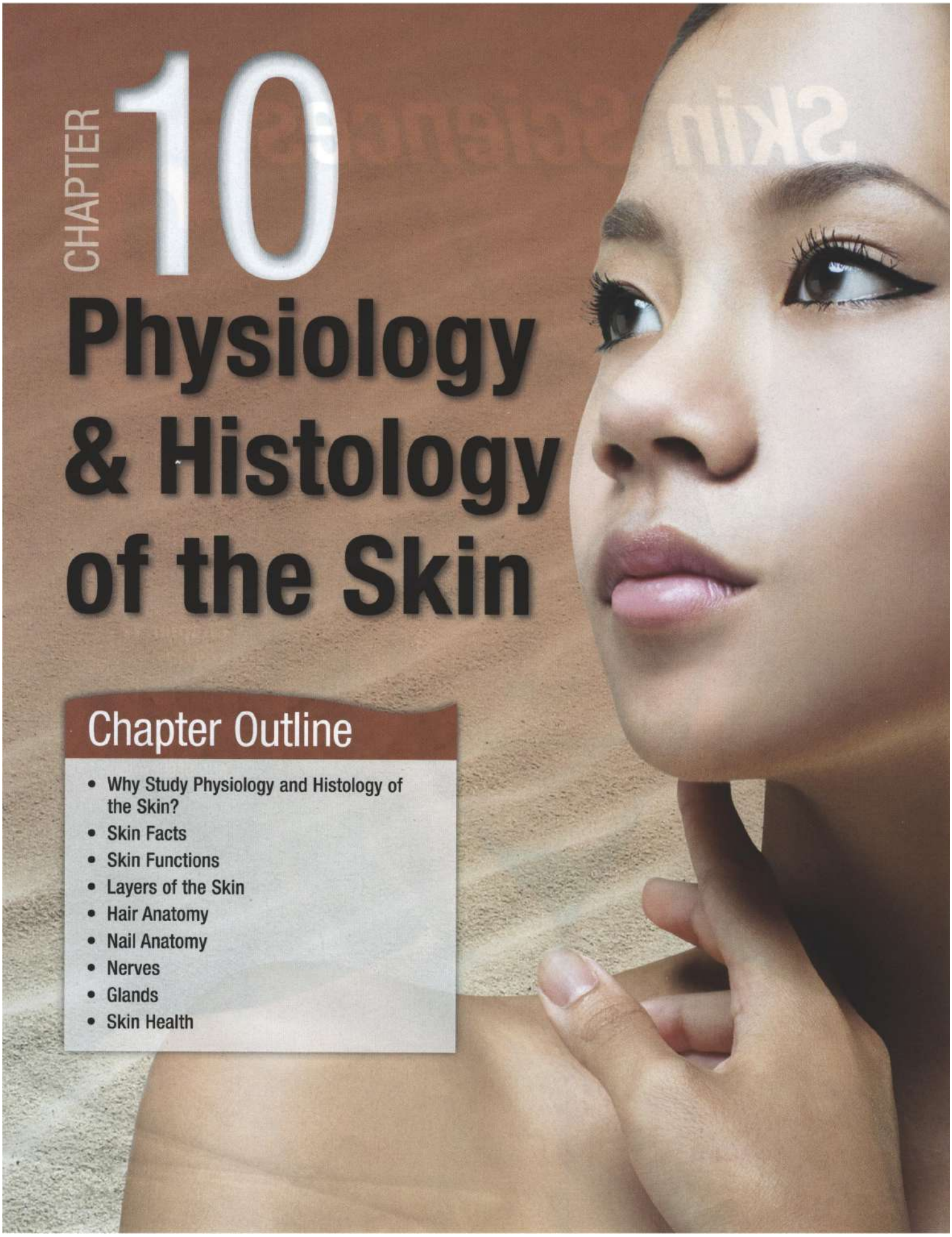
CHAPTER 10

Physiology & Histology of the Skin



Chapter Outline

- Why Study Physiology and Histology of the Skin?
- Skin Facts
- Skin Functions
- Layers of the Skin
- Hair Anatomy
- Nail Anatomy
- Nerves
- Glands
- Skin Health

Learning Objectives

After completing this chapter, you will be able to:

- ☑ **LO1** Explain the functions of the skin.
- ☑ **LO2** Describe the layers of the skin.
- ☑ **LO3** Describe how skin gets its color.
- ☑ **LO4** Define collagen and elasticity.
- ☑ **LO5** Name the glands of the skin.
- ☑ **LO6** Discuss how sun damage affects skin.
- ☑ **LO7** Understand free radical damage.
- ☑ **LO8** Understand the effects of hormones on the skin.
- ☑ **LO9** Explain how the skin ages.

Key Terms

Page number indicates where in the chapter the term is used.

apocrine glands pg. 243

arrector pili muscle pg. 232

barrier function pg. 230

ceramides pg. 244

collagen pg. 238

corneocytes pg. 234

dermal papillae pg. 239

dermis pg. 237

desmosomes pg. 235

eccrine glands pg. 243

elastin pg. 238

epidermal growth factor (EGF) pg. 230

epidermis pg. 233

eumelanin pg. 237

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reticular layer pg. 239

rosacea pg. 250

sebaceous glands (oil glands) pg. 232

sebum pg. 232

stratum corneum (horny layer) pg. 234

stratum germinativum (basal cell layer) pg. 235

stratum granulosum (granular layer) pg. 235

stratum lucidum pg. 235

stratum spinosum (spiny layer) pg. 235

subcutaneous layer (hypodermis) pg. 239

subcutis tissue (adipose tissue) pg. 239

sudoriferous glands (sweat glands) pg. 232

T-cells pg. 244

telangiectasia pg. 250

transepidermal water loss (TEWL) pg. 230

tyrosinase pg. 237

UVA radiation (aging rays) pg. 245

UVB radiation (burning rays) pg. 245

Estheticians have an opportunity to study a most fascinating science. The science of skin *histology* and *physiology* includes the functions, layers, and anatomy of the skin. Skin histology is the study of the structure and composition of the skin tissue. Physiology is the study of the functions of living organisms. These are the foundational sciences estheticians need to learn before caring for the skin.

Estheticians who specialize in the health and beauty of skin are sometimes referred to as *technicians, skin therapists,* or *specialists.* There is much more to being an esthetician than simply performing facials and selling products. As scientific research in the industry changes constantly, estheticians must continue their education at all times. Clients value an esthetician's understanding of their skin and personalized treatment suggestions (**Figure 10–1**). By educating clients, estheticians are sharing their knowledge and expertise. An esthetician's primary focus is on preserving, protecting, and nourishing the skin.

The complexity of the skin is amazing. The layers, components, and functions all work to protect and regulate the skin and the body. There is much to study about the body's largest organ and how to best maintain its optimum health. The aging process, sun exposure, hormones, and nutrition affect the skin's health and appearance. By understanding skin physiology, estheticians can be confident in treating this intricate system.

▲ **Figure 10–1**
Consulting with a client.

Why Study Physiology and Histology of the Skin?

Estheticians should study and have a thorough understanding of the physiology and histology of the skin because they must understand the skin and how it functions in order to effectively treat their clients.

- The functions, layers, and anatomy of the skin are the foundations estheticians need to learn before caring for the skin.
- By understanding skin physiology, estheticians can be confident in treating the skin and sharing their knowledge with clients.
- Understanding how the skin cell layers function is important in choosing ingredients and treatments for clients.
- Part of providing skin care services is understanding how the aging process, sun exposure, hormones, and other influencing factors affect the skin's health and appearance.

Skin Facts

Skin, or the *integumentary system*, is the largest organ in the body. It is a strong barrier designed to protect us from the outside elements. The body systems that make up our outermost layer are incredibly complex. Skin layers, nerves, cellular functions, hair follicles, and glands all work together harmoniously to regulate and protect the body.

Hormones, growth factors, and other biochemicals control the skin's intricate functions.

The basic material and building blocks for our body's tissues are proteins. Proteins are made up of amino acids. Amino acids form peptides (part of a protein) and proteins. Peptide bonds are what hold these amino acids together. Chains of amino acids then become polypeptides. Proteins are the foundation of our cells and skin.

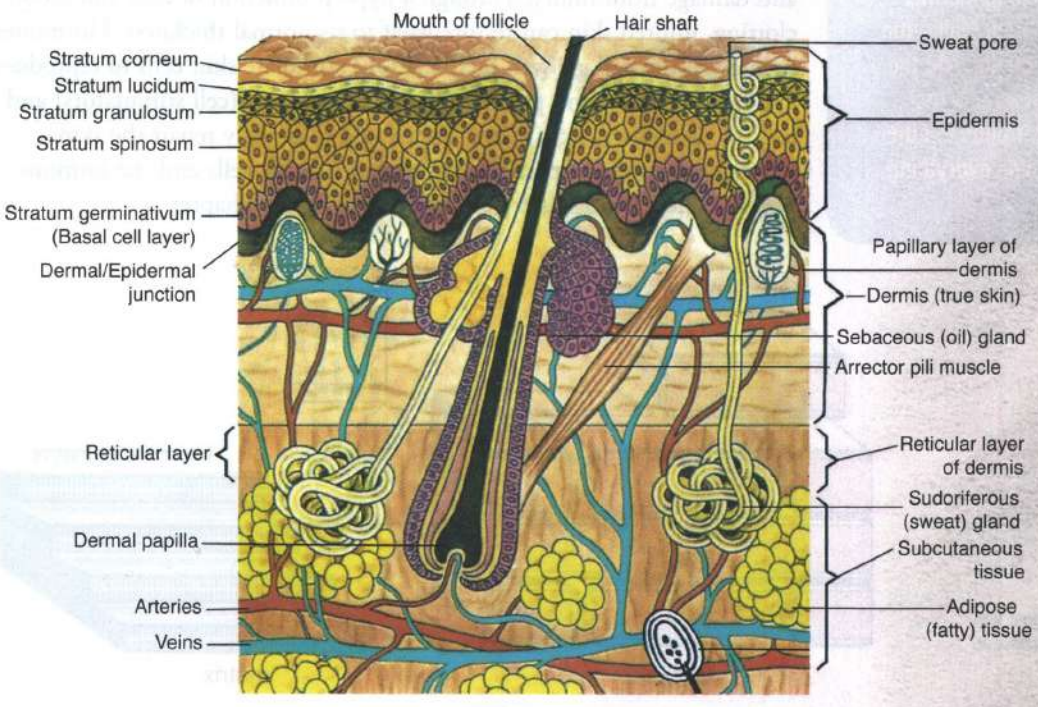
Our skin is a cell-making factory with miles (kilometers) of blood vessels, millions of sweat glands, and an array of nerves within a network of fibers (**Figure 10–2**). Appendages of the skin include hair, nails, sweat glands, and oil glands. Healthy skin is slightly moist, soft, smooth, and somewhat acidic. Skin is thickest (4 millimeters or ⅕ inch) on the palms of the hands and soles of the feet. It is thinnest on the eyelids (1.5 millimeters or 1/16 inch). The skin of an average adult weighs 7 pounds (3 kilograms) and averages an area of about 22 square feet (6.5 square meters) in size. It contains one-half to two-thirds of the blood in the body and one-half of the primary immune cells.

fyi

Each square inch (2.5 square cm) of skin contains:

- Millions of cells.
- 8 feet (2.5 m) of blood vessels.
- 32 (10 m) feet of nerves.
- 650 sweat glands.
- 100 oil glands.
- 65 hairs.
- 1,300 nerve endings.
- 155 pressure receptors.
- 12 cold and heat receptors.

▼ **Figure 10–2**
Layers of the skin.



Did You Know?

Touch is one of the first senses to develop. Nerve fibers in the skin sense when we are touched. Depending on the type of stimulation, sensations felt on our skin cause us to feel, react, or move. Massage sends messages to the brain through nerve stimulation and lowers stress in the body. Studies have shown stress reduction in babies and older adults when they experience more touch and interaction with others.

Skin Functions

The six primary functions of the skin are protection, sensation, heat regulation, excretion, secretion, and absorption.

Protection

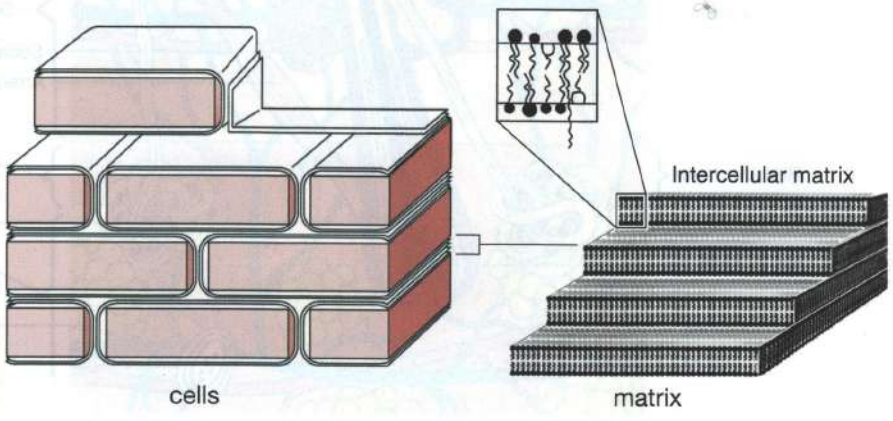
The skin is a thin, yet strong, protective barrier to outside elements and microorganisms. It has many defense mechanisms to protect the body from injury and invasion. Sebum (oil) on the epidermis gives protection from external factors such as invasion by certain bacteria. The acid mantle is the protective barrier made up of sebum, lipids, sweat, and water. These components form a **hydrolipidic** film to protect the skin from drying out and from exposure to external factors. The acid mantle has an average pH of 5.5. The balanced pH of the skin is important for maintaining the proper acidic level of 5.5 to protect from pathogens and for regulating enzymatic functions.

The acid mantle is part of the skin's natural barrier function. The **barrier function** is the skin's mechanism that protects us from irritation and intercellular **transepidermal water loss (TEWL)**, the water loss caused by evaporation on the skin's surface. Lipids are substances that contribute to the barrier function of the epidermis. Lipids are protective oils and are part of the **intercellular matrix** (fluid) between epidermal cells. Damage to our barrier layer is the cause of many skin problems including sensitivities, aging, and dehydration (**Figure 10–3**).

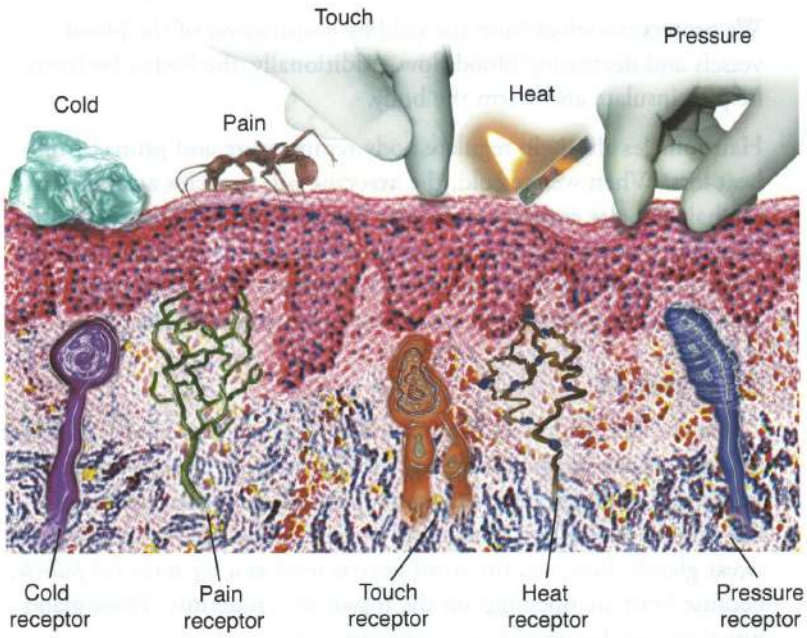
fyi

The microscopic view of the structure of the epidermis resembles a brick wall—the cells are the bricks, and the intercellular matrix is the cement mortar between the bricks that holds everything together.

The skin's most amazing feature is the ability to heal itself. Skin can repair itself when injured, thus protecting the body from infection and damage from injury. Through a hyperproduction of cells and blood clotting, injured skin can restore itself to its normal thickness. Hormones such as **epidermal growth factor (EGF)** stimulate skin cells to reproduce and heal. Proteins and peptides trigger **fibroblasts** (cell stimulators) and cells to rejuvenate. Skin cells are activated to quickly repair the skin. Other protective components of the skin include cells and the immune system. These processes are discussed later in this chapter.



▶ Figure 10–3
Barrier layer function: the brick-and-mortar concept.



▲ Figure 10–4
Sensory nerve endings in the skin.

Another form of protection in the skin is melanin, the pigment that protects us from the sun. Melanin is the pigment in the eyes, hair, and skin that gives us some protection from the UV rays emitted by the sun.

Sensation

Sensory nerve endings in the dermis respond to touch, pain, cold, heat, and pressure (**Figure 10–4**). When the body senses touch, it affects our body's functions. Massage and product application produce physiological benefits to the body such as increased circulation. Millions of nerve-end fibers on the surface of the skin detect stimuli. These sensations send messages to the brain as a protective defense mechanism or as a positive message that something is stimulating the surface. These signals also cause other nerves or muscles to react. Sensory nerve fibers are most abundant in the fingertips and thus are designed to be one of the most sensitive parts of the body.

fyi

Hydro means *water. Lipidic* means *oil.* A *hydrolipidic film* is an oil–water balance on the skin's surface.

Heat Regulation

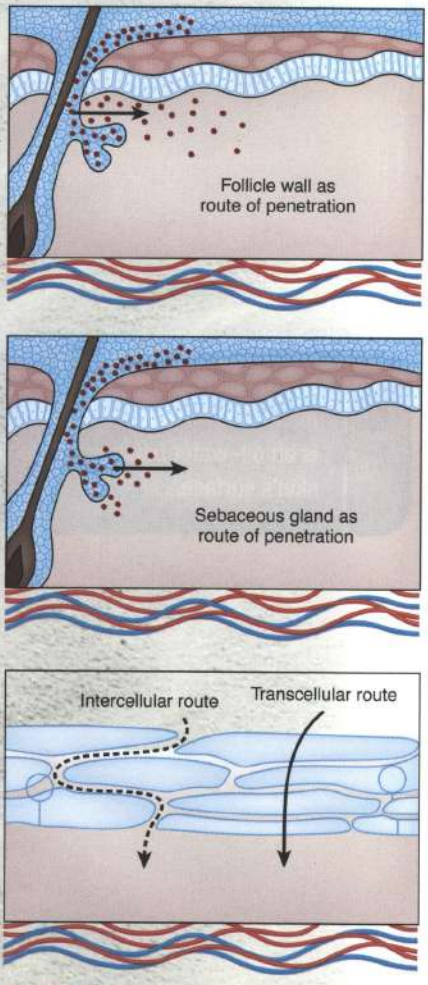
The body's average internal thermostat is set at 98.6 degrees Fahrenheit (37 degrees Celsius). When the outside temperature changes, the skin automatically adjusts to warm or cool the body.

The body maintains thermoregulation through evaporation, perspiration, radiation, and insulation. Millions of sweat glands release heat from the body through perspiration to keep us from overheating. We then cool ourselves through evaporation on the skin's surface. Blood flow and blood vessel dilation also assists in cooling the body.

fyi

Sometimes the terms *pore* and *follicle* are used interchangeably. Pores are actually sweat gland openings, not follicles. Pore is a common term that clients usually use when describing their skin. These are technically follicles they are referring to, not pores.

Follicles are tube-like depressions with oil glands attached to them. Some follicles have hair and others are hairless.



▲ **Figure 10–5**
Primary routes of penetration.

We protect ourselves from the cold by constriction of the blood vessels and decreasing blood flow. Additionally, the body's fat layers help to insulate and warm the body.

Hair follicles also help regulate body temperature and protect from heat loss. When we are cold, the **arrector pili muscles** attached to the hair follicles contract and cause "goose bumps." This reaction is thought to warm the skin by the air pocket that is created under the hairs that stand up when the muscle contracts. Shivering is also an automatic response to cold and a way to warm up the body.

Excretion

The **sudoriferous glands** (soo-duh-RIF-uh-rus), also known as **sweat glands**, excrete perspiration and detoxify the body by excreting excess water, salt, and unwanted chemicals through the pores. Sweat, just like sebum, is also part of the acid mantle. **Pores** are the openings for sweat glands, however, the word pore is used as a lay term for *follicle*, because both are openings on the top of the epidermis. These gland functions are discussed later in the chapter.

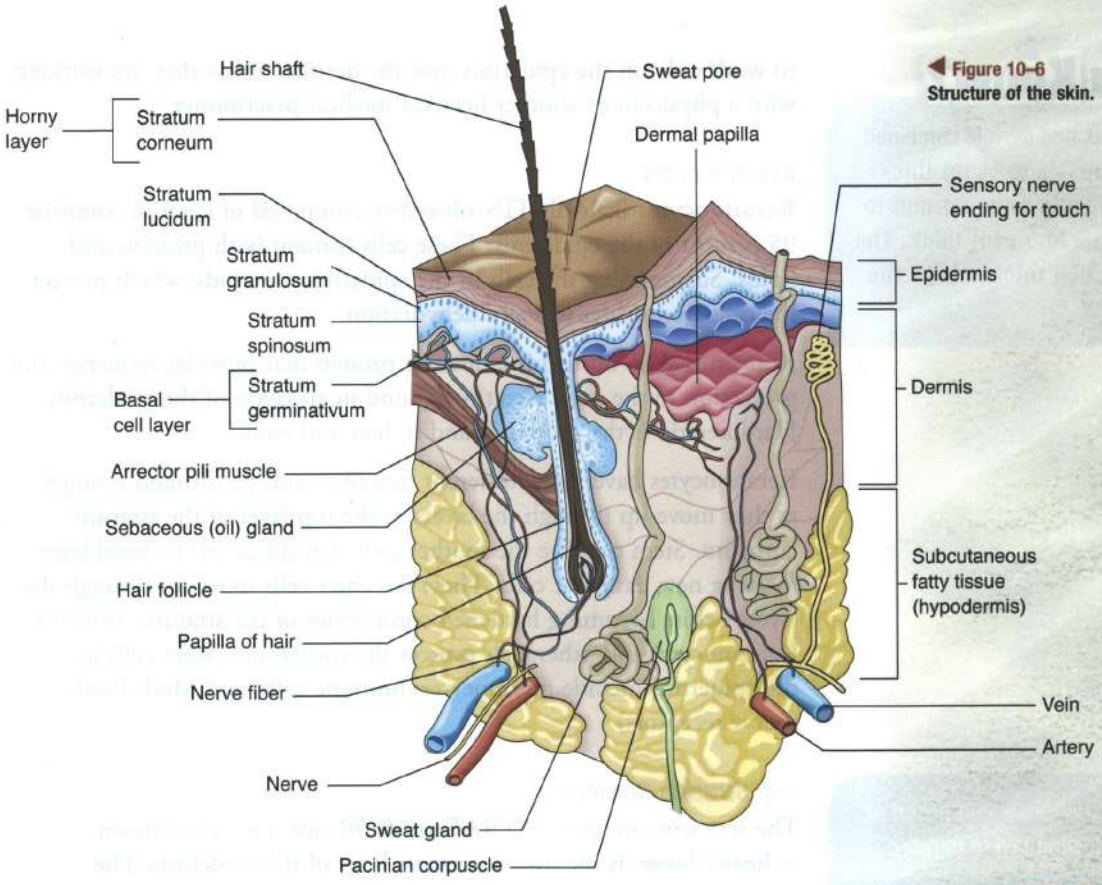
Secretion

Sebum is an oily substance that protects the surface of the skin and lubricates both the skin and hair. **Sebaceous glands**, (sih-BAY-shus GLANZ), also known as **oil glands**, are appendages attached to follicles that produce sebum. These oils help keep the skin soft and protected from outside elements. The skin is approximately 50 to 70 percent water. Sebum coating the surface of the skin slows down the evaporation of water, also known as transepidermal water loss (TEWL), and helps maintain water levels in the cells. Emotional stress and hormone imbalances can stimulate oil glands to increase the flow of sebum, which can lead to skin problems.

Absorption

Absorption of ingredients, water, and oxygen is necessary for our skin's health. Vitamin D is also synthesized and produced in the skin upon exposure to the sun. The skin selectively absorbs topical products and creams through the cells, hair follicles, and sebaceous glands. While absorption is limited, some ingredients with a smaller molecular size can penetrate into the skin. The penetration ability of the ingredient is determined by the size of the molecule and other characteristics of the product. Lipid-soluble products penetrate better. The routes of penetration into the skin are through the follicle walls, sebaceous glands, intercellular, or transcellular (**Figure 10–5**).

Absorption of select topical products helps keep skin moisturized, nourished, and protected. Scientific advances continually result in the creation of new products that are more readily absorbed by the skin, thus making them more effective. Many chemicals and prescription



◀ **Figure 10–6**
Structure of the skin.

creams can penetrate the skin. This effect can be either harmful or beneficial, depending on the chemicals. L01

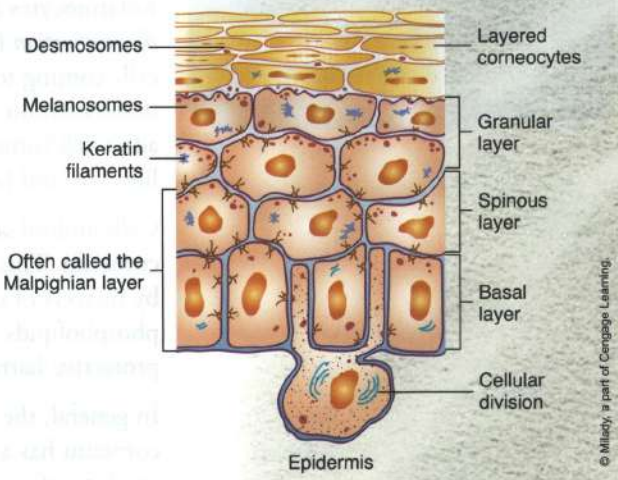
fyi Intercellular means "between" the cells and transcellular is "across" or through the cells.

Layers of the Skin

The skin is comprised of two main layers, the epidermis and the dermis (**Figure 10–6**).

The Epidermis

The **epidermis** is the outermost layer of the skin. This is the epithelial tissue that covers our body. It is a thin, protective covering with many nerve endings. The epidermis is composed of five layers called strata (singular: stratum). The uppermost surface layer is the stratum corneum, followed by the stratum lucidum, stratum granulosum, and stratum spinosum; the bottom layer is the stratum germinativum (the basal layer) (**Figure 10–7**). Understanding how the skin cell layers function is important in choosing ingredients and treatments. Estheticians are licensed



▲ **Figure 10–7**
Individual layers of the skin.

Did You Know?

The epidermis and dermis combined is 1.5 to 4 mm (1/16 to 1/5 in) thick. The epidermis is only .04 mm to 1.5 mm (1/1,000 to 1/16 in) thick. The dermis is much thicker than the epidermis.

to work only on the epidermis, not the dermis, unless they are working with a physician or another licensed medical practitioner.

Keratinocytes

Keratinocytes (kair-uh-TIN-oh-sytes), composed of keratin, comprise 95 percent of the epidermis. These cells contain both proteins and lipids. Surrounding the cells in the epidermis are lipids, which protect the cells from water loss and dehydration.

Keratin (KAIR-uh-tin) is a fiberous protein that provides resiliency and protection to the skin. Keratin is found in all layers of the epidermis. Hard keratin is the protein found in hair and nails.

Keratinocytes have many different functions and go through changes as they move up through the layers to the top layer of the stratum corneum. Stem cells are the mother cells that divide in the basal layer forming new daughter cells. These daughter cells move up through the layers before becoming hardened corneocytes of the stratum corneum. Keratinocytes and other cells protect the epidermis. Other cells in the epidermis include melanocytes, immune cells, and Merkel cells (nerve receptors).

fyi

The epidermis is composed of the following layers (strata):

- Stratum corneum—"the horny cells"
- Stratum lucidum—"the clear cells"
- Stratum granulosum—"the grainy cells"
- Stratum spinosum—"the spiny cells"
- Stratum germinativum—"the germination or growth layer"

The Stratum Corneum

The **stratum corneum** (STRAT-um KOR-nee-um), also known as **horny layer**, is the top, outermost layer of the epidermis. The esthetician is primarily concerned with this layer. The stratum corneum is very thin, yet it is waterproof, permeable, regenerates itself, detoxifies the body, and responds to stimuli. Keratinocytes on the surface have hardened into **corneocytes** (KOR-nee-oh-sytes), the waterproof, protective cells. These "dead" protein cells have dried out and lack nuclei. This layer is referred to as the *horny layer* because of these scale-like cells.

Keratinocytes are continually shed from the skin in a process called *desquamation* (DES-kwuh-may-shun). These cells are replaced by new cells coming to the surface from the lower stratums. This process of desquamation and replacement is known as *cell turnover*. The average adult cell turnover rate is every 28 days depending on a person's age, lifestyle, and health. The cell turnover rate slows down with age.

Cells and oil combine to form a protective barrier layer on the stratum corneum. This is the acid mantle. Stratum corneum cells are surrounded by bilayers of oil and water. Lipids of the cell membranes, such as phospholipids and essential fatty acids, determine the health of this protective barrier.

In general, the stratum corneum has 15 to 20 layers of cells. The stratum corneum has a thickness between 0.01 to 0.04 mm. The keratinocytes on the surface of the skin are also called *squamous* (flat, scaly) keratinized cells. There are different terms used to describe the same

cells, so it is helpful to remember these surface cells are both flat and hardened (squamous and cornified).

The Stratum Lucidum

The **stratum lucidum** (STRAT-um LOO-sih-dum) is a thin, clear layer of dead skin cells under the stratum corneum. It is a translucent layer made of small cells that let light pass through. This layer is thickest on the palms of the hands and soles of the feet. The keratinocytes in this layer contain clear keratin. The cells here release lipids forming bilayers of oil and water. The thicker skin on the palms and soles is composed of epidermal ridges that provide a better grip while walking and using our hands. This layer also forms our unique fingerprints and footprints.

fyi Contrary to popular belief, the stratum lucidum is found all over the body, not just on the palms and soles, where it is most apparent.

The Stratum Granulosum

The **stratum granulosum** (STRAT-um gran-yoo-LOH-sum), also known as **granular layer**, is composed of cells that resemble granules and are filled with keratin. The production of keratin and intercellular lipids also takes place here. In this layer, enzymes dissolve the structures (desmosomes) that hold cells together. As these cells become keratinized, they move to the surface and replace the cells shed from the stratum corneum.

Natural moisturizing substances such as triglycerides, ceramides, waxes, fatty acids, and other intercellular lipids are made here and are excreted from cells to form components of the skin's waterproofing barrier function of the top layer. These water-soluble compounds are referred to as natural moisturizing factors (NMFs) and hydrate the lipid layer surrounding cells, absorb water, and prevent water loss.

The Stratum Spinosum

The **stratum spinosum** (STRAT-um spy-NOH-sum), also known as **spiny layer**, is above the stratum germinativum. Cells continue to divide and change shape here, and enzymes are creating lipids and proteins. Cell appendages, which resemble prickly spines, become desmosomes, the intercellular structures that assist in strengthening and holding cells together. **Desmosomes** (DEZ-moh-somes) are keratin filaments—the protein bonds that create the junctions between the cells. These strengthen the epidermis and assist in intercellular communication.

Also found here are the **Langerhans** (läng-ER-häns) **immune cells**, which protect the body from infections by identifying foreign material (antigens). The immune cells help destroy these foreign invaders. Keratinocytes and melanocytes work in synergy here forming the even placement of pigment granules. The spinosum is the largest layer of the epidermis.

fyi Stratum Germinativum (the basal cell layer) is where everything starts or germinates. Basal means the fundamental, or basic, layer.

The Stratum Germinativum

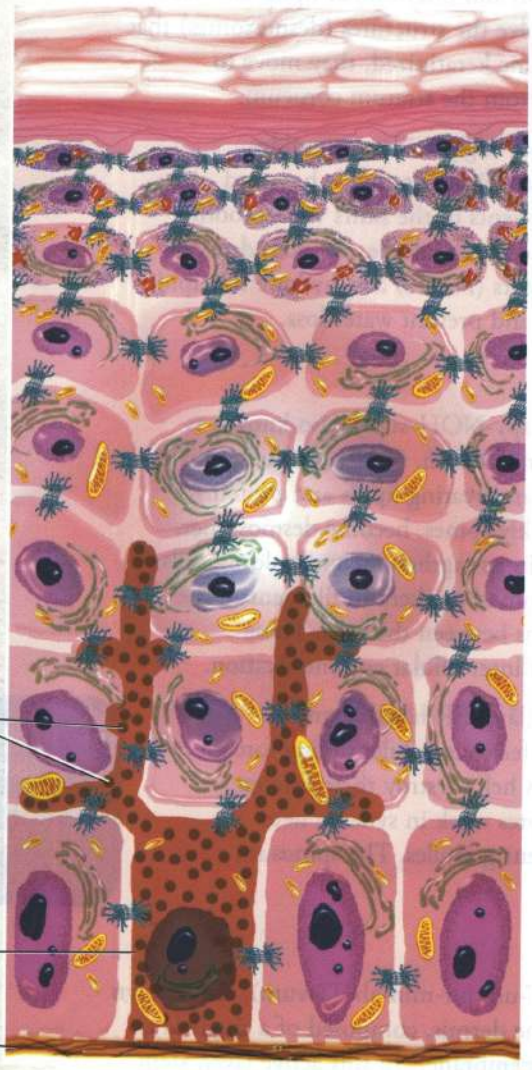
The **stratum germinativum** (STRAT-um jur-min-ah-TI-vum), also known as **basal cell layer**, is located above the dermis, composed of a single layer of basal cells laying on a "basement membrane." In this active layer, stem

cells undergo continuous cell division (mitosis) to replenish the regular loss of skin cells shed from the surface. Stem cells are basically mother cells that divide to produce daughter cells.

Mother cells divide to form two daughter cells. Some stem cells and daughter cells always remain undifferentiated and keep dividing for constant self-renewal over a lifetime. These either remain stem cells or are programmed to become something else, such as a keratinocyte. In the body, some daughter cells go on to become skin cells. Other cells become glands, follicles, tissues, or organs. Daughter cells that are not able to divide anymore are now programmed to end up as one specific type of cell. This is known as *terminal differentiation*. Cells such as these keratinocytes begin their journey of terminal differentiation as they migrate to the surface and eventually become strong and protective.

Cells in the basal layer produce the necessary lipids that form cell membranes and hold the cells together. Merkel cells (sensory cells) are touch receptors also located in the basal layer. The stratum germinativum also contains **melanocytes** (muh-LAN-uh-sytes), which are cells that produce pigment granules in the basal layer (**Figure 10–8**). About 5 to 10 percent of the basal cells are melanocytes. The pigment carrying granules, called **melanosomes** (MEL-uh-noh-sohms), then produce a complex protein, **melanin** (MEL-uh-nin), which determines skin, eye, and hair color. L02

▶ **Figure 10–8**
Melanin production.

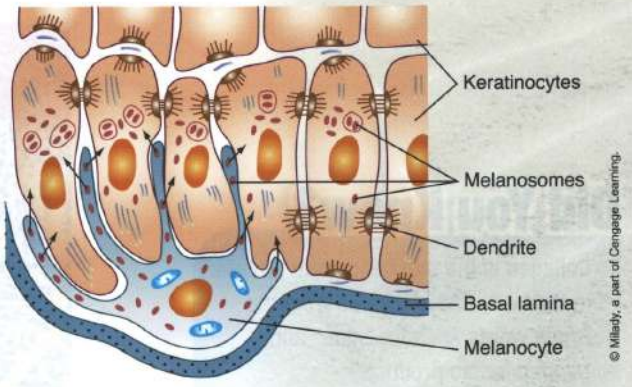


Skin Color: Melanin, Melanocytes, and Melanosomes

Melanin is the pigment that protects us from the sun. Damage to DNA triggers melanocyte stimulating hormones to produce melanin. Melanocyte cells make melanosome spheres which are transferred to keratinocytes (**Figure 10–9**). Melanosomes carry the pigment granules that provide skin's color. One melanocyte will deposit pigment-carrying melanosomes into about 30 keratinocytes

through its dendrites. Dendrites are the arms, or cellular projections, that branch out to interact with other cells in the extracellular matrix between cells. This process is how pigment darkening occurs.

Melanin is transferred into the cells through dendrites (branches) that move up to the skin's surface. Melanin production is stimulated by exposure to sunlight and protects the cells below by absorbing and blocking UV radiation. **Tyrosinase** (TY-ruh-sin-ays) is the enzyme that stimulates melanocytes and thus produces melanin. It is estimated that there are over 1,000 melanocytes per square mm (⅛ square inch) of skin.



▲ Figure 10–9
Melanin protects the skin.

Every person has approximately the same number of melanocytes. Differences in genetic skin color are due to the amount of melanin activated in the skin and the way it is distributed. Individuals with darker skin and melanin have more activity in their melanocytes. Both internal and external factors affect melanin activation and production.

The body produces two types of melanin: **pheomelanin** (fee-oh-MEL-uh-nin), which is red to yellow in color, and **eumelanin** (yoo-MEL-uh-nin), which is dark brown to black. People with light-colored skin mostly produce pheomelanin, while those with dark-colored skin mostly produce eumelanin. Fair skin individuals have approximately 20 melanosomes per keratinocyte and dark skin contains about 200 melanosomes per keratinocyte.

Products that suppress melanin production by interrupting biochemical processes are referred to as *brightening agents*. Some are called *tyrosinase inhibitors*. These products are designed to reduce hyperpigmentation. Pigmentation disorders are discussed in Chapter 11, Disorders and Diseases of the Skin. Products and treatments for hyperpigmentation are discussed in other chapters. L03

FOCUS ON

Melanin

Melanocytes **are cells that produce pigment granules, called** ***melanosomes.***

↓

Melanosomes **carry and produce the protein, called** ***melanin.***

↓

Melanin **is transferred to cells from melanosomes through dendrite branches.**

The Dermis

The **dermis** (DUR-mis), also called the derma, corium (KOH-ree-um), cutis (KYOO-tis), or true skin, is the support layer of connective tissues below the epidermis. The dermal/epidermal junction connects the dermis to the epidermis. This junction consists of layers of a connective collagen tissue with many small pockets and holes. Collagen fibrils from the dermis are embedded into these layers to provide strength and adhesion. Keratin filaments on the epidermis side also ensure strength and adhesion to the junction.

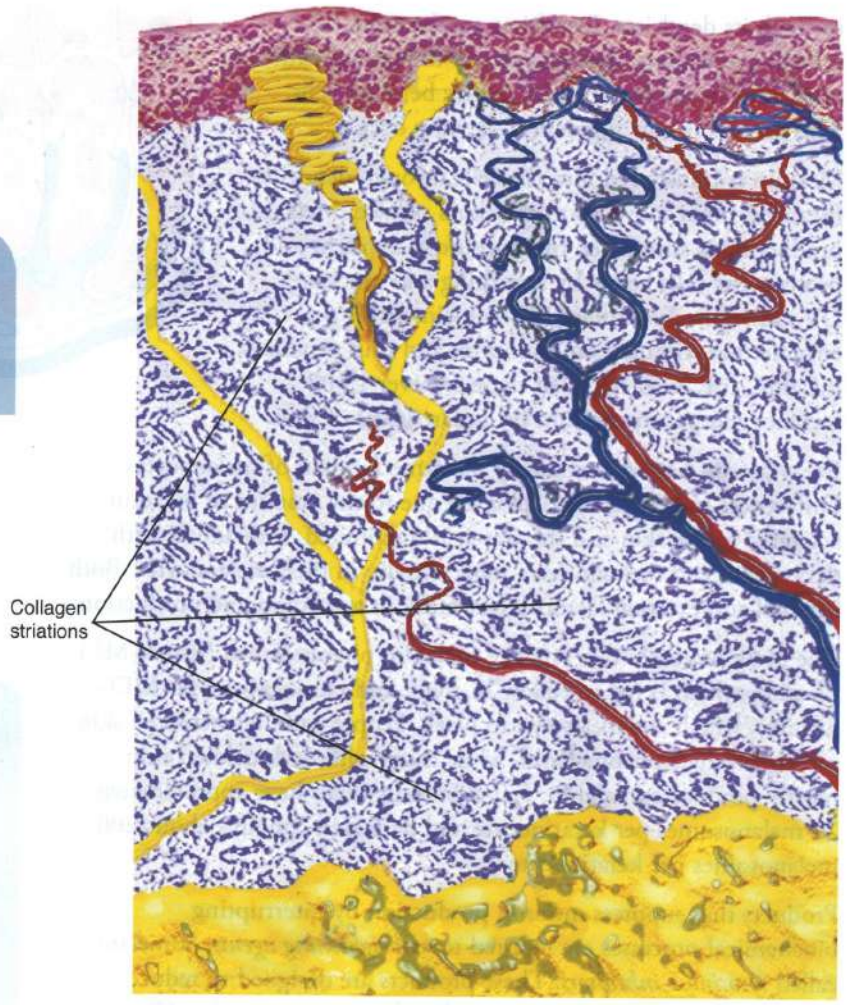
The dermis, which is about 25 times thicker than the epidermis, consists of two layers: the papillary layer (PAP-uh-lair-ee LAY-ur) above and the reticular layer below. The dermis is primarily comprised of connective tissues made of collagen protein and elastin fibers. The dermis also supplies the skin with oxygen and nutrients.

Did You Know?

Melanoma is a cancer that begins in melanocytes. It is the most serious type of skin cancer because it can spread rapidly throughout the body. This metastasis (spreading of cells within the body) is why melanoma is so dangerous.

Did You Know?

Collagen is the most abundant protein in the body and is derived from the Greek words *kolla* for "glue" and *gennan* for "to produce."



▲ **Figure 10–10**
Collagen in the dermis.

Collagen (KAHL-uh-jen) is a protein substance of complex fibers that gives skin its strength and is necessary for wound healing. Produced by fibroblasts, collagen makes up 70 percent of the dermis (**Figure10–10**). Fibroblast cells produce proteins and aid in the production of collagen and elastin.

In contrast, the quantity of elastin is a small percentage of the dermis. Elastin is only about one-fifteenth compared to the amount of collagen. **Elastin** is the fibrous protein that forms elastic tissue and gives skin its elasticity.

Blood and lymph vessels, capillaries, follicles, sebaceous glands, sweat glands, sensory nerves, additional receptors, and the arrector pili muscles are all located in the dermis. **Lymph vessels** remove waste products, bacteria, and excess water. L04

Fibroblasts (cell stimulators), lymphocytes (fight infections), Langerhans cells (guard cells), mast cells (involved in allergic reactions), and leukocytes (white blood cells to fight infections) are all found in the dermis.

Collagen and extracellular matrix proteins give support and function to the skin. Other components give tautness or firmness to the skin by interacting with elastin and hyaluronic acid. Hormones such as epidermal growth factor (EGF) and fibroblast growth factor (FGF) stimulate fibroblasts, cells, proteins, and DNA synthesis.

In the dermis is a fluid matrix called *ground substance*. It is also referred to as the *extracellular matrix* (ECM) composed of collagen, other proteins, and GAGs (Glycosaminoglycans). These intercellular substances are comprised of water and other components to maintain water balance, provide dermal support and assist cell metabolism, growth, and migration.

Glycosaminoglycans are large protein molecules and water-binding substances found between the fibers of the dermis. GAGs are polysaccharides–protein and sugar complexes. Beneficial hydrating fluids such as **hyaluronic acid** (HY-uh-luhr-ahn-ik A-sid) are part of this dermal substance. Hyaluronic acid is a GAG. Ingredients that duplicate these natural intercellular fluids are important in esthetics and skin care products and are discussed in other chapters.

Did You Know?

Collagenase and elastase are enzymes that help protect collagen and elastin; however, when excessive levels are produced from UV radiation or other damage, it causes dermal breakdown and premature aging.

The Papillary Layer

The **papillary layer** connects the dermis to the epidermis, forming the epidermal/dermal junction. The **dermal papillae** are membranes of ridges and grooves that attach to the epidermis. Attached to the dermal papillae are either looped capillaries that nourish the epidermis or tactile corpuscles, the nerve endings sensitive to touch and pressure. Note that papillae in the hair follicle are called **hair papillae** (puh-PILL-ay)—the small, cone-shaped structures at the bottom of hair follicles. The blood supplies nourishment within the skin through capillaries. The papillary layer comprises 10 to 20 percent of the dermis. Collagen and elastin is more widely spaced here than in the reticular layer.

The Reticular Layer

The **reticular layer**, the denser and deeper layer of the dermis, is comprised mainly of collagen and elastin. Damage to these elastin fibers as they break down are the primary cause of sagging, wrinkles, and aging—loss of elasticity in the skin. Stretch marks are caused by damaged elastin fibers. Collagen and elastin are broken down by ultraviolet (UV) damage and other factors.

fyi

Growth factors such as epidermal growth factor (EFG) are chemicals that induce cells to divide and grow.

Subcutaneous Tissue

Below the reticular layer is a **subcutaneous layer**, also known as **hypodermis**, composed of loose connective tissue or **subcutis** (sub-KYOO-tis) **tissue**, also known as **adipose tissue**. This layer is 80 percent fat. This tissue creates a protective cushion that gives contour and smoothness to the body, as well as providing a source of energy for the body. Fat storage in the body is also influenced by hormones.

Vessels, nerves, fibers, adipose cells, fibroblasts, and other cells are just some of the components of the hypodermis. This layer decreases and thins with age.

A summary of the main components and functions in the skin's layers is included for the following terms.

Epidermis: Layers of the epidermis include keratinocytes, immune cells, and intercellular fluids.

Stratum Corneum: Hardened corneocytes (also referred to as flattened squamous cells), melanin, barrier layer, acid mantle, desquamation.

Stratum Lucidum: Clear cells; thickest on the palms and soles.

Stratum Granulosum: Production of keratin granules in cells; additional lipid production and excretion; desmosomes dissolved by enzymes.

Stratum Spinosum: Large layer, cell activity, desmosomes created, Langerhans immune cells, melanosome pigment distribution.

Stratum Germinativum: Single layer of cells, cell mitosis, stem cells, merkel cells. Keratinocytes, melanocytes, and lipids are all produced here.

Dermis: Collagen, elastin, and intercellular fluids are the main components of the dermis. Fibroblasts and immune cells are found here.

Papillary Layer: Touch receptors, blood vessels, capillaries, dermal papilla.

Reticular Layer: Collagen and elastin, glands, blood and lymph vessels, nerve endings, intercellular fluids.

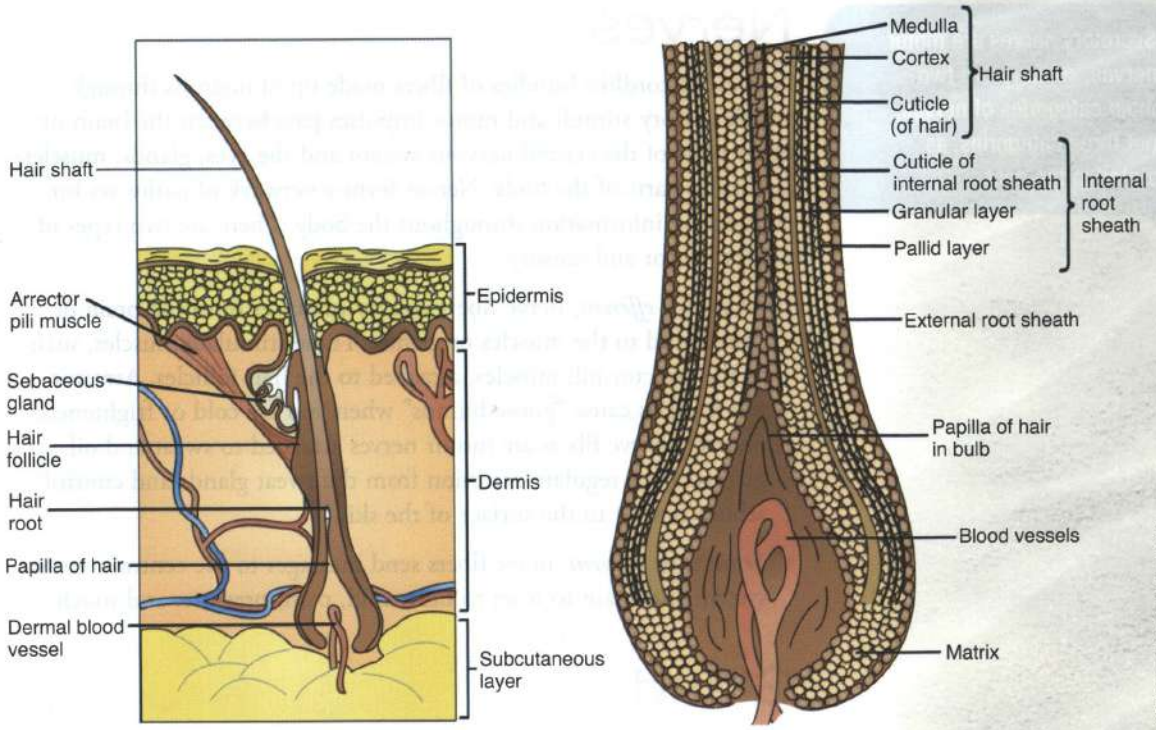
ACTIVITY

To become more familiar with the layers of the skin, use an unlabeled, blank skin chart to draw in and label all of the parts and layers. Use a different color to represent each layer and each component. What could you do to show the difference between each layer? Have fun with this and compare each other's diagrams in the classroom.

Hair Anatomy

Hair is an appendage of the skin—it is a slender, threadlike outgrowth of the skin and scalp. **Figure 10–11** shows the structure of the hair follicle. There is no sense of feeling in the hair, due to the absence of nerves.

Much of the hair on the body is invisible to the naked eye. The heavier concentration of hair is on the head, under the arms, around the genitals, and on the arms and legs. Due to hormonal influence, there are different male and female hair growth patterns. Genetics influence the distribution of each person's hair, its thickness, quality, color, rate of growth, and whether the hair is curly or straight. Hair on the scalp grows an average of .35 millimeters (1/60 inch) per day.



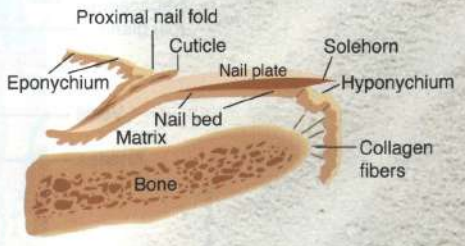
▲ Figure 10–11
Hair follicle structure.

The hair contains 90 percent hard keratin. It has a lower moisture and fat content than soft keratin, and is a particularly tough, elastic material. Keratin forms continuous sheets (fingernails) or long, endless fibers (hair). Hard keratin does not normally break off or flake away. It remains a continuous structure. Hair also contains melanin, which determines hair color.

The hair follicle structure is partially the cause of some skin disorders such as ingrown hairs or folliculitis (a bacterial infection). Hair growth is discussed extensively in Chapter 18, Hair Removal.

Nail Anatomy

The nail, an appendage of the skin, is a hard translucent plate that protects fingers and toes. The nail is composed of hard keratin. **Figure 10–12** shows the nail structure. *Onyx* (AH-niks) is the technical term for the nail. The hard, or horny, nail plate contains no nerves or blood vessels. Nails grow approximately 1/10 of an inch (3.7millimeters) per month.



▲ Figure 10–12
Nail Structure

fyi

Secretory nerves are motor nerves, so there are two main categories of nerves, not three categories, as stated in the past.

Nerves

Nerves are cordlike bundles of fibers made up of neurons through which sensory stimuli and motor impulses pass between the brain or other parts of the central nervous system and the eyes, glands, muscles, and other parts of the body. Nerves form a network of pathways for conducting information throughout the body. There are two types of nerves: motor and sensory.

- *Motor*, or *efferent*, nerve fibers convey impulses from the brain or spinal cord to the muscles or glands. These stimulate muscles, such as the arrector pili muscles, attached to the hair follicles. Arrector pili muscles cause "goose bumps" when you are cold or frightened. *Secretory* nerve fibers are motor nerves attached to sweat and oil glands. They regulate excretion from the sweat glands and control sebum output to the surface of the skin.
- *Sensory*, or *afferent*, nerve fibers send messages to the central nervous system and brain to react to heat, cold, pain, pressure, and touch.

Glands

The dermis of the skin contains two types of duct glands, each producing different substances. The sebaceous glands secrete oil, while the sudoriferous glands excrete sweat (**Figure 10–13**).

The Sebaceous (Oil) Glands

Sebaceous glands are connected to the hair follicles and produce oil, which protects the surface of the skin. Glandular sacs open into

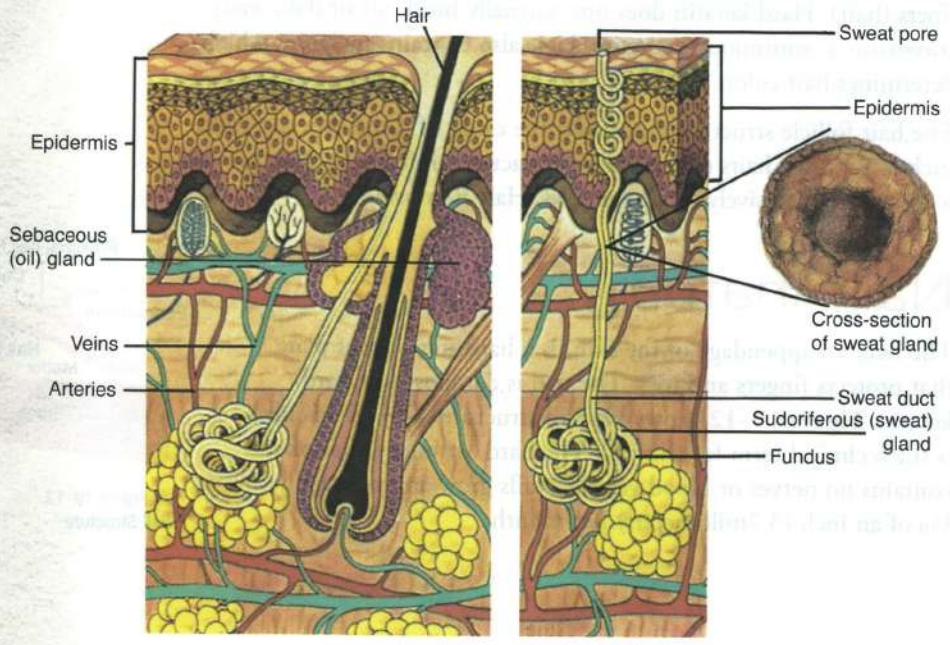


Figure 10–13
Oil and sweat glands.

the follicles through ducts. If the ducts become clogged, comedones (blackheads) are formed. The oily secretions lubricate both the skin and hair. Sebaceous glands are larger on the face and scalp than on the rest of the body. Other chapters include further discussion on sebaceous glands and acne.

The Sudoriferous (Sweat) Glands

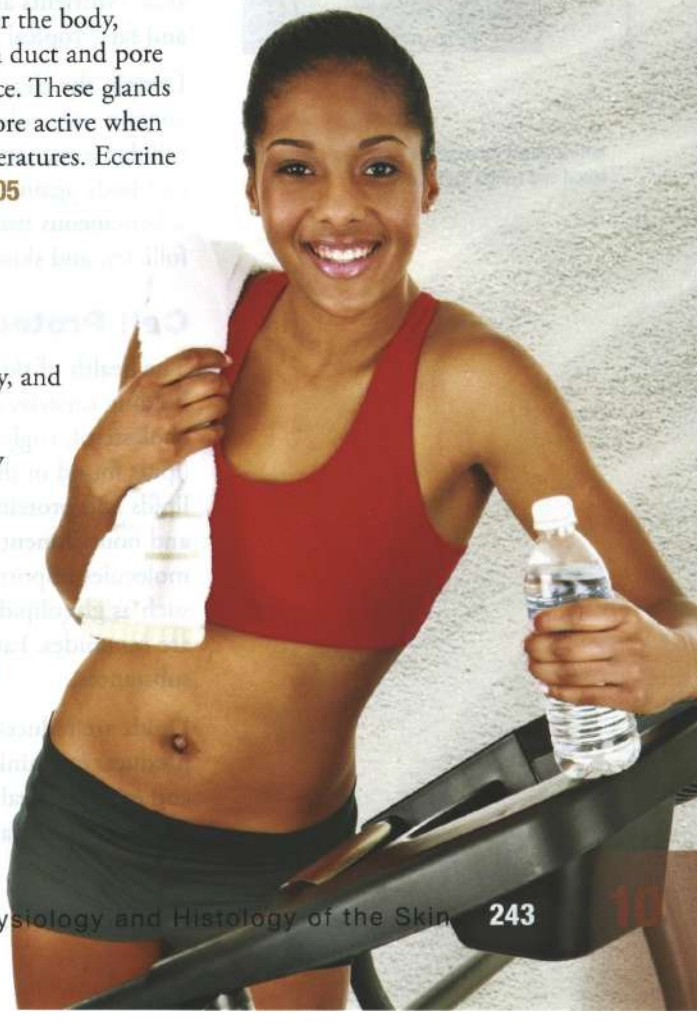
Sudoriferous glands help to regulate body temperature and eliminate waste products by excreting sweat. They have a coiled base and duct openings at the surface, known as pores. Liquids and salts are eliminated daily through these pores. The excretion of sweat is controlled by the nervous system. Normally, 1 to 2 pints (.5 to 1 liter) of liquids containing salts are eliminated daily through sweat pores in the skin. There are two kinds of sweat glands—the apocrine and the eccrine.

The **apocrine glands** (AP-uh-krin GLANZ) are coiled structures attached to the hair follicles found under the arms and in the genital area. Their secretions are released through the oil glands. These are more active during emotional changes. Odors associated with these glands are due to the interaction of the secretions and bacteria on the surface of the skin. According to some authorities, apocrine glands are not true sweat glands because their openings connect to oil glands instead of pore openings directly on the skin's surface.

The **eccrine glands** (EK-run GLANZ) are found all over the body, primarily on the forehead, palms, and soles. They have a duct and pore through which secretions are released on the skin's surface. These glands are not connected to hair follicles. Eccrine glands are more active when the body is subjected to physical activity and high temperatures. Eccrine sweat does not typically produce an offensive odor. L05

Did You Know?

Apocrine glands produce chemicals known as *pheromones*. Pheromones are hormones that trigger biological reactions or communicate signals to others. This reaction is thought to attract others through scent production and is sometimes referred to as body chemistry.



Skin Health

In order to survive, cells need these important elements: nourishment, protection, the ability to function properly, and continual replacement or proliferation.

Skin health and aging of the skin are both influenced by many different factors including heredity, sun exposure, the environment, health habits, and general lifestyle. This topic is discussed thoroughly in Chapter 12, Skin Analysis.

The Immune System and the Skin

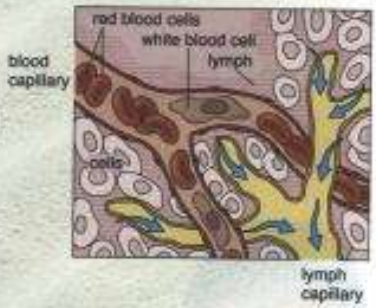
Our immune system is a complex defense mechanism that protects the body from foreign substances. The immune system is activated when antigens (foreign invaders) are identified. Antibodies are molecules

formed to fight and neutralize bacteria, viruses, and antigens. Langerhans cells, T-cells, and leukocyte cells are part of the immune system.

A primary part of the system are the Langerhans cells (guard cells) that sense unrecognized foreign invaders such as bacteria and then process these antigens for removal through the lymph system.

The immune system also produces **T-cells**, which identify molecules that have foreign peptides and also help regulate immune response. Another part of the immune system is **leukocytes**, the white blood cells that have enzymes to digest and kill bacteria and parasites. These white blood cells also respond to allergies.

Other components of the immune system are enzymes and other cells that protect the body from foreign substances, bacteria, and infections. Infections and allergic reactions speed up cell growth and migration rates for faster healing. The skin's capacity to heal, fight infection, and protect itself is truly extraordinary.



▲ Figure 10–14
Nourishment through the blood and lymph systems.

Skin Nourishment

Blood and lymph are the fluids that nourish the skin (**Figure 10–14**). Networks of arteries and lymphatics send essential materials for growth and repair throughout the body. Water, vitamins, and nutrients are all important for skin health. Blood supplies nutrients and oxygen to the skin. Nutrients are molecules from food such as protein, carbohydrates, and fats. Topical products also nourish the epidermis.

Lymph, the clear fluids of the body that resemble blood plasma but contain only colorless corpuscles, bathe the skin cells, remove toxins and cellular waste, and have immune functions that help protect the skin and body against disease. Networks of arteries and lymph vessels in the subcutaneous tissue send their smaller branches up to dermal papillae, follicles, and skin glands.

Cell Protection

The health of skin cells depend on the cellular membrane and the water-holding capacity of the stratum corneum. Phospholipids, glycolipids, cholesterol, triglycerides, squalene, and waxes are all different types of lipids found in the stratum corneum and cell membranes. Intercellular lipids and proteins surround cells and provide protection, hydration, and nourishment to the cells. **Ceramides** are a group of waxy lipid molecules important to barrier function and water-holding capacity such as glycolipids. Fifty percent of the lipids in the stratum corneum are ceramides. Fatty acids are also components of the intercellular substances.

Lipids are reduced if the skin is dry, damaged, or mature. Topical products containing ceramides and other lipids benefit wrinkled skin and expedite healing. Exfoliation removes and depletes lipids, so topical product reapplication is necessary to balance what was lost in exfoliation.

Cell recovery depends on water to function properly, so drinking water and keeping skin hydrated is essential to keep cells healthy.

Did You Know?

Proteins, enzymes, vitamins, and metabolites are natural antioxidants in the body.

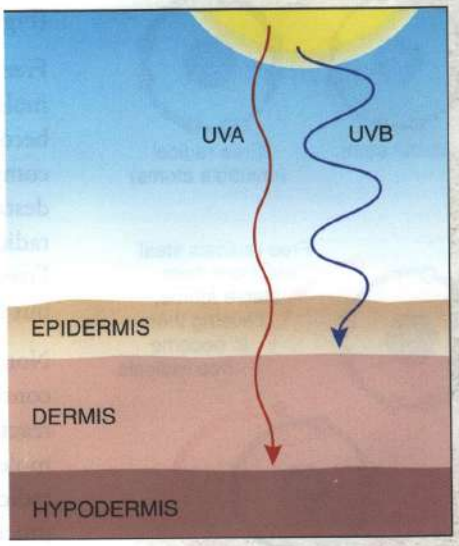
Cell Replacement

The body replaces billions of cells daily. Organs such as the skin, heart, liver, and kidneys have their cells replaced every 6 to 9 months. Cells of the bones are replaced every 7 years. Unfortunately, elastin and collagen are not easily replaced by the body, and the skin does not regain its once pliable shape after being stretched or damaged by UV radiation; however, research shows that certain procedures and ingredients, such as vitamin A and alpha hydroxy acids (AHAs), stimulate skin cell turnover and reduce visible signs of aging. Regular cell turnover is necessary to keep skin healthy.

Sun Damage

The sun and its ultraviolet (UV) electromagnetic radiation have the greatest impact on how our skin ages. According to the U.S. Department of Health and Human Services, ultraviolet radiation (UVR) is a proven carcinogen. UV exposure alters DNA and can cause skin cancer. Approximately 80 to 85 percent of our aging is caused by sun exposure. As we age, the collagen and elastin fibers of the skin naturally weaken. This weakening happens at a much faster rate when the skin is frequently exposed to ultraviolet radiation.

UV reaches the skin in two different forms, as UVA and UVB radiation. Each of the UV forms affects the skin at different levels (**Figure 10–15**). Cell damage is cumulative, and photodamage (from the sun) causes photoaging. Pigment dysfunction, wrinkles, sagging, collagen and elastin breakdown, and skin cancer are the results of exposure to UV radiation.

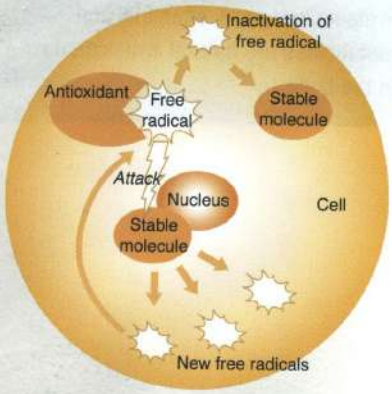


▲ **Figure 10–15**
UV rays penetrate into the skin at different levels.

UVA radiation, also known as **aging rays**, contributes up to 95 percent of the sun's ultraviolet radiation reaching the Earth's surface. The longer wavelengths of UVA (320 to 400 nanometers) penetrate deeper into the skin and cause genetic damage and cell death. UVA weakens the skin's collagen and elastin fibers causing wrinkling and sagging in the tissues. UVA can also penetrate glass and clouds. UVA is present all year and more prevalent than UVB.

UVB radiation, also known as **burning rays**, causes burning of the skin as well as tanning, aging, and cancer. UVB wavelengths range between 290 to 320 nanometers. Although UVB penetration is shorter than and not as deep as UVA, these wavelengths are stronger and more damaging to the skin and can damage the eyes as well. On a positive note, UVB radiation contributes to the body's synthesis of vitamin D and other important minerals.

Melanin is designed to help protect the skin from the sun's UV radiation, but melanin can be altered or destroyed when large, frequent doses of UV are allowed to penetrate the skin. It is important that you advise your clients



▲ Figure 10–16
Free radicals.

▲ Figure 10–17
Free radicals and antioxidants.

about the necessary precautions to take when they are exposed to the sun. Sun protection does more than protect the skin; it defends cells from radiation, cell death, tissue breakdown, and aging.

In addition to taking sun protection precautions, clients should be advised to see a physician specializing in dermatology for regular skin checkups, especially if they detect any changes in the coloration, size, or shape of a mole.

Home self-examinations can also be an effective way to check for signs of potential skin cancer between scheduled doctor visits. When performing a self-care exam, clients should be advised to check for any changes in existing moles and to pay attention to any new visible growths on the skin. Sun damage, skin cancer, and sunscreens are discussed further in Chapter 12, Skin Analysis, and in other chapters. ☑ L06

Free Radical Damage

Free radicals are chemically active atoms or molecules with unpaired electrons. They have an unequal number of electrons and an unbalanced electrical charge. Consequently, these are unstable and steal electrons from other molecules, which then damages the other molecules (**Figure 10–16**).

Free radicals are reactive oxidants (derived from reactions with oxygen molecules) that search the body for other electrons that will allow them to become stable, neutral molecules again. Free radicals take electrons from compounds in the body such as proteins, lipids, or DNA; this process destabilizes and oxidizes the once healthy molecules and creates more free radicals, starting a chain reaction of cellular destruction (**Figure 10–17**). Free radicals are super-oxidizers that not only cause an oxidation reaction but also produce new free radicals in the process.

Normal oxidation deactivates the oxidizer and stops the oxidation from continuing, but the oxidation caused by free radicals continues in a chain reaction that can oxidize millions of other compounds. The donating molecules are now missing an electron and become an unstable new free radical. This process is then repeated in other cells. This is an oxidation process that continues and expands, damaging more cells.

The prevention of free radical formation is a critical process and complex task that is necessary for cells to survive. Antioxidants are vital to neutralize this chain reaction by donating their electrons to stabilize the free radical's electrons. Proteins, enzymes, vitamins, and metabolites are all antioxidants.

Free radicals are generated by many factors including exposure to UV, unhealthy foods, chemicals, smoke, and trauma from medical treatments. The free radicals generated when the skin is exposed to sunlight will damage skin cells. When sunlight contacts the skin, it reacts with oxygen to create free radicals. These free radicals attack cell membranes. UV light can also kill cells by damaging their DNA.

The melanin pigment produced by tanning darkens the skin and absorbs UV radiation to help keep cells from being damaged. Skin cells have built-in antioxidants to protect against sun damage, but their ability to protect cells deteriorates with sun exposure. Inflammation also causes free radical damage and leads to aging, skin pigmentation, and disease. Red and inflamed skin is another indication of free radical damage. L07

Skin Health and the Environment

While the sun may play the predominant role in how the skin ages, changes in our environment also greatly influence this aging process. Pollutants in the air from factories, automobile exhaust, and even secondhand smoke can all influence the appearance and overall health of our skin. While these pollutants affect the surface appearance of the skin, they can also change the health of the underlying cells and tissues, thereby speeding up the aging process.

Climate, humidity levels, and other factors also affect the skin. Routine cleansing at night helps to remove the buildup of pollutants that have settled on the skin's surface throughout the day. Applying daily moisturizers, protective lotions, sunscreen, and even foundation products all help to protect the skin from airborne pollutants and the environment.

Skin Health and Lifestyle Choices

What we choose to put into our bodies significantly affects our overall health. The impact of poor choices can be seen most visibly on the skin. Smoking, drinking, drugs, and poor dietary choices all greatly influence the aging process. It is the esthetician's responsibility to be aware of how these habits affect the skin and to tactfully point out these effects to clients without stepping outside the scope of practice into the medical arena.

Smoking and tobacco use may not only cause cancer but are linked to the premature aging and wrinkling of the skin. Nicotine in tobacco causes contraction and weakening of the blood vessels and small capillaries that supply blood to the tissues, causing decreased circulation. Eventually, the tissues are deprived of essential oxygen, and the skin's surface may appear yellowish or gray in color and can look dull (**Figure 10–18**). Lack of oxygen and nutrients accelerates skin aging.

Using prescription or illegal drugs also affects the skin. Certain drugs have been shown to interfere with the body's intake of oxygen, thus affecting healthy cell growth. Some drugs can even aggravate serious skin conditions, such as acne. Others can cause dryness and allergic reactions on the skin's surface.

fyi

Many free radicals are related to the oxygen molecule and are by-products of our use of oxygen in the energy cycle. In our bodies, free radicals cause the same type of oxidative damage that is observed as fruit decays and turns brown, or when a car rusts as the metal is exposed to oxygen. Our organs also experience damage over time from free radicals.

Did You Know?

By inhaling just one puff of one cigarette, we create three trillion free radicals in the lungs. Free radicals attack our cells and produce a tremendous inflammatory response.

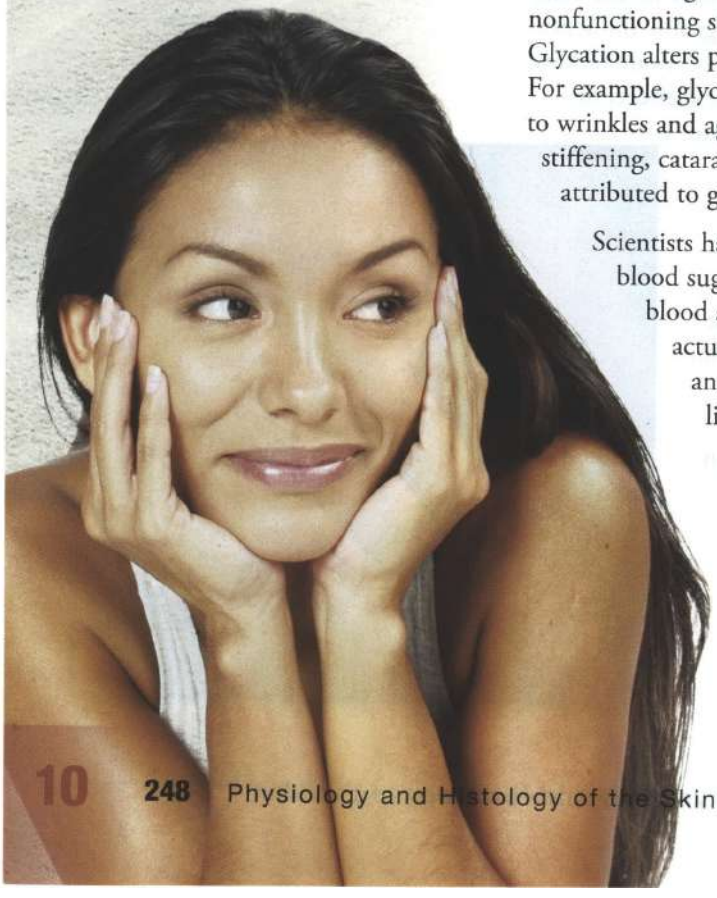
▼ Figure 10–18
Smoking ages the skin.

Similarly, consuming alcohol has a damaging effect on the skin. Heavy or excessive intake of alcohol dilates the blood vessels and capillaries. Over time, this constant over-dilation and weakening of the fragile capillary walls can cause them to expand and burst. This causes a constant flushed appearance of the skin and red splotches in the whites of the eyes. Alcohol can also dehydrate the skin by drawing essential water out of the tissues, making the skin appear dull and dry. When dehydrated, skin is in an inflammatory state that also accelerates the aging process. Alcohol in excess results in a rapid and sustained increase in blood sugar, which causes inflammation and a glycation reaction. In addition, alcohol is metabolized by the liver into chemicals which are toxic to cells.

Both smoking and drinking contribute to the aging process on their own, but the combination of the two can be even more damaging to the tissues. The constant dilation and contraction of the tiny capillaries and blood vessels, as well as the constant deprivation of oxygen and water to the tissues, quickly makes the skin appear lifeless and dull. It is very difficult for the skin to adjust and repair itself. Usually, the damage done by these lifestyle habits is hard to reverse or even diminish.

Glycation

Recent research indicates that an intrinsic part of the aging process involves damaged structures and tissues that gradually accumulate in the body through a destructive process called *glycation*, which is caused by an elevation in blood sugar. **Glycation** is the binding of a protein molecule to a glucose molecule resulting in the formation of damaged, nonfunctioning structures known as *advanced glycation end products*. Glycation alters protein structures and decreases biological activity. For example, glycation contributes to the aging of skin, contributing to wrinkles and age spots. Many age-related diseases such as arterial stiffening, cataracts, and neurological impairment are partially attributed to glycation.



Scientists have established that anything that causes a rise in our blood sugar results in inflammation on a cellular level. When blood sugar goes up rapidly and continually, the sugar can actually attach to the collagen in the skin, making it stiff and inflexible. This is glycation. When collagen is cross-linked by sugar, it leads to stiff and sagging skin.

When blood sugar is elevated we are in an inflammatory state. For example, lack of sleep elevates the hormone cortisol. On the days we do not get enough sleep, we tend to crave carbohydrates because cortisol raises blood sugar and insulin levels, setting up this craving. Even though it is an essential hormone in the body,

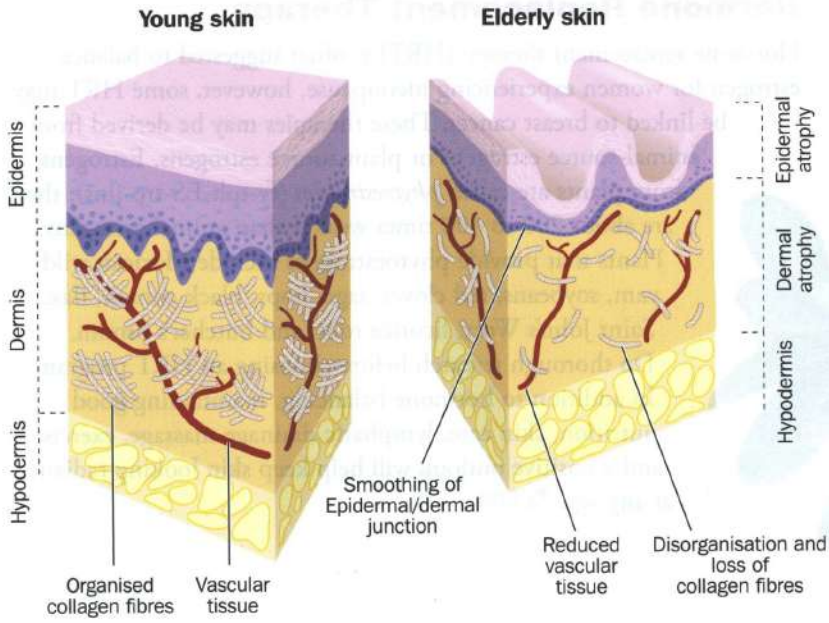
cortisol has many negative side effects in excess quantities. For example, it can break down muscle tissue, thin skin, decalcify bones, and elevate blood sugar. In summary, glycation is an unhealthy biological process for many reasons. A healthy lifestyle and a diet with low sugar intake can help keep sugar levels balanced in the body.

Aging Skin and Hormones

As we age, our skin changes significantly. This is partially because of shifts in the hormone balance. Hormones are the internal messengers for most of the body's systems and are significant internal factors in the skin's appearance, strength, and health. Estrogen (present in both men and women, but predominantly in women) is a crucial hormone for good health and the appearance of skin. Estrogen is anti-inflammatory, an antioxidant, and a key factor in tissue repair. The hormone is also responsible for maintaining health in several body functions such as coordination, balance, skin moisture, vision, bones, and the nervous system. Estrogen has even been linked to memory and emotions.

Changes to the skin begin as women enter perimenopause in their forties, and these changes continue into menopause (fifties) and beyond, because of the decrease in estrogen. All tissues begin to thin and change. This affects the skin's protective barrier, epithelial (external covering) tissue, and dermis. As skin ages, vascular and capillary walls begin to weaken, lipids are reduced, the lymphatic system is less efficient, glands slow down, and there are fewer fibroblasts, thus affecting cells, collagen, and elastin (**Figure 10–19**, page 249). Collagen loses its ability to respond to physical changes from aging and sun damage (**Figure 10–20**, page 249).

▲ **Figure 10–19**
Aging of the skin.



◀ **Figure 10–20**
The physiology of aging skin.

As estrogen is depleted, skin begins to lose its tone. Reduced glycosaminoglycans mean less moisture in the tissues; keratinocytes are reduced (slower cell mitosis); melanocytes are reduced (less protective pigment); and cellular exchanges are reduced. Testosterone levels become dominant as estrogen decreases, which can increase sebum production, pore size, and hair growth on the face. This partially explains the unwanted hair growth and unexpected adult acne. L08

Web Resources

www.skincancer.org
www.ncbi.nlm.nih.gov (National Library of Medicine, National Institute of Health)
www.medicinenet.com

Microcirculation

Microcirculation is the circulation of blood from the heart to arterioles (small arteries), to capillaries, to venules (small veins), and then back to the heart. Hormonal changes are one cause of the microcirculation problems common in mature skin. One such problem is couperose (KOO-per-ohs) skin, or **telangiectasia** (tell-ann-jee-ek-TA-zhuh), the dilation of the capillary walls. As the endothelium (wall of the capillary) atrophies and loses its elasticity, the walls dilate and fill with blood, sometimes bursting.

Other causes of couperose skin or spider veins are heredity, alimentary (digestive) problems, alcohol, smoking, sun damage, harsh cosmetics, trauma, pregnancy, excess localized heat, topical corticosteroids, inflammation, and heat/cold fluctuations. These all lead to permanent dilation of the capillaries.

Rosacea (roh-ZAY-see-uh) is a chronic vascular disorder characterized by couperose veins and congestion of the skin. Acne rosacea includes papules and pustules. In some cases, rosacea may be caused by parasitic microorganisms (mites). Skin disorders are discussed in Chapter 11, Disorders and Diseases of the Skin.

Hormone Replacement Therapy

Hormone replacement therapy (HRT) is often suggested to balance estrogen for women experiencing menopause, however, some HRT may be linked to breast cancer. These therapies may be derived from animal-source estrogens or plant-source estrogens. Estrogens from plants are called *phytoestrogens* (fy-toh-ES-tro-jins); they are about 200 to 400 times weaker than animal estrogens. Plants that provide phytoestrogens include Mexican wild yam, soybeans, red clover, sage, hops, black cohash, flax, Saint John's Wort, licorice root, and butcher's broom. Do thorough research before choosing an HRT program. In addition to hormone balancing, maintaining good nutrition, skin care, lymphatic drainage massage, exercise, and a positive outlook will help keep skin looking radiant at any age. L09

Review Questions

1. What are the six main functions of the skin?
2. What does barrier function mean?
3. How does sebum protect the skin?
4. What is the acid mantle?
5. Name the five layers of the epidermis.
6. What glands help regulate the body's temperature?
7. What are keratinocytes?
8. What are melanocytes?
9. Name the two layers of the dermis.
10. What is collagen?
11. Why is skin elasticity important?
12. Name the two main types of nerves and describe what they do.
13. What are the two main glands associated with the skin?
14. What are the two types of sweat glands?
15. How does skin get its nourishment?
16. Describe the difference between UVA wavelengths and UVB wavelengths.
17. How does UVA and UVB radiation affect the skin?
18. What are free radicals?

Glossary

apocrine glands	Coiled structures attached to hair follicles found in the underarm and genital areas that secrete sweat.
arrector pili muscle	Small, involuntary muscles in the base of the hair follicle that cause goose flesh when the appendage contracts, sometimes called goose bumps and papillae.
barrier function	Protective barrier of the epidermis; the corneum and intercellular matrix protect the surface from irritation and dehydration.
ceramides	Glycolipid materials that are a natural part of skin's intercellular matrix and barrier function.
collagen	Fibrous, connective tissue made from protein; found in the reticular layer of the dermis; gives skin its firmness. Topically, a large, long-chain molecular protein that lies on the top of the skin and binds water; derived from the placentas of cows or other sources.
corneocytes	Another name for a stratum corneum cell. Hardened, waterproof, protective keratinocytes; these "dead" protein cells are dried out and lack nuclei.
dermal papillae	Membranes of ridges and grooves that attach to the epidermis; contains nerve endings and supplies nourishment through capillaries to skin and follicles.
dermis	Also known as the *derma*, *corium*, *cutis*, or *true skin*; support layer of connective tissue, collagen, and elastin below the epidermis.
desmosomes	The structures that assist in holding cells together; intercellular connections made of proteins.

Glossary

eccrine glands	Sweat glands found all over the body with openings on the skin's surface through pores; not attached to hair follicles, secretions do not produce an offensive odor.
elastin	Protein fiber found in the dermis; gives skin its elasticity and firmness.
epidermal growth factor	Abbreviated EGF; stimulates cells to reproduce and heal.
epidermis	Outermost layer of skin; a thin, protective layer with many cells, mechanisms, and nerve endings. It is made up of five layers: stratum corneum, stratum lucidum, stratum granulosum, stratum spinosum, and stratum germinativum.
eumelanin	A type of melanin that is dark brown to black in color. People with dark-colored skin mostly produce eumelanin. There are two types of melanin; the other type is pheomelanin.
fibroblasts	Cells that stimulate cells, collagen, and amino acids that form proteins.
follicles	Hair follicles and sebaceous follicles are tube-like openings in the epidermis.
glycation	Caused by an elevation in blood sugar, glycation is the binding of a protein molecule to a glucose molecule resulting in the formation of damaged, nonfunctioning structures, known as Advanced Glycation End products(a.k.a. AGES). Glycation alters protein structures and decreases biological activity.
hair papillae	Cone-shaped elevations at the base of the follicle that fit into the hair bulb. The papillae are filled with tissue that contains the blood vessels and cells necessary for hair growth and follicle nourishment.
hyaluronic acid	Hydrating fluids found in the skin; hydrophilic agent with water-binding properties.
hydrolipidic	Hydrolipidic film is an oil–water balance that protects the skin's surface.
intercellular matrix	Lipid substances between corneum cells that protect the cells from water loss and irritation.
keratin	Fiberous protein of cells that is also the principal component of skin, hair, and nails; provides resiliency and protection.
keratinocytes	Epidermal cells composed of keratin, lipids, and other proteins.
Langerhans immune cells	Guard cells of the immune system that sense unrecognized foreign invaders, such as bacteria, and then process these antigens for removal through the lymph system.
leukocytes	White blood cells that have enzymes to digest and kill bacteria and parasites. These white blood cells also respond to allergies.
lymph vessels	Located in the dermis, these supply nourishment within the skin and remove waste.
melanin	Tiny grains of pigment (coloring matter) that are produced by melanocytes and deposited into cells in the stratum germinativum layer of the epidermis and in the papillary layers of the dermis.It is a protein that determines hair, eye, and skin color; a defense mechanism to protect skin from the sun.
melanocytes	Cells that produce skin pigment granules in the basal layer.
melanosomes	Pigment carrying granules that produce melanin, a complex protein.
papillary layer	Top layer of the dermis next to the epidermis.
pheomelanin	A type of melanin that is red and yellow in color. People with light-colored skin mostly produce pheomelanin. There are two types of melanin; the other is eumelanin.

Glossary

pores	Tube-like opening for sweat glands on the epidermis.
reticular layer	Deeper layer of the dermis that supplies the skin with oxygen and nutrients; contains fat cells, blood vessels, sudoriferous (sweat) glands, hair follicles, lymph vessels, arrector pili muscles, sebaceous (oil) glands, and nerve endings.
rosacea	Chronic condition that appears primarily on the cheeks and nose and is characterized by flushing (redness), telangiectasis (distended or dilated surface blood vessels), and, in some cases, the formation of papules and pustules.
sebaceous glands	Also known as *oil glands*; protect the surface of the skin. Sebaceous glands are appendages connected to follicles.
sebum	Oil that provides protection for the epidermis from external factors and lubricates both the skin and hair.
stratum corneum	Also known as *horny layer*; outermost layer of the epidermis, composed of corneocytes.
stratum germinativum	Also known as *basal cell layer*; active layer of the epidermis above the papillary layer of the dermis; cell mitosis takes place here that produces new epidermal skin cells and is responsible for growth.
stratum granulosum	Also known as *granular layer*; layer of the epidermis composed of cells filled with keratin that resemble granules; replaces cells shed from the stratum corneum.
stratum lucidum	Clear, transparent layer of the epidermis under the stratum corneum; thickest on the palms of hands and soles of feet.
stratum spinosum	Also known as *spiny layer*; layer of the epidermis above the stratum germinativum (basal) layer containing desmosomes, the intercellular connections made of proteins.
subcutaneous layer	Also known as *hypodermis*; subcutaneous adipose (fat) tissue located beneath the dermis; a protective cushion and energy storage for the body.
subcutis tissue	Also known as *adipose tissue*; fatty tissue found below the dermis that gives smoothness and contour to the body, contains fat for use as energy, and also acts as a protective cushion for the outer skin.
sudoriferous glands	Also known as *sweat glands*; excrete perspiration, regulate body temperature, and detoxify the body by excreting excess salt and unwanted chemicals.
t-cells	Identify molecules that have foreign peptides and also help regulate immune response.
telangiectasia	Capillaries that have been damaged and are now larger, or distended, blood vessels; commonly called *couperose skin*.
transepidermal water loss	Abbreviated TEWL; water loss caused by evaporation on the skin's surface.
tyrosinase	The enzyme that stimulates melanocytes and thus produces melanin.
UVA radiation	Also known as *aging rays*; longer wavelengths ranging between 320 to 400 nanometers that penetrate deeper into the skin than UVB; cause genetic damage and cell death. UVA contributes up to 95 percent of the sun's ultraviolet radiation.
UVB radiation	Also known as *burning rays*; UVB wavelengths range between 290 to 320 nanometers. UVB rays have shorter, burning wavelengths that are stronger and more damaging than UVA rays. UVB causes burning of the skin as well as tanning, skin aging, and cancer.