Waxing for Cosmetologists

Waxing

This module introduces cosmetology continuing education students to the principles of hair removal and waxing. Topics include general facts about and structure of hair; the hair growth cycle; origins of waxing; trends in waxing; waxing tips; sanitation; autoclave safety; and a health and safety checklist.

Waxing

General Facts about Hair

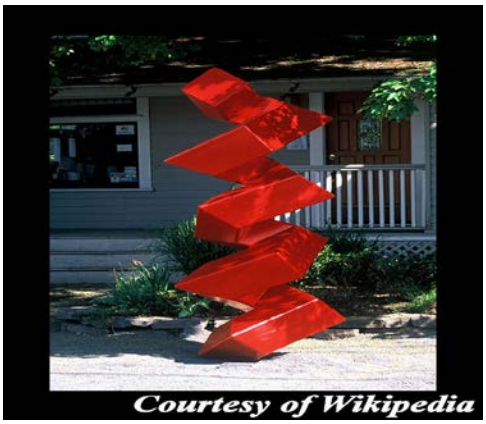
Hair is a filamentous outgrowth of dead cells from skin, found only on mammals. Although many other life forms, especially insects, show filamentous outgrowths, these are not considered "hair" in the accepted meaning of the term. So-called "hairs" (trichomes) are also found on plants. The projections on arthropods, such as insects and spiders are actually bristles. The hair of non-human species is commonly referred to as fur. There are varieties of cats, dogs, and mice bred to have little or no visible fur.

The primary chemical composition of hair includes 45% carbon, 27% oxygen, 15% nitrogen, 6% hydrogen, and 5% sulfur (Stevens, n.d.). According to Dane (2003), hair contains at least 19 different amino acids joined together end to end in various combinations. Alpha (i.e., α) amino acids are the building blocks of proteins. These amino acid chains, called polypeptides or proteins, wind around each other forming fibers of increasing size, which form an individual hair.

The main component of hair fiber is *keratin*. Polypeptide chains are formed together in a certain order to create keratin. Keratin has high sulphur content which gives it strength (Dane, 2003), and its proteins form the cytoskeleton (miniature skeleton within a cell) of all epidermal cells. Keratin filaments run within a cell from the inside of the outer membrane to weave a "basket" around the nucleus of the cell. There are various types of keratins, even within a single animal, such as the *α-keratins* in the hair, horns, nails, claws and hooves of mammals ("Keratin," 2007).

Keratins are fibrous structural proteins made into long polypeptide chains of amino acids. *Polypeptides* (Greek meaning digestible) are the family of short molecules formed from the linking, in a defined order, of various α-amino acids. The link between one amino acid residue and the next is an amide bond and is sometimes referred to as a peptide bond. Proteins are polypeptide molecules (or consist of multiple polypeptide subunits). The distinction is that peptides are short and polypeptides proteins are long.

Polypeptides are chains of amino acids held together by peptide bonds ("Peptide Bond," 2007). A *peptide bond* is a chemical bond formed between two molecules when the carboxyl group (containing carbon) of one molecule reacts with the amino group (containing nitrogen) of the other molecule. The carbon atom of one amino acid connects to the nitrogen atom of another amino acid, resulting in a peptide bond. A peptide bond can be broken by amide hydrolysis (the adding of water).

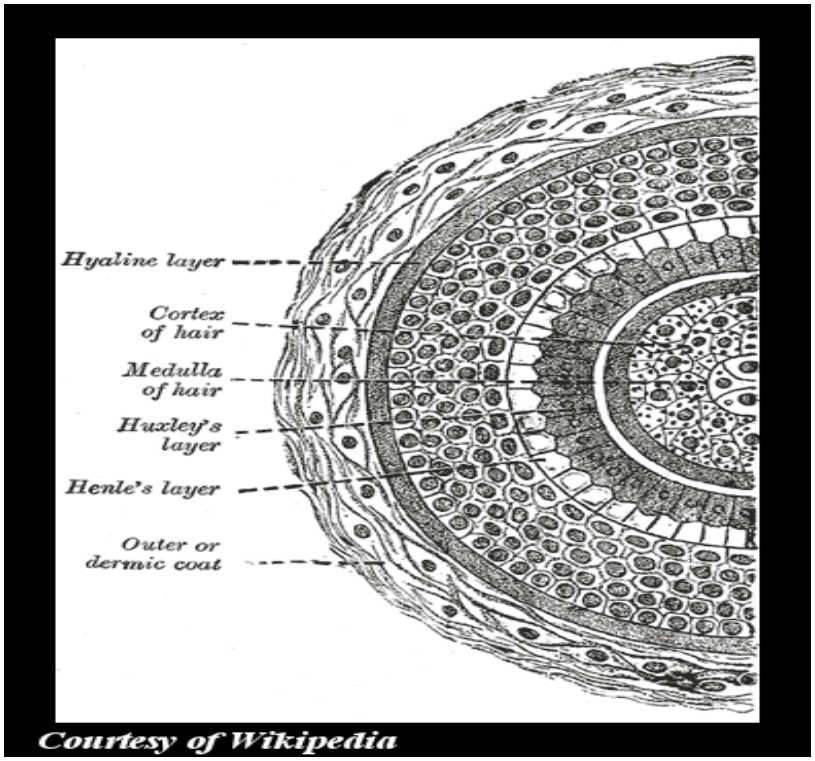


Polypeptide chains of keratin found in human hair are in the form of an *alpha-helix* (i.e., α-helix). A helix is a twisted shape like a spring, screw or a spiral staircase ("Helix," 2007). Helices are important in biology, as DNA is helical and many proteins have helical substructures, known as α-helices. An α-helix is a right-

handed coiled formatin that resembles a spring. Each turn of the α-helix contains 3.6 amino acids, and each amino acid is linked to adjoining amino acids via a peptide bond.

Three α-helices are twisted together to form a protofibril. A microfibril is a stranded structure created by eleven protofibrils. The microfibril is a very fine fibril, or fiber-like strand, consisting of glycoproteins ("Microfibril," 2007). Its most frequently observed structural pattern is 9+2 pattern in which two central protofibrils are surrounded by nine others. In turn, hundreds of microfibrils are bundled together to form the cortex of the hair fiber.

Though it grows from hair follicles deep in the dermis, hair projects from the epidermis ("Epidermis," 2007). The *epidermis* is the outermost layer of the skin and forms the waterproof, protective wrap over the body's surface. It contains no blood vessels, and is nourished by diffusion from the dermis. The main type of cells that make up the epidermis are keratinocytes, melanocytes, Langerhans cells, and Merkels cells. The epidermis is divided into several layers where cells are formed through mitosis at the innermost layers. They move up the strata changing shape and composition as they differentiate and become filled with keratin. They eventually reach the top layer called stratum corneum and become sloughed off, or desquamated. This process is called keratinization and takes place within weeks. The outermost layer of Epidermis consists of 25 to 30 layers of dead cells.



The *dermis* is a layer of skin beneath the epidermis that consists of connective tissue and cushions the body from stress and strain ("Dermis," 2007). The dermis is tightly connected to the epidermis by a basement membrane. It also harbors many nerve endings that provide the sense of touch and heat. It contains the hair follicles, sweat glands, sebaceous glands, apocrine glands and blood vessels. The blood vessels in the dermis provide nourishment and waste removal to its own cells as well as the stratum basale of the epidermis.

Hair has three basic layers: the *medulla*, the *cortex*, and the *cuticle* (Stevens, n.d.). The medulla is the innermost core of the hair where body and strength is determined. The cortex is the middle (and largest) layer. It provides strength to the hair shaft, and determines the color, texture and elasticity. The cuticle protects hair from the environment by forming a tightly packed layer of protective scales that overlap.

Types of Human Hair

Different parts of the human body feature different types of hair. Humans have three different types of hair:

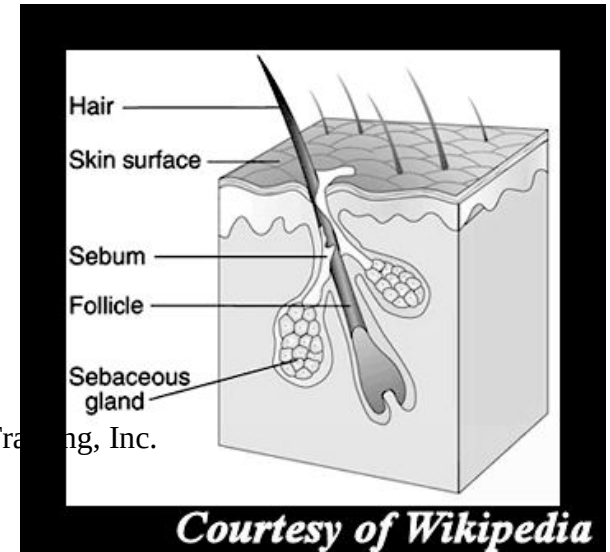
- Lanugo, the fine hair that covers nearly the entire body of fetuses
- Vellus hair, the short, fine, "peach fuzz" body hair that grows in most places on the human body in both sexes
- Terminal hair, the fully developed hair, which is generally longer, coarser, thicker, and darker than vellus hair

Lanugo are hairs that grow on the body to attempt to insulate it because of lack of fat ("Lanugo," 2007). It is a type of pelage, hair that serves to protect the body from heat and cold. Lanugo is

very fine, and grows on the body in places which do not usually grow hair, like the stomach, back and chest. Lanugo occurs on fetuses as a normal part of gestation: the fetus drinks amniotic fluid and urinates it back into its environment. As the lanugo is lost, it is normal for the developing fetus to consume the hair with the fluid, which then contributes to the newborn baby's first feces (meconium). Lanugo hair is usually shed and replaced by vellus hair at 36–40 weeks gestation. The presence of lanugo in newborns is a sign of premature birth. Lanugo is also a common symptom of serious anorexia nervosa, as the body attempts to insulate itself as body fat is lost.

Vellus hair is short, fine, "peach fuzz" body hair (“Vellus,” 2007). Vellus hair is a very soft and short hair that grows in most places on the human body in both sexes. It is usually less than 2mm long and the follicles are not connected to sebaceous glands. It is most easily observed in women and children, as they have less terminal hair to obscure it. Vellus hair is also found in pre-adolescents as well as in male pattern baldness. However, it should not be confused with the much thicker lanugo type of hair developed by fetuses and the bodies of anorexics in an attempt to retain body heat. From childhood onward, vellus hair covers the entire human body regardless of sex or race except in the following locations: the lips, the palms of hands, the soles of feet, certain external genital areas, the navel and scar tissue. The density of vellus hairs (in hair follicles per square centimeter) varies from one person to another.

Terminal hair, such as head hair and body hair (after puberty), is developed hair, which is generally longer, coarser, thicker, and darker than the shorter and finer vellus hair. Phases of growth in terminal hair are more apparent than in



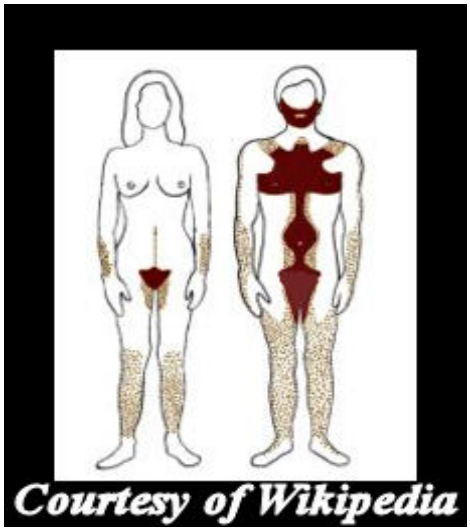
vellus hair; terminal hair generally has a longer growth phase. A terminal hair has associated sebaceous glands, whereas a vellus hair may not. *Sebaceous glands* secrete an oily substance called sebum (Latin, meaning fat or tallow) that is made of lipids and the debris of dead fat-producing cells (“Sebaceous Gland,” 2007). Sebum is odorless, but its bacterial breakdown can produce odors. Sebum is the cause of some people experiencing "oily" hair if it is not washed for several days. Sebum acts to protect and waterproof hair and skin, and keep them from becoming dry, brittle, and cracked.

Under certain conditions, such as puberty, some vellus hairs may become androgenic terminal hairs. Under other conditions, such as male pattern baldness, terminal hairs may revert to a vellus-like state. In humans, terminal hair is generally more abundant on males than females. However, variations exist within populations with some women appearing more hairy than some men.

A medical term for post-puberty terminal body hair is *androgenic* since its growth depends primarily on the level of androgens (male hormones) contained within the individual (“Androgenic Hair,” 2007). The appearance of androgenic hair is caused by the rising level of androgens due to puberty that causes a transformation process of vellus hair into terminal hair on several parts of the human body. The hair follicles respond to androgens, primarily testosterone and its derivatives. The rate of hair growth and the weight of the hairs increase. Different areas respond with different sensitivities. As testosterone levels increase, the sequence of appearance of androgenic hair reflects the gradations of androgen sensitivity. The pubic area is most sensitive, and heavier hair usually grows there first in response to androgens. Areas on the human body that develop

terminal hair growth due to rising androgens in both sexes, men and women, are the axillary (i.e., underarm) hair and the pubic hair. In contrast to that, normally only men grow androgenic hair in other areas.

There is a sexual dimorphism in the amount and distribution of androgenic hair, with males having more terminal hair (particularly facial hair, chest hair, abdominal hair and leg and arm hair) and females having more vellus hair, which is less visible. The genetic disposition determines the sex-dependent and individual rising of androgens and therefore the development of androgenic hair. Increased body hair on women following the male pattern can be referred to as hirsutism. An excessive and abnormal hair growth on the body of males and females is defined as hypertrichosis. Considering an individual occurrence of body hair as abnormal does not implicitly depend on medical indications but also on cultural and social attitudes.



Historically, several ideas have been advanced to describe the reduction of human body hair. All were faced with the same problem that there is no fossil record of human hair to back up the conjectures nor to determine exactly when the feature evolved. Savanna theory suggests that nature selected humans for shorter and thinner body hair as part of a set of adaptations to the warm plains of the savanna, including bipedal locomotion and an upright posture. There are several problems with this theory, not least of which is that cursorial hunting is used by other animals that do not show any thinning of hair. Another theory for the thin body hair on humans proposes that sexual selection played a role here with more juvenile appearing females being selected by males as more desirable. The aquatic ape hypothesis posits that sparsity of hair is an adaptation to an aquatic environment, but it has little support amongst scientists and very few

aquatic mammals are, in fact, hairless. In reality, there may be little to explain. Humans, like all primates, are part of a trend toward sparser hair in larger animals; the *density* of human hair follicles on the skin is actually about what one would expect for an animal of equivalent size. The outstanding question is why so much of human hair is short, underpigmented vellus hair rather than terminal hair.

Head hair ("Hair," 2007; Stevens, n.d.)

Head hair is a type of hair that is grown on the scalp. The most noticeable part of human hair is the hair on the head, which can grow longer than on most mammals and is more dense than most hair found elsewhere on the body. The average human head has about 100,000 hair follicles. Its absence is termed alopecia, commonly known as baldness. Anthropologists speculate that the functional significance of long head hair may be adornment, a by-product of secondary natural selection once other somatic hair had been lost. Another possibility is that long head hair is a result of Fisherian runaway sexual selection, where long lustrous hair is a visible marker for a healthy individual (with good nutrition, waist length hair—approximately 1 meter or 39 inches long—would take around 48 months, or about 4 years, to grow).

According to Stevens (n.d.), scalp hair density and growth rate varies by hair color and ethnicity. Among caucasians, blondes average 146,000 hairs, those with black hair average 110,000 hairs, brunettes average 100,000 hairs, and red-head average 86,000 hairs. Caucasian hair averages a growth rate of 1-2 cm (.4 to .8 inches) per month. Those of African and Caribbean origin possess predominantly black hair with multi-helixal hairshafts, which average between 50,000 and 100,000 scalp hairs. Due to the fragility of the multi-helixal hair shaft, growth rate among African-Caribbean hair types averages about half that of Caucasian hair types, rarely attaining long lengths. Asian hair types possess predominantly black, straight hair shafts, with the number

of scalp hairs ranging between 80,000 and 140,000. Comparatively, straight shafted Asian hair grows rapidly and may attain great length.

Hair Texture

Hair texture is measured by the degree to which one's hair is either fine or coarse, which in turn varies according to the diameter of each individual hair. There are usually four major types of hair texture: fine, medium, coarse and wiry. Within the four texture ranges hair can also be thin, medium or thick density and it can be straight, curly, wavy or kinky. Hair conditioner will also alter the ultimate equation and can be healthy, normal, oily, dry, damaged or a combination. Hair can also be textured if straighteners, crimpers, curlers, etc are used to style hair. Also, a licensed hairdresser can change the hair texture with the use of special chemicals.

Hair and Aging

As people age they tend to develop gray hair because the pigment in the hair is lost and the hair becomes colorless. Gray hair is considered to be a characteristic of normal aging. The age at which this occurs varies from person to person, but the majority of people 75 years or older have gray hair, and in general, men tend to become gray at younger ages than women.

It should be noted however, that gray hair in itself is not actually gray; the gray head of hair is a result of the contrast between the dark and white/colorless hair forming an overall 'gray' appearance to the observer. As such, people starting out with very pale blond hair usually develop white hair instead of gray hair when aging. Red hair usually doesn't turn gray with age; rather it becomes a sandy color and afterward turns white. In fact, the gray or white appearance of individual hair fibers is a result of light scattering from air bubbles in the central medula of the hair fiber. Some degree of scalp hair loss or thinning generally accompanies aging in both males and females, and it's estimated that half of all men are affected by male pattern baldness by the

time they are 50. The tendency toward baldness is a trait shared by a number of other primate species, and is thought to have evolutionary roots.

Pathological Impacts on Hair

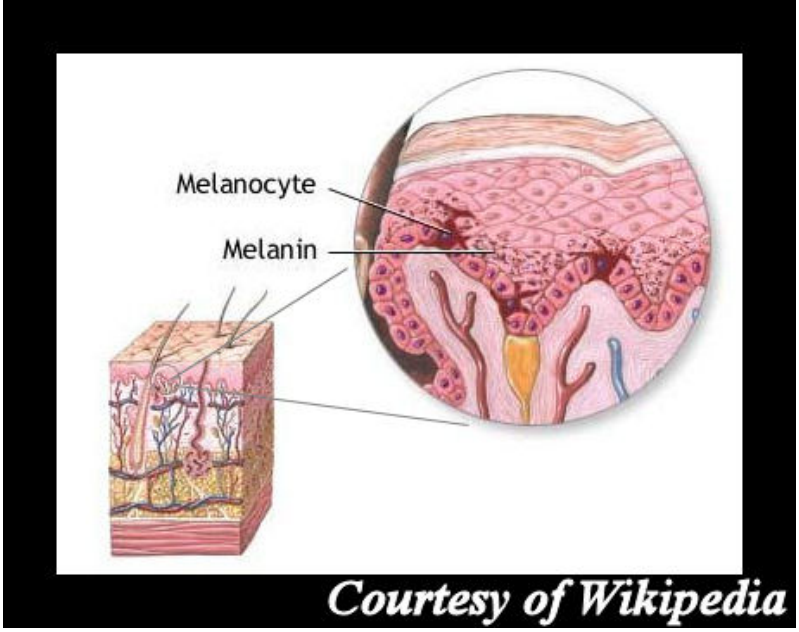
Drugs used in cancer chemotherapy frequently cause a temporary loss of hair, noticeable on the head and eyebrows, because they kill all rapidly dividing cells, not just the cancerous ones. Other diseases and traumas can cause temporary or permanent loss of hair, either generally or in patches.

The hair shafts may also store certain poisons for years, even decades, after death. In the case of Col. Lafayette Baker, who died in 1868, use of an atomic absorption spectrophotometer showed the man was killed by white arsenic. The prime suspect was Wally Pollack, Baker's brother-in-law. According to Dr. Ray A. Neff, Pollack had laced Baker's beer with it over a period of months, and a century or so later minute traces of arsenic showed up in the dead man's hair. Mrs. Baker's diary seems to confirm that it was indeed arsenic, as she writes of how she found some vials of it inside her brother's suitcoat one day.

Hair Follicle (“Hair Follicle,” 2007)

A *hair follicle* is part of the skin that grows hair by packing old cells together. Attached to the follicle is a sebaceous gland, a tiny sebum-producing gland found everywhere except on the palms, lips and soles of the feet. The thicker density of hair, the more sebaceous glands are found.

At the base of the follicle is a large structure that is called the papilla. The papilla is made up mainly of connective tissue and a capillary loop. Cell division in the papilla is either rare or non-existent. Around the papilla is the hair matrix, a collection of epithelial cells often interspersed with melanocytes.



Melanocytes are cells located in the bottom layer, the basal lamina, of the skin's epidermis and in the middle layer of the eye, the uvea ("Melanocytes," 2007). Through a process called melanogenesis, these cells produce melanin, a pigment in the skin, eyes, and hair. In humans, melanin is found in skin, hair, and the pigmented tissue underlying the iris. Melanin is the primary determinant of human skin color ("Melanin," 2007). Because melanin is an aggregate of smaller component molecules, there are a number of different types of melanin with differing proportions and bonding patterns of these component molecules.

Both pheomelanin and eumelanin are found in human skin and hair, but eumelanin is the most abundant melanin in humans, as well as the form most likely to be deficient in albinism. *Eumelanin* is found in hair and skin, and colors hair gray, black, yellow, and brown. In humans, it is more abundant individuals with dark skin. There are two different types of eumelanin, black and brown, which are distinguished from each other by their pattern of polymer bonds. A small amount of black eumelanin in the absence of other pigments causes gray hair. A small amount of brown eumelanin in the absence of other pigments causes yellow (blond) color hair. *Pheomelanin* is also found in hair and skin and is more abundant in lighter skinned humans. Pheomelanin imparts a pink to red hue and, thus, is found in particularly large quantities in red hair. Pheomelanin may become carcinogenic when exposed to the ultraviolet rays of the sun.

Cell division in the hair matrix is responsible for the cells that will form the major structures of the hair fibre and the inner root sheath. The hair matrix epithelium is one of the fastest growing

cell populations in the human body, which is why some forms of chemotherapy that kill dividing cells or radiotherapy may lead to temporary hair loss, by their action on this rapidly dividing cell population. The papilla is usually ovoid or pear shaped with the matrix wrapped completely around it except for a short stalk-like connection to the surrounding connective tissue that provides access for the capillary.

Also attached to the follicle is a tiny bundle of muscle fiber called the *arrector pili* that is responsible for causing the follicle and hair to become more perpendicular to the surface of the skin, and causing the follicle to protrude slightly above the surrounding skin. Arrector pili are tiny muscle fibers attached to each hair follicle, which contract to make the hairs stand on end, causing goose bumps. They exist in most mammals, including humans ("Arrector Pili," 2007). Stem cells are located at the junction of the arrector and the follicle, and are principally responsible for the ongoing hair production during a process known as the Anagen or growth stage. Arrector pili are smooth muscles, not skeletal muscles, which explains why humans cannot voluntarily give themselves goose bumps. In other animals with more hair than humans, they serve an important function — they raise the hairs so air gets trapped between them, providing a layer of insulation to keep the animal warm. Some animals also contract these muscles when they are cornered, in order to appear larger and more threatening. Although humans' arrector pili also contract in response to cold or arousal, they are vestigial because humans do not have enough hair to make them effective.

Stages of Hair Growth

Parts of the following on the stages of hair growth are adapted from Stophairlossnow.com (2005).

Did you know that the average growth rate of hair follicles on the scalp is .04 cm per day? Or, that hair grows fastest between the ages of sixteen and the late twenties? How about the fact that

new hair grows the fastest while the rate of growth slows with the hair's increasing length? Did you know that each follicle can grow about 20 individual hairs in a person's lifetime, and the average hair loss is about 100 strands a day?

Each hair follicle undergoes a life cycle. The hair grows to a maximum length, hair growth ceases, and the hair is shed and replaced. Healthy hair has an average lifespan of 2-6 years. At any point in time, a healthy scalp will possess only about 85 percent of its total possible hair, while the remaining hair follicles are in their resting phase. Individual hairs alternate periods of growth and dormancy. During the growth portion of the cycle, hair follicles are long and bulbous, and the hair advances outward at about a third of a millimeter per day. After three to six months, body hair growth stops (the pubic and armpit areas having the longest growth period). The follicle shrinks and the root of the hair grows rigid. Following a period of dormancy, another growth cycle starts, and eventually a new hair pushes the old one out of the follicle from beneath. Head hair, by comparison, grows for a long duration and to a great length before being shed. The rate of growth is approximately 15 millimeters, or about ⅝ inch, per month.

Hair grows in cycles of various phases: *anagen* is the growth phase; *catagen* is the regressing phase; and *telogen*, the resting phase. Each phase has several morphologically and histologically distinguishable sub-phases. Normally up to 90% of the hair follicles are in anagen phase while, 10–14% are in telogen and 1–2% in catagen.

<u>*Anagen*</u> **–** In this period of active growth, the root of the hair is formed by epidermal cells that surround the dermal papilla. As these cells continually grow and divide, older cells are pushed

upward, until they are approximately one-third of the way up the follicle, where they have become dead and fully keratinized. If protected from damage, each hair on the scalp can grow up to seven years. However, the average growth period for scalp hair is three years. At any point in time, about 85 percent of follicles on the scalp are in the anagen phase with the average growth rate being about ½ inch per month.

Catagen – This stage averages about three weeks in duration and is the end of active growth, encompassing the breakdown of and change in the hair follicle. This stage begins when the hair stops growing, becoming detached from its base. As the hair bulb begins to breakdown, the follicle become shorter, while a small portion of the outer root remains in contact with the epidermal cells. However, even as the inner root sheath breaks down, the hair will remain in the follicle due to its shape. On the average human head, only one percent of follicles are in the catagen stage at any point in time.

Telogen – The shortened follicle rests for about three months. The hair may be brushed out at this time or at the onset of anagen. During this resting phase before the resumption of growth, the section of remaining root sheath still in contact with the papilla is called the root germ. The new hair follicle grows from this germ. On average, 14 percent of follicles are in the telogen stage.

Following the telogen phase, the cycle returns to an anagen stage where the root germ grows downward to form a new bulb surrounding the dermal papilla. The new hair will usually push the old hair out, although you may rarely see two hairs, the old and new, emerging from the same follicle. Prior to the start of cycling is a phase of follicular morphogenesis (formation of the follicle). There is also a shedding phase, or exogen, that is independent of anagen and telogen in which one of several hairs that might arise from a single follicle exits.

Growth cycles are controlled by a chemical signal called an epidermal growth factor. The cycle's length varies on different parts of the body. For eyebrows, the cycle is completed in around 4 months, while it takes the scalp 3–4 years to finish; this is the reason eyebrow hairs have a fixed length, while hairs on the head seem to have no length limit. In addition, the length of time that these phases last can vary across hair color and follicle shape. Furthermore, there are seasonal fluctuations in these cycles due to daylight and weather. For example, a person is more likely to lose additional hair during the autumn and spring, relative to the summer. There are even some rare cases of men and women who lose all of their hair every seven years due to a non-continuous growth cycle and remain virtually bald for up to four months after which hair re-grows normally.

Both males and females often have unwanted body and/or facial hair; approximately 80% of women and 50% of men report the desire for some form of hair removal. And, the face is a popular site for hair removal among both women and men. In many cultures, particularly North American, Eastern European and Middle Eastern cultures, women frequently remove some or all of their body hair, due to societal values that consider it unattractive and/or not feminine or as a matter of practicing good hygiene. Hair removal on the hands, legs, arms, underarms, bikini area, face, and eyebrows are commonly practiced in the U.S. today. Athletes (e.g., swimmers, bicyclists, runners) will often opt for hair removal in the name of reducing wind/water resistance and improving their competitive edge.

Permanent versus Temporary Hair Removal

There are numerous devices, methods, and products available for both temporary and permanent hair removal on different parts of the body. Waxing, sugaring, and electrolysis are the most popular methods for temporary body hair removal. Waxing is a method of hair removal in which wax is applied over the hairs and then a cotton strip is rubbed on the wax in the direction of the hair growth then quickly removed. Electrolysis and Laser treatments remove the hair

permanently from the skin. In these methods the hair follicle is destroyed so that the hair does not grow again. Electrolysis uses needles to supply electric current to the hair follicles. This electric current creates some chemical changes or generates heat to destroy the hair follicles. In Laser treatment, the laser is directed towards the hair follicles to destroy it. Laser treatments are costly when compared to other methods of hair removal.

Permanent hair removal involves several options. A number of methods have been developed that use chemicals, energy of varying types, or a combination to target the areas that regulate hair growth. Permanently destroying these areas while sparing surrounding tissue is a difficult challenge.

Permanent hair removal

- Electrolysis

Permanent hair reduction

- Laser (Does not permanently remove all hair, but does reduce the amount of visible hair)
- Flashlamp (also called Intense Pulsed Light or IPL)
- EpiLight (an Intense Pulsed Light device)

Lasting hair inhibition for many (requires continuous use)

- Prescription oral medications
- A new method of epilation is to use enzymes that inhibit the development of new hair cells. Hair growth will become less and less until it finally stops, normal depilation/epilation will be performed during that time. Products include the prescription drug Vaniqa (active ingredient eflornithine hydrochloride inhibiting the enzyme ornithine decarboxylase).

Temporary hair removal can be broadly classified in terms of depilation or epilation. Lasting several hours to several days, *depilation* affects the part of the hair above the surface of the skin and can be achieved by:

- Shaving or trimming (manually or with electric shavers)
- Depilatories (creams or "shaving powders" which chemically dissolve hair)
- Friction (rough surfaces used to buff away hair)

Lasting several days to several weeks, *epilation* involves removal of the entire hair, including the part below the skin, and can be achieved by:

- Plucking (hairs are plucked, or pulled out, with tweezers or with fingers)
- Waxing (a hot or cold layer is applied and then removed with porous strips)
- Sugaring (similar to waxing, but with a sticky paste)
- Threading (also called *fatlah* or *khite*, in which a twisted thread catches hairs as it is rolled across the skin)
- Epilators (devices that rapidly grasp hairs and pull them out by the root)