



# ***CHEMICAL STRUCTURE OF HAIR***

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# ACKNOWLEDGING THE HAIR SCIENCE

-GOING SCIENTIFIC WITH HAIR



# INTRODUCING HAIR

- **Hair** is a protein that grows from follicles in the dermis, or skin.
- It is a thread-like structure on our body.
- The Scientific study of hair is called "Trichology".



# COMPOSITION OF HAIR:

- Hair is chiefly composed of a protein called “KERATIN”. The chemical composition of hair varies with its color.
- Proteins, raw elements, **amino acids** and bonds work together in forming hair fiber.
- **Amino acids**, the building blocks of **protein**, are made up of COHNS elements, (**Carbon**, Oxygen, Hydrogen, Nitrogen and **Sulfur**).
- The average hair is composed of:
  - Carbon: 50.65%
  - Hydrogen: 6.36%
  - Nitrogen: 17.14%
  - Sulphur: 5%
  - Oxygen: 20.85%

# FORMS OF HAIR:

Straight Hair

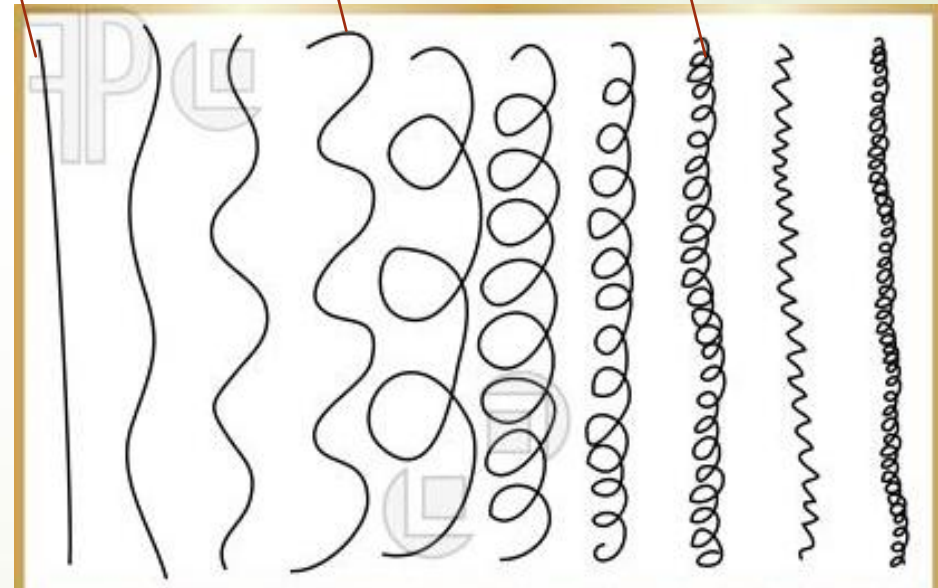
Wavy Hair

Extra Wavy Hair

Straight Hair

Wavy Hair

Extra Wavy Hair

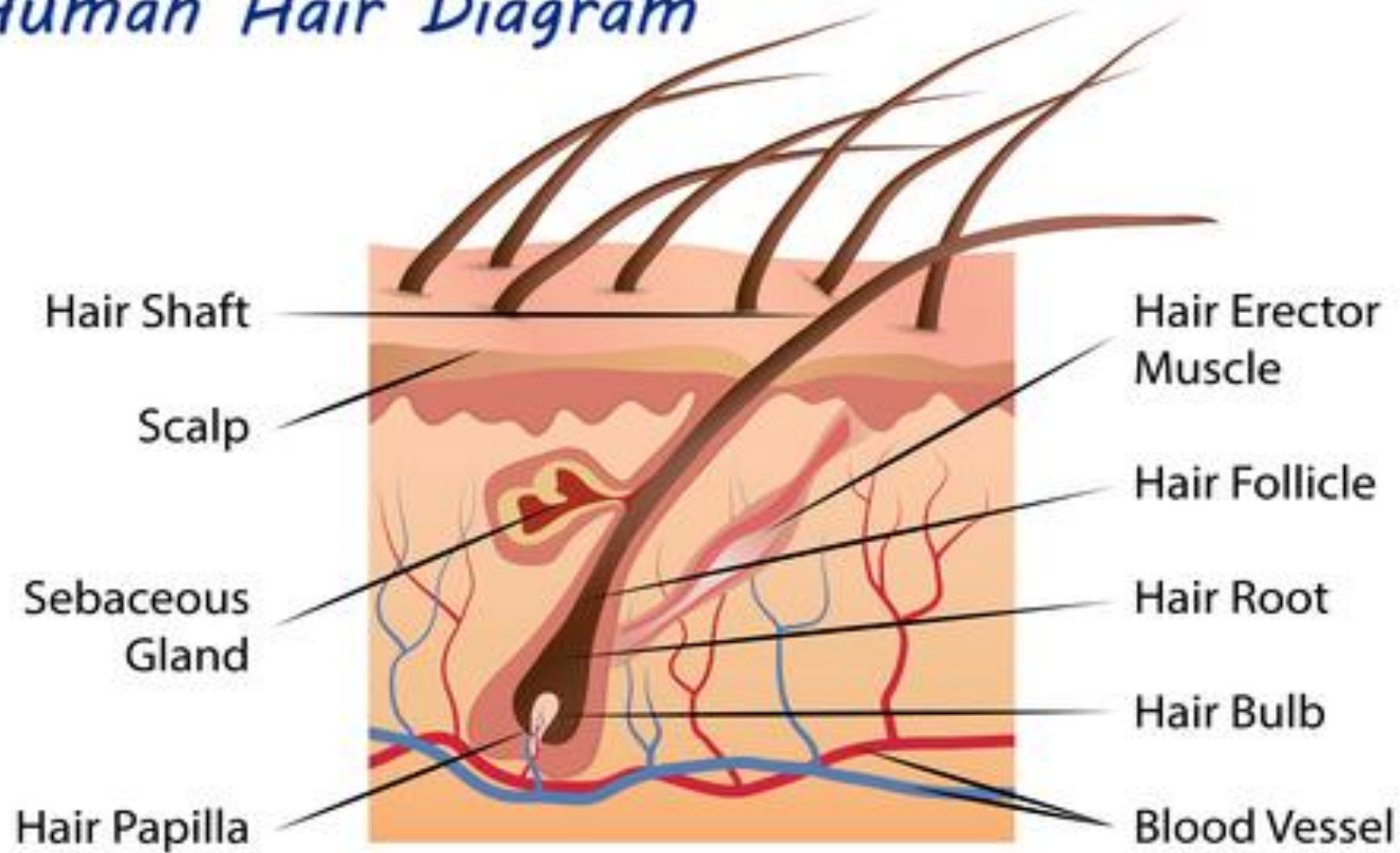


# CHARACTERISTICS OF HAIR:

- ▶ In describing hair, we usually speak of its texture, elasticity, porosity, and density:
  - 1) Texture: The texture of hair may be coarse, medium, fine, or very fine. This is usually determined by the diameter of the hairs.
  - 2) Porosity: It refers to the ability of the hair to absorb moisture. Hair that is very porous takes less time to treat than does less porous hair.
  - 3) Elasticity: It refers to the ability of hair to stretch beyond its normal length and then spring back.
  - 4) Density: It refers to the amount of hair per square inch on the scalp. The hair are said to be thin, medium or thick depending upon how much hair there is.

# STRUCTURE OF HAIR:

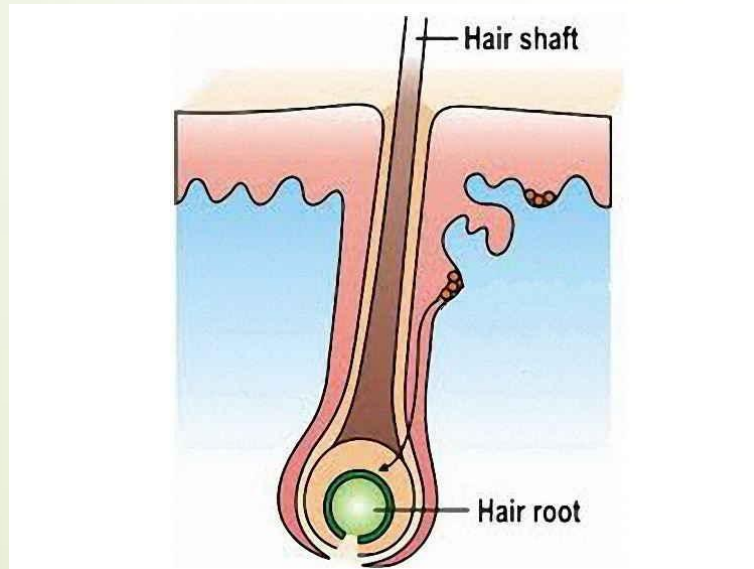
*Human Hair Diagram*





# DIVISION OF HAIR:

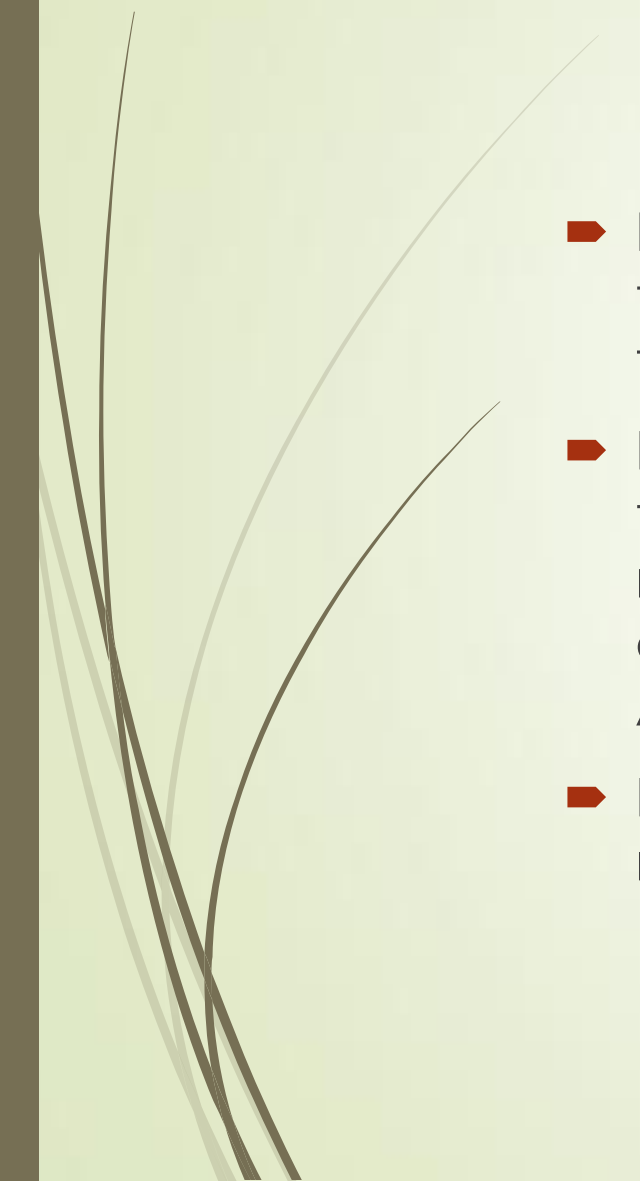
- ▶ There are two main divisions of Hair-
- 1. Hair Root: It is that portion of the hair structure located beneath the skin surface. This is the portion of the hair enclosed within the follicle.
- 2. Hair Shaft: It is that portion of the hair structure extending above the skin surface.





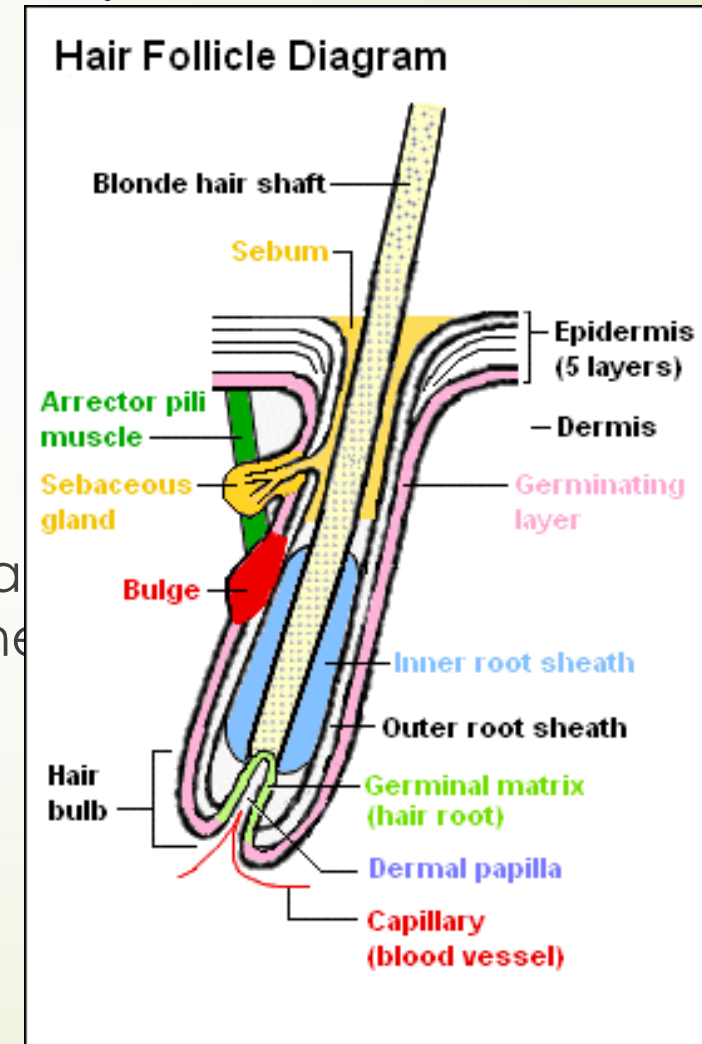


# STRUCTURE ASSOCIATED WITH HAIR ROOT:

- Hair Follicle: It is a tiny tube-like structure in the skin which is like a test tube that holds the hair root. Every hair on your body has its own follicle.
  - Papilla: It is found at the base of the follicle. It is well supplied with the blood vessels and nerves. It is through the Papilla that nourishment reaches the Hair Bulb. Papilla contributes to the growth and regeneration of Hair and it has the ability to produce hair cells. As long as the Papilla functions, the hair will grow.
  - Hair Bulb: It lies just above the papilla and fits over it tightly and is nourished by the papilla.
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# STRUCTURE ASSOCIATED WITH HAIR FOLLICLE:

- **Arrector Pili Muscle:** It is a small involuntary muscle attached to the underside of Hair Follicle. Fear or cold contracts it causing the hair to stand up straight giving the skin the appearance of “gooseflesh”.
- **Sebaceous Gland:** It consists of little sacular structures situated in Dermis. Their ducts are connected to hair secretion of oily substance. Sebum gives luster and pliability to the hair and keeps the skin soft and supple.



# LAYERS OF HAIR SHAFT

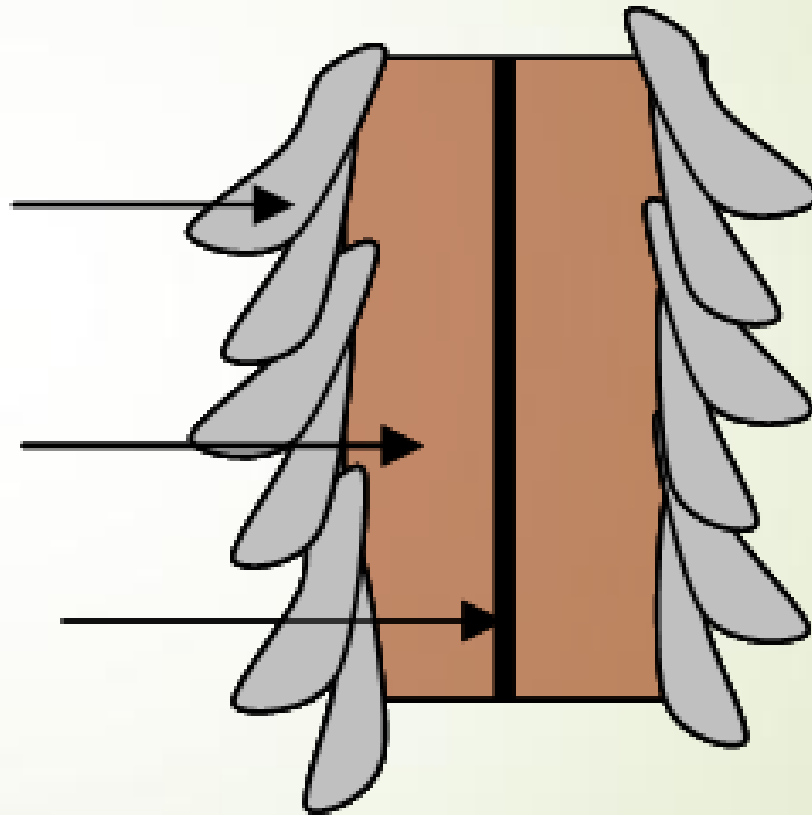
**Outer covering  
(protective shell)**

**cuticle**

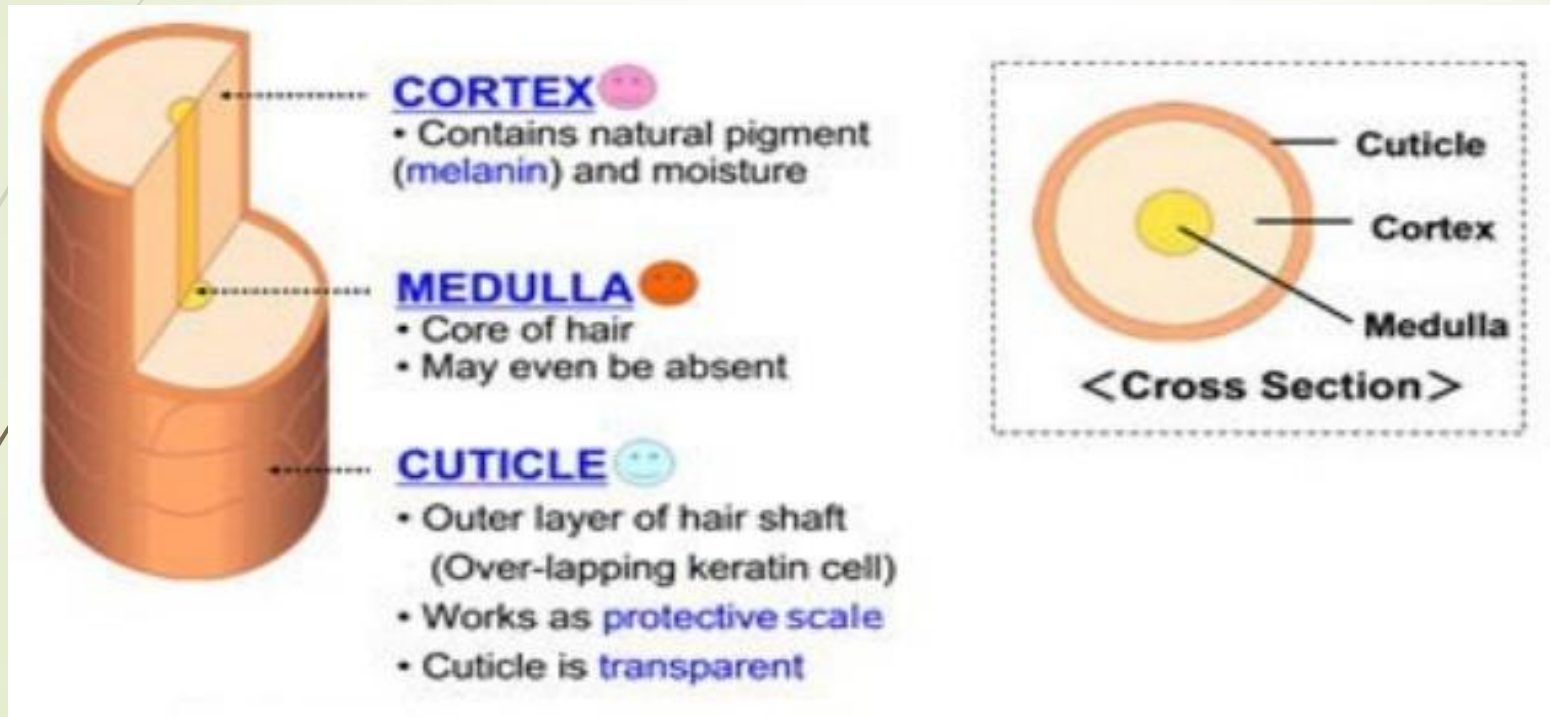
**cortex**

**Inner hair shaft  
(strength)**

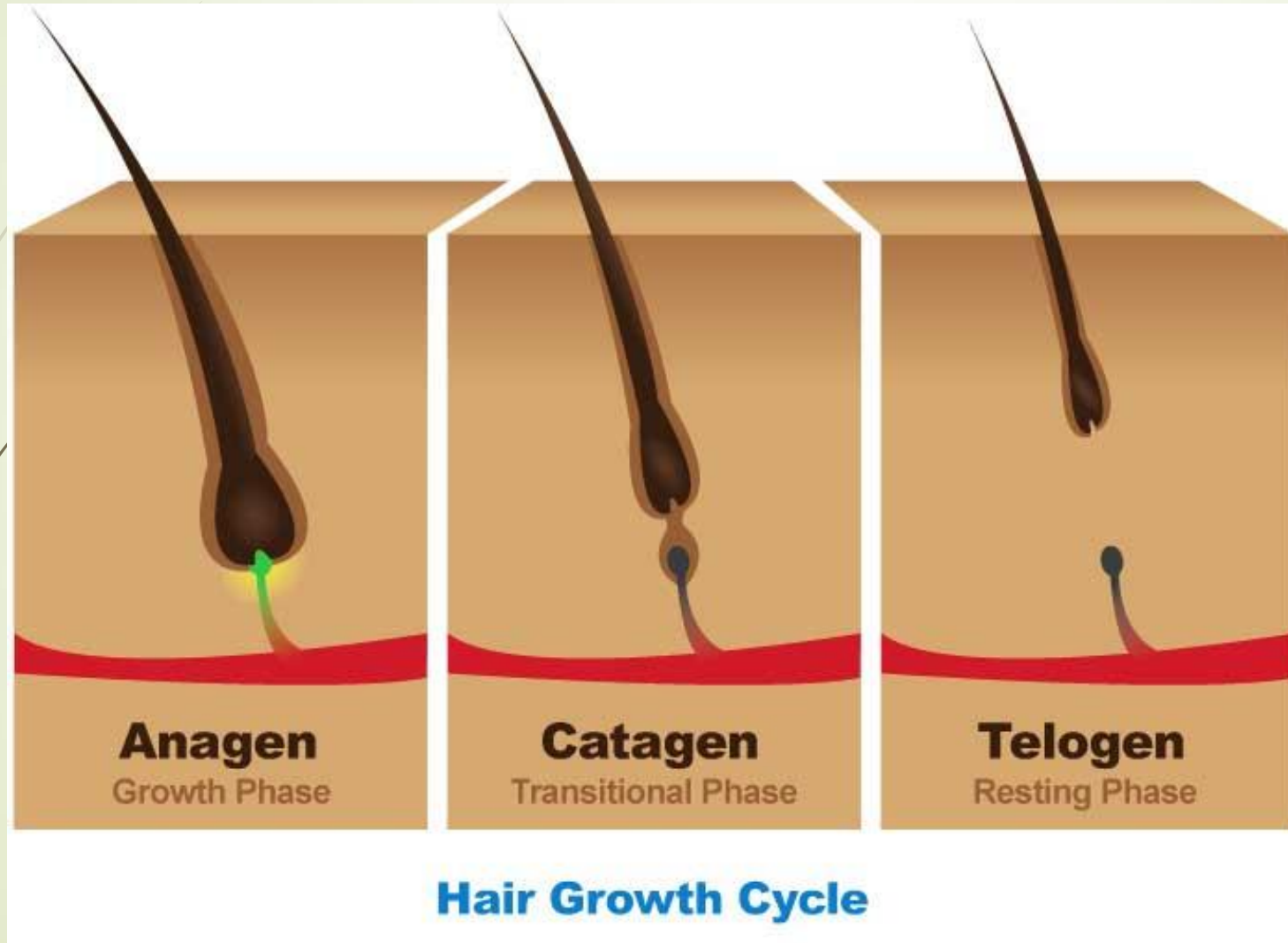
**medulla**



# CUTICLE, CORTEX AND MEDULLA:




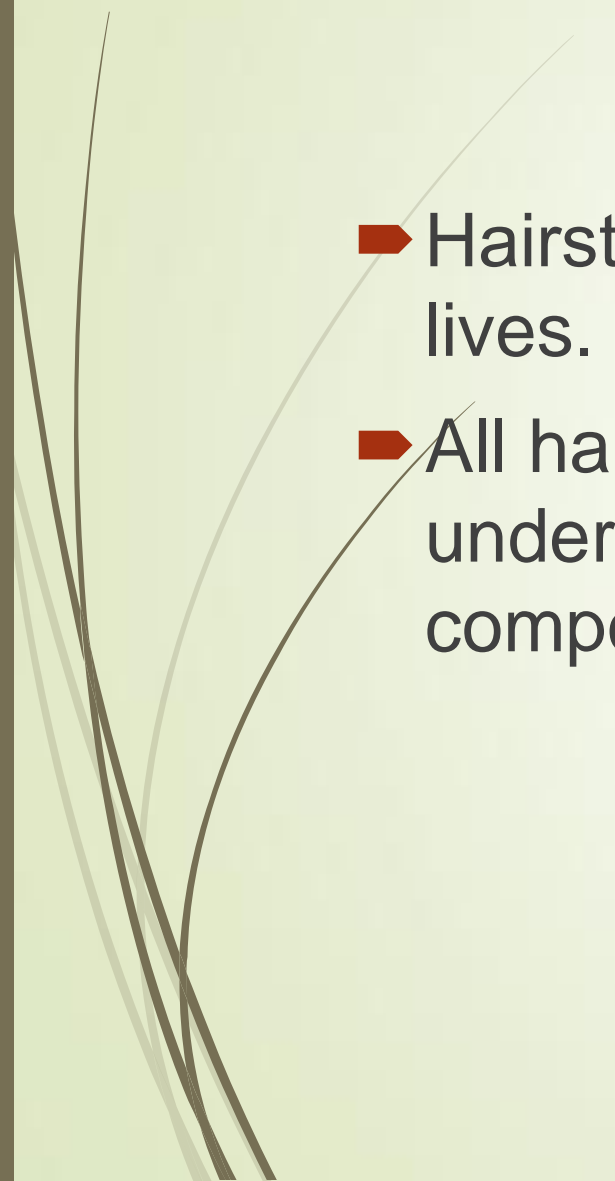
# HAIR GROWTH AND



# STAGES OF GROWTH CYCLE:

- Scalp hair growth follows a cycle which has three stages:
  1. Anagen: It is the first stage known as Active stage because hair grows actively in this stage. In this phase, scalp continues to grow anywhere from 2-6 years.
  2. Catagen: At the end of anagen stage, hair growth slows down, the follicle shrinks, the bulb thickens and slightly lifts from the papilla. This stage is also called Transitional stage.
  3. Telogen: This is the last stage which is also called resting phase. In this stage, papilla goes for rest for about 3 months and this stage ends when a new hair forming from the papilla pushes the old hair up and out. In this stage old hair is replaced by new hair. That's why this stage is also called Replacement stage.

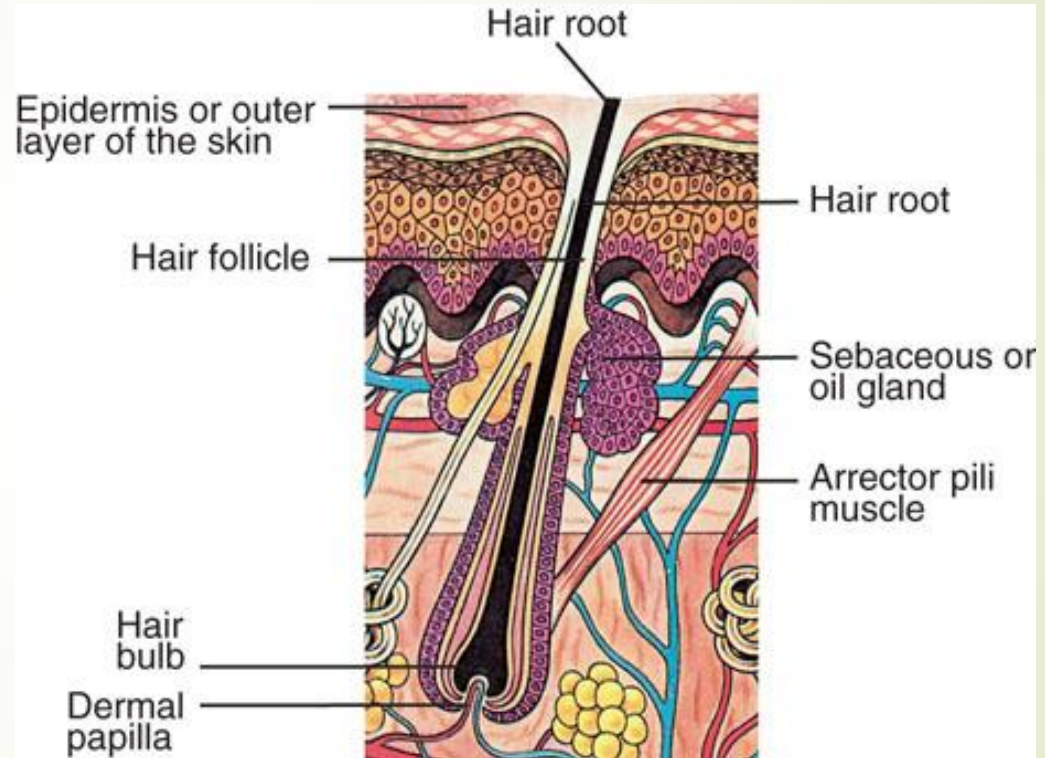
HENCE THE CYCLE IS REPEATED AGAIN!

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- Hairstylists play an important role in many people's lives.
  - All hair services must be based on a thorough understanding of the growth, structure, and composition of hair.




# Structures of the Hair Root

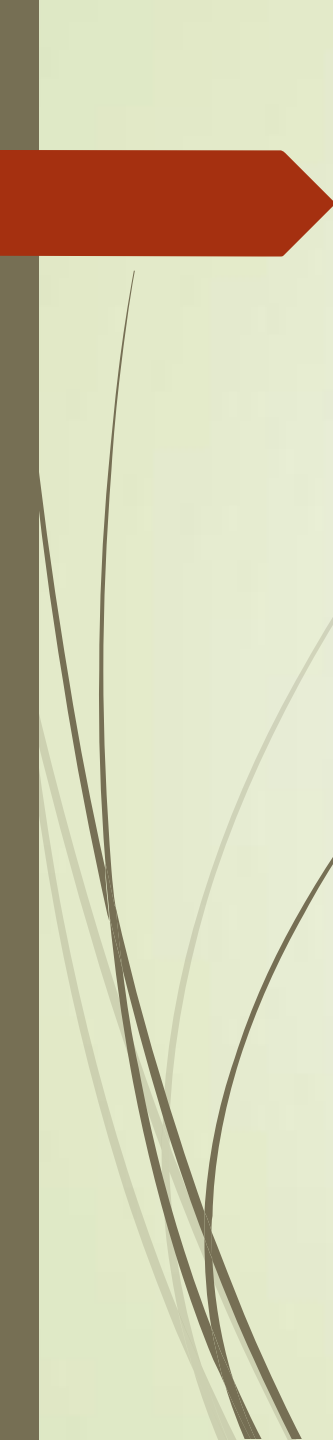
- **Hair follicle**
  - Distribution
  - Growth
- **Hair bulb**
- **Dermal papilla**
- **Arrector pili muscle**
- **Sebaceous glands**

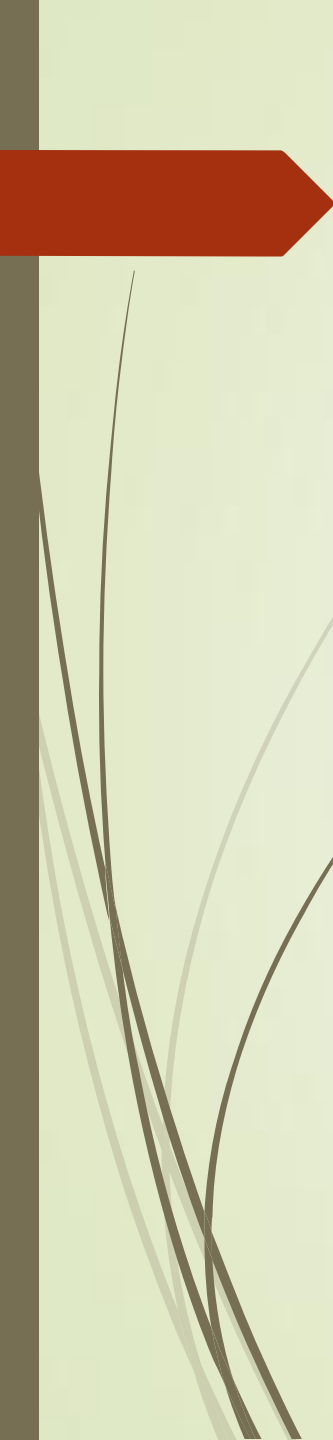




## STRUCTURES OF THE HAIR ROOT

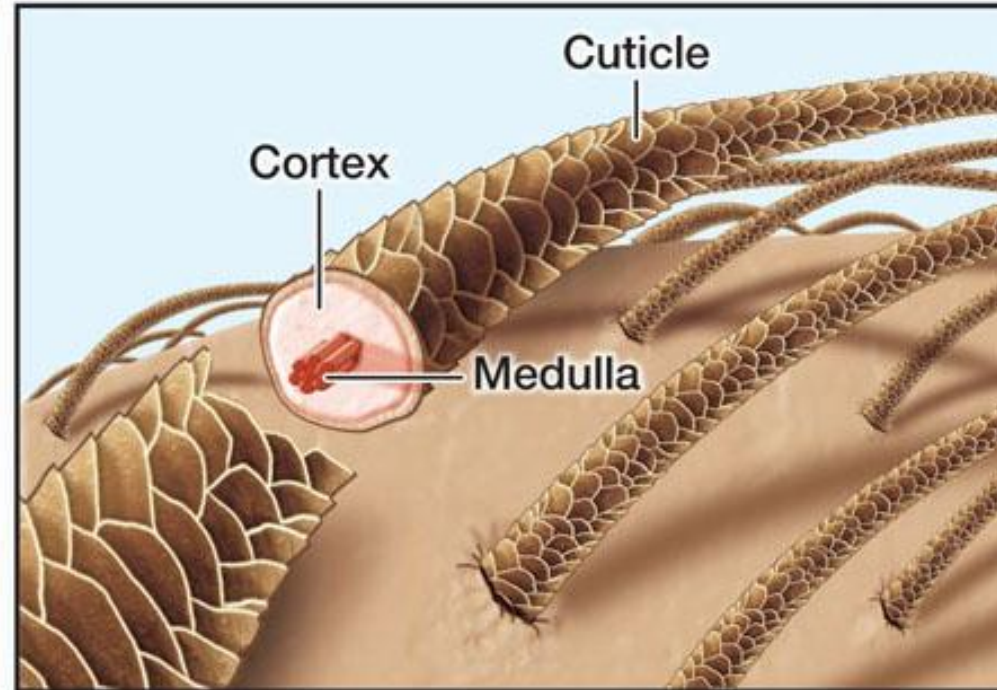
- **Hair follicle:** The hair follicle is the tube-like depression or pocket in the skin or scalp that contains the hair root. Hair follicles are distributed all over the body, with the exceptions of the palms of the hands and the soles of the feet. The follicle extends downward from the epidermis into the dermis (the inner layer of skin), where it surrounds the dermal papilla. Sometimes more than one hair will grow from a single follicle.
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- **Hair bulb:** The lowest area or part of a hair strand, it is the thickened, club-shaped structure that forms the lower part of the hair root. The lower part of the bulb fits over and covers the dermal papilla.
  - **Dermal papilla:** A small, cone-shaped elevation located at the base of the hair follicle that fits into the hair bulb; it contains the blood and nerve supply that provides the nutrients needed for growth.

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- **Arrector pili muscle:** These are minute, involuntary muscle fibers in the skin inserted in the base of the hair follicle. Fear or cold causes them to contract, which makes the hair stand up straight, resulting in goose bumps.
  - **Sebaceous glands:** These are the oil glands of the skin and are connected to the hair follicles. The **sebaceous** glands secrete an oily substance called **sebum**, which lubricates the hair and skin.

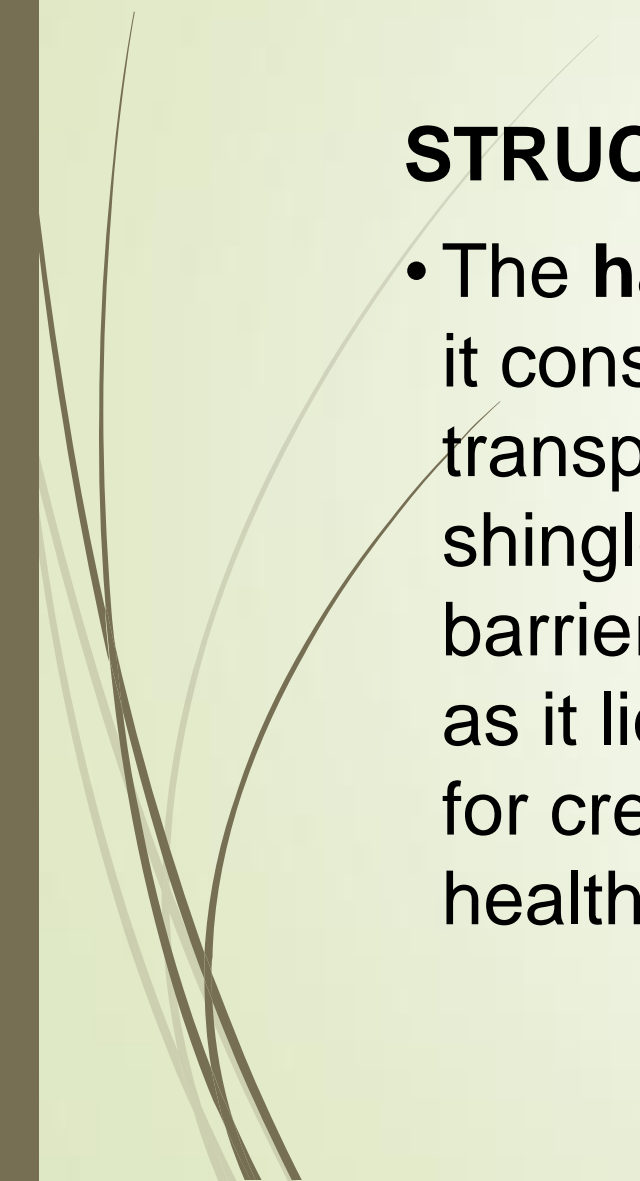
# Structures of the Hair Shaft


- Hair cuticle
- Cortex
- Medulla





## STRUCTURES OF THE HAIR SHAFT

- The **hair cuticle** is the outermost layer of the hair; it consists of a single, overlapping layer of transparent, scale-like cells that overlap like shingles on a roof. The cuticle layer provides a barrier that protects the inner structure of the hair as it lies tightly against the cortex. It is responsible for creating the shine and the smooth, silky feel of healthy hair.
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- The **cortex** is the middle layer of hair; it is a fibrous protein core formed by elongated cells containing melanin pigment. About 90 percent of hair weight comes from the cortex. Protein structures located in the cortex provide hair elasticity. Changes resulting from chemical services occur in the cortex.
  - The **medulla** is the innermost layer. It is composed of round cells. Very fine and naturally blond hair may not even have a medulla. Thick coarse hair and beard hair always contain a medulla. The medulla is not involved in salon services.



## Learn About the Chemical Composition of Hair

- Hair is approximately 90 percent protein.
- The protein is made up of long chains of amino acids, which, in turn, are made up of elements.
- The major elements that make up human hair are carbon, oxygen, hydrogen, nitrogen, and sulfur and are often referred to as the **COHNS elements**.
- These five elements are also found in skin and nails.

## COHNS Elements

- Carbon – 51 percent
- Oxygen – 21 percent
- Hydrogen – 6 percent
- Nitrogen – 17 percent
- Sulfur – 5 percent

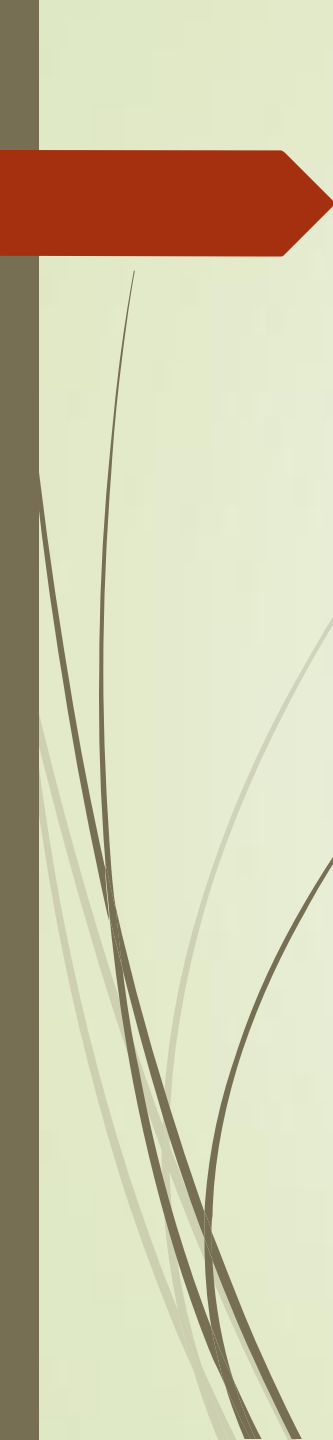
# Keratinization

- **Keratinization** – --maturing process of living cells that originate within the hair follicle.
- As these newly formed cells mature, they fill up with a fibrous protein called **keratin**.



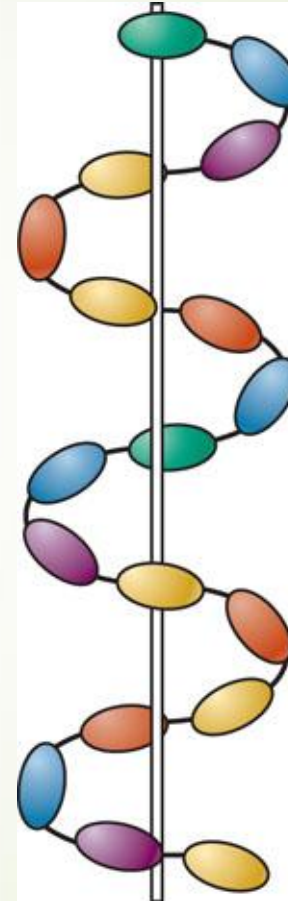
## KERATINIZATION

- Hair is composed of protein that grows from cells originating within the hair follicle. This is where the hair begins. As soon as these living cells form, they begin their journey upward through the hair follicle. They mature in a process called **keratinization**.

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- As these newly formed cells mature, they fill up with a fibrous protein called **keratin**. After they have filled with keratin, the cells move upward, lose their nucleus, and die. By the time the hair shaft emerges from the scalp, the cells of the hair are completely keratinized and are no longer living. The hair shaft that emerges is a nonliving fiber composed of keratinized protein.

# Amino Acids

- Linked like pop beads
- Peptide or end bonds
- Polypeptide chain
- Helix



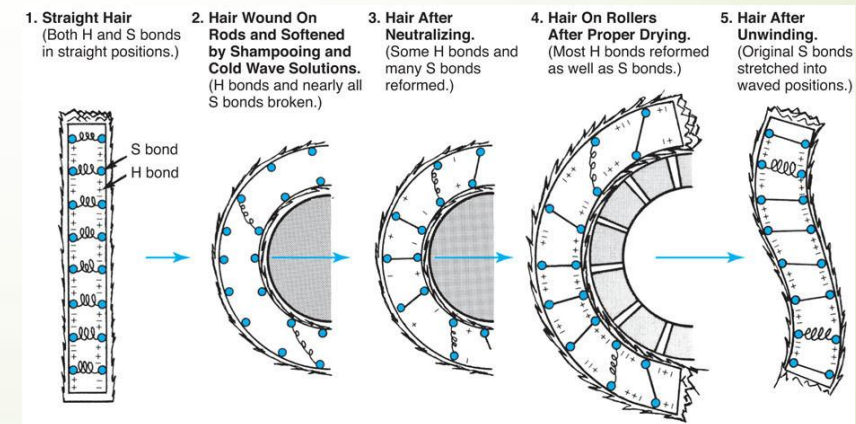
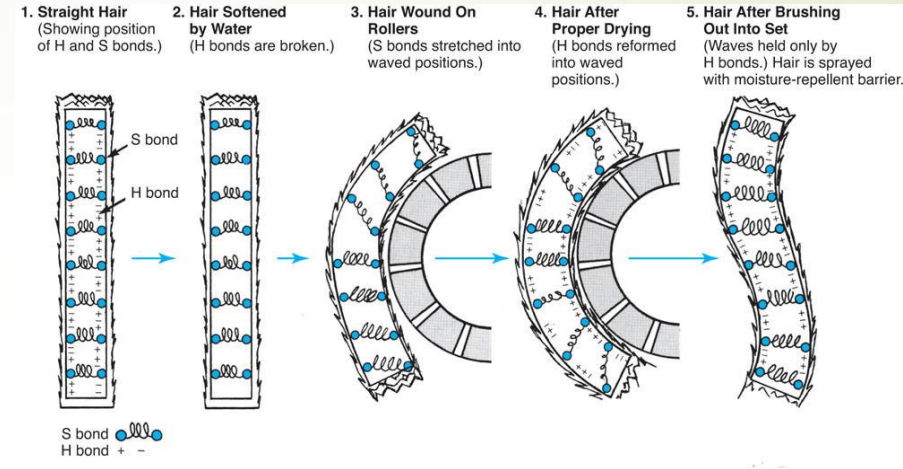
# Side Bonds of the Cortex

➔ Hydrogen bonds

➔ Salt bonds

➔ Disulfide bonds


➔ Lanthionine bonds

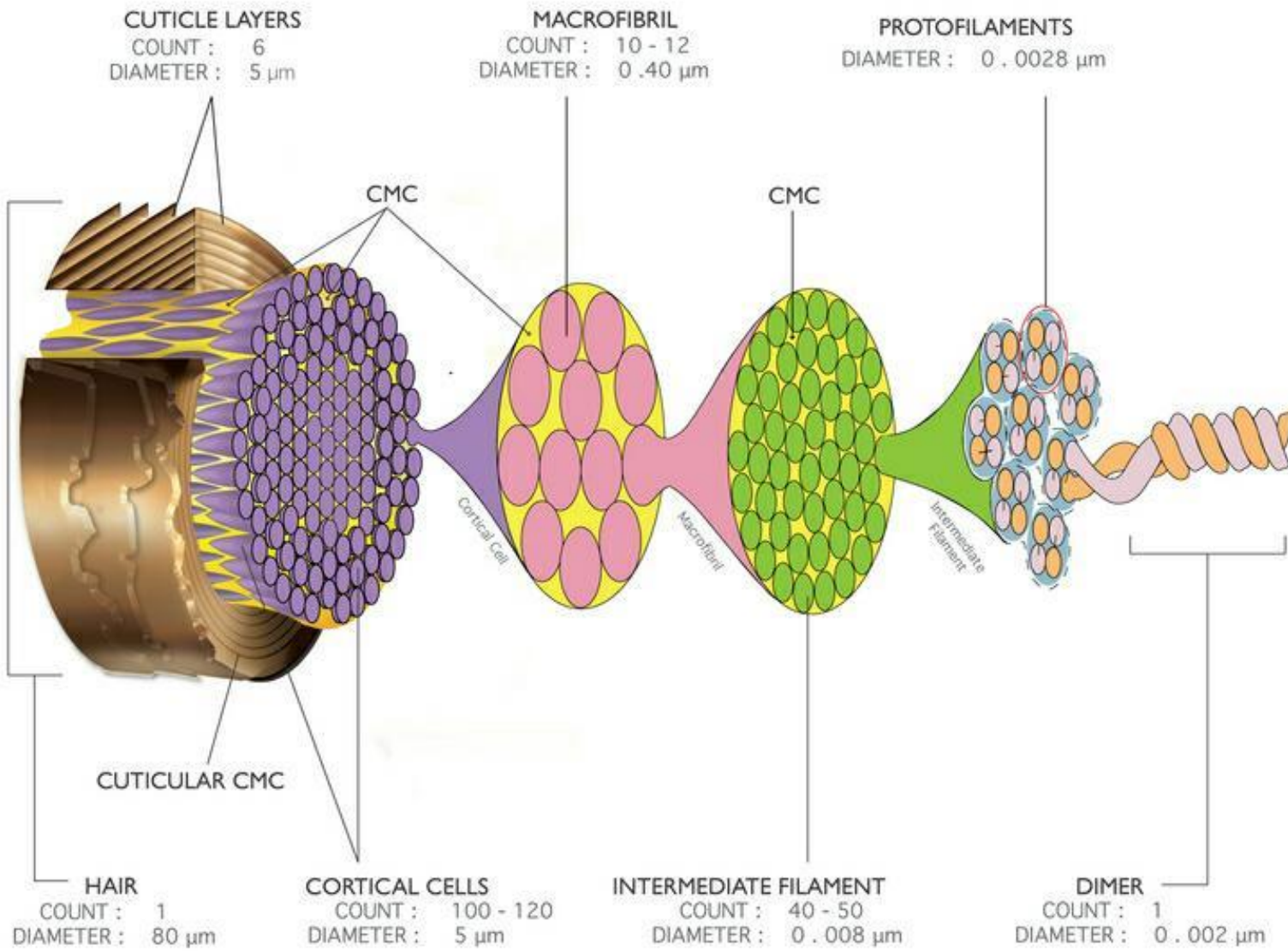


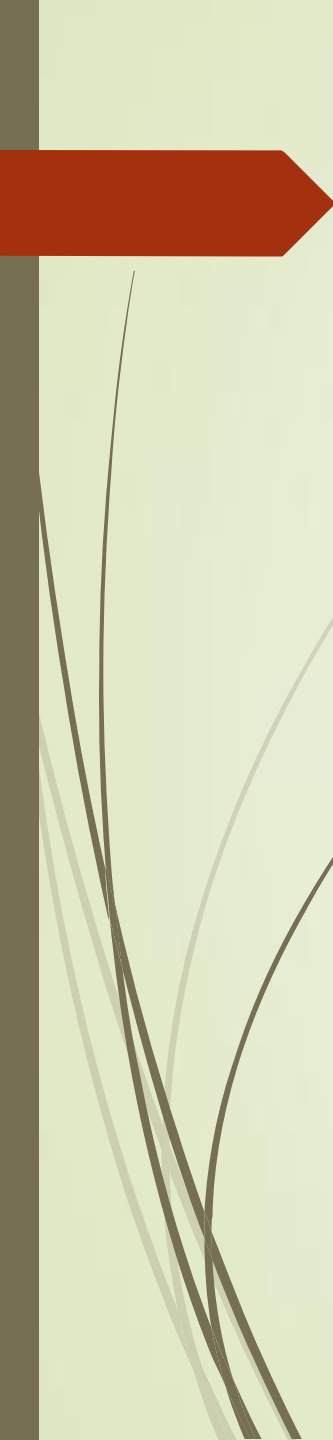


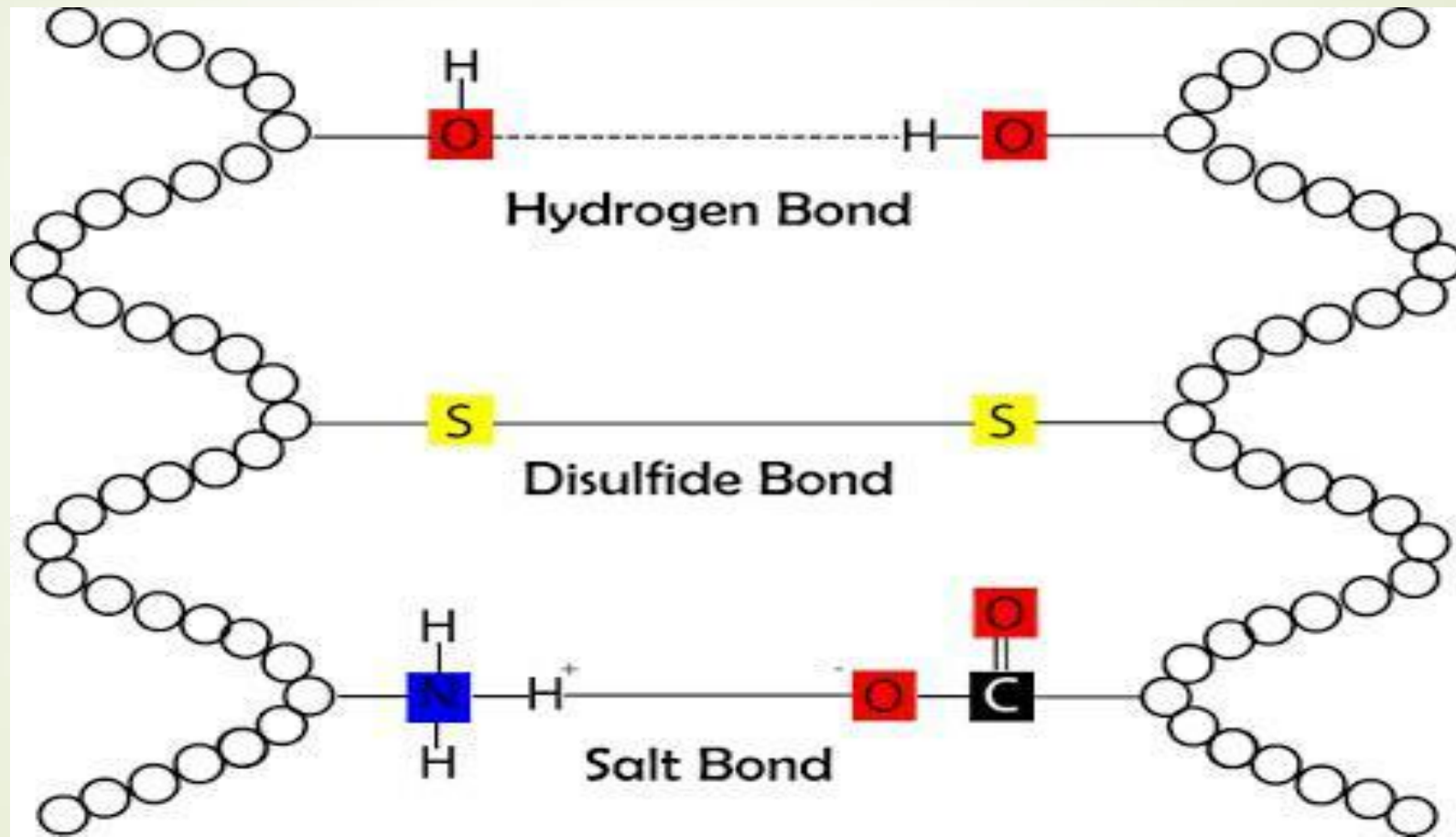


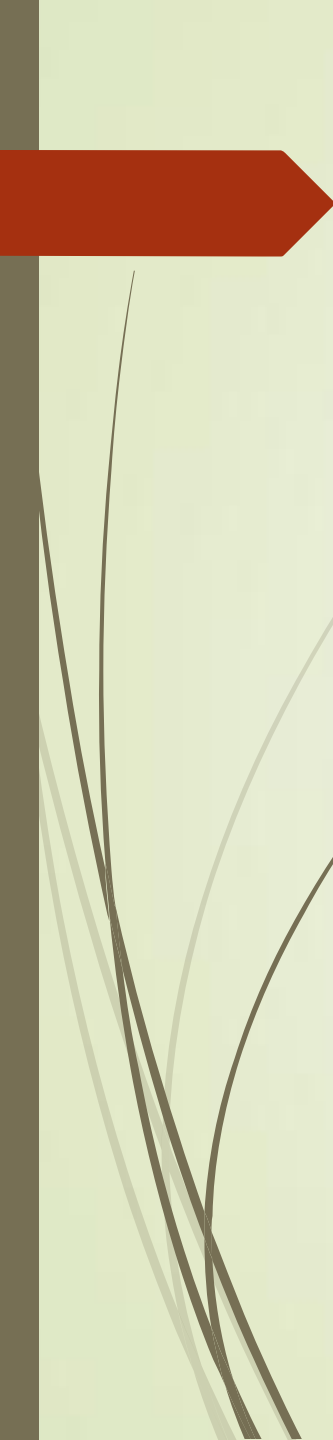
## **SIDE BONDS OF THE CORTEX**

- The cortex is made up of millions of polypeptide chains.
  - Polypeptide chains are cross-linked like the rungs on a ladder by three different types of side bonds that link the polypeptide chains together and are responsible for the extreme strength and elasticity of human hair.
  - They are essential to services such as wet setting, thermal styling, permanent waving, and chemical hair relaxing.
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- The three types of side bonds are hydrogen, salt, and disulfide bonds.
  - A **hydrogen bond** is a weak, physical, cross-link side bond that is easily broken by water or heat. They are weak individually, but because there are so many, they account for about one-third of the hair's strength.
  - A **salt bond** is another weak, cross-link side bond that can be broken by changes in pH. They are easily broken by strong alkaline or acidic solutions and account for about one-third of the hair's overall strength.



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- **Disulfide bond:** A strong, chemical side bond that joins the sulfur atoms of two neighboring **cysteine** amino acids to create **cystine**. The cystine joins together two polypeptide strands. Although there are far fewer disulfide bonds than hydrogen or salt bonds, disulfide bonds are so much stronger that they also account for about one-third of the hair's overall strength. Disulfide bonds are not broken by water. They are broken by permanent waves and chemical hair relaxers that alter the shape of hair.
  - **Lanthionine bonds:** The bond that occurs from hydroxide chemicals relaxing the hair and breaking the disulfide bonds.