A scanning electron micrograph (SEM) showing a dense array of hair shafts. The shafts are cylindrical and have a scaly, overlapping surface texture. They are arranged in a regular, grid-like pattern, with some shafts in the foreground being more prominent than others in the background. The background is dark, and there are some small, bright, out-of-focus spots.

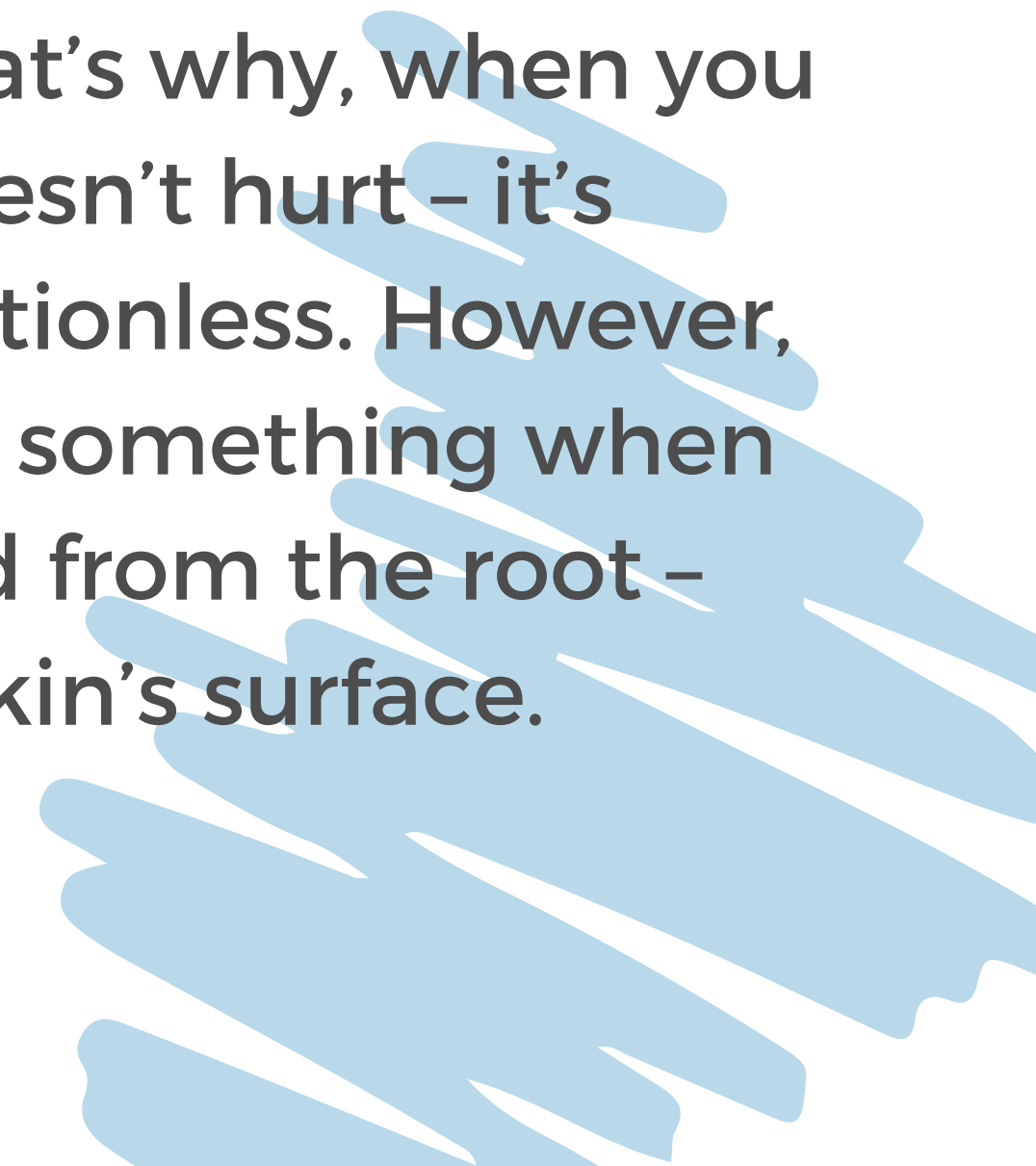
AP ACADEMY PRESENTS

Module 2 : Lesson 1

The Structure of Hair

Did You Know?

Did you know that the **fibers of hair** that we find all over our bodies **are actually dead cells**? The hair that we see is comprised of **dead protein called keratin**. That's why, when you cut hair, it doesn't hurt – it's completely sensationless. However, we definitely feel something when hair is extracted from the root – below the skin's surface.

A series of overlapping, diagonal blue brushstrokes of varying lengths and thicknesses, located in the bottom right corner of the slide, extending from the text area towards the bottom edge.

The underlying structure of hair can be divided into two parts, the **follicle** and **shaft**. The **shaft is comprised of the dead keratin cells**. It is the part that we can see and touch. The root of the hair shaft is housed inside of the **follicle – a small cavity of cells and connective tissues below the surface of the skin that anchors the hair shaft in place**.

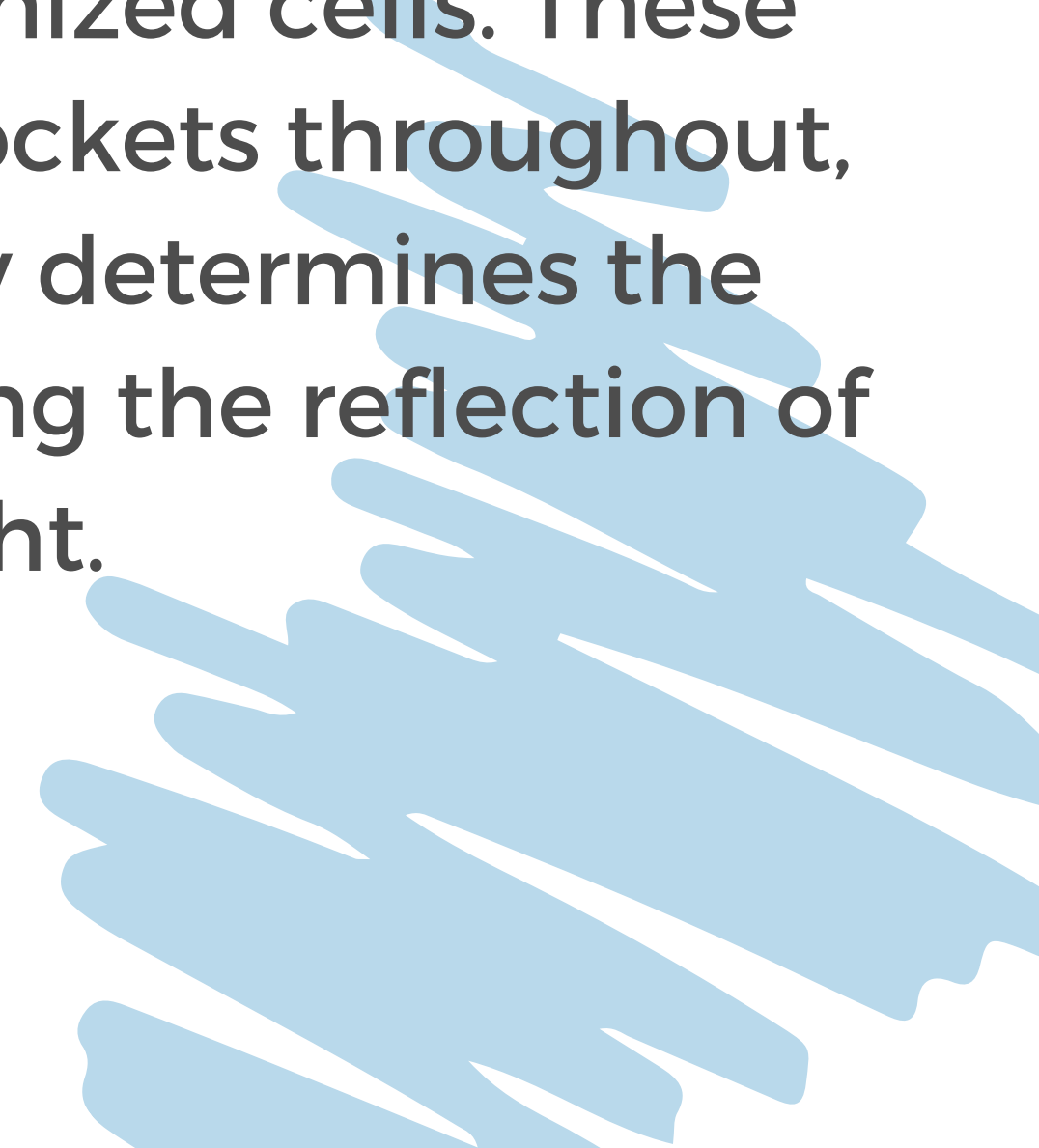
Let's look at the **shaft** first. **The shaft consists of three concentric layers.**

That is, you can envision them as three circles, each with the same center. The largest circle, or outermost layer, is the cuticle.

Encased within the cuticle is a smaller circle called the cortex, and within the cortex lies the innermost layer called the medulla.

The cuticle – the outermost layer – contains transparent keratin cells that overlap each other to protect the inner layers of the hair – the cortex and medulla. **The cortex is the largest part of the hair shaft** and is also comprised of elongated, keratinized cells that contain melanin, a pigment that gives hair its color and also determines your skin complexion. **The more melanin the hair or skin contains, the darker it will be.** For instance, people with blond and gray hair lack melanin.

Finally, the **innermost layer** of the hair shaft is the **medulla**, which is composed of large and loosely connected keratinized cells. These cells contain air pockets throughout, which ultimately determines the sheen by influencing the reflection of light.

A series of overlapping, diagonal blue brushstrokes located in the bottom right corner of the page, extending from the right edge towards the center.



Now, let's move onto the structure of the **hair follicle**, a dynamic organ whose function is to grow the hair. This tiny structure is actually quite complex and multifaceted. The follicle can be seen as a tube whose bottom is slightly larger. It is **housed in the epidermal** – or outermost layer – of the skin. Rather than entering the skin straight down, **the follicles enter at different angles**. The follicle contains the following structures:

- The Outer Root Sheath
- Inner Root Sheath
- Hair Bulb
- Dermal Papilla

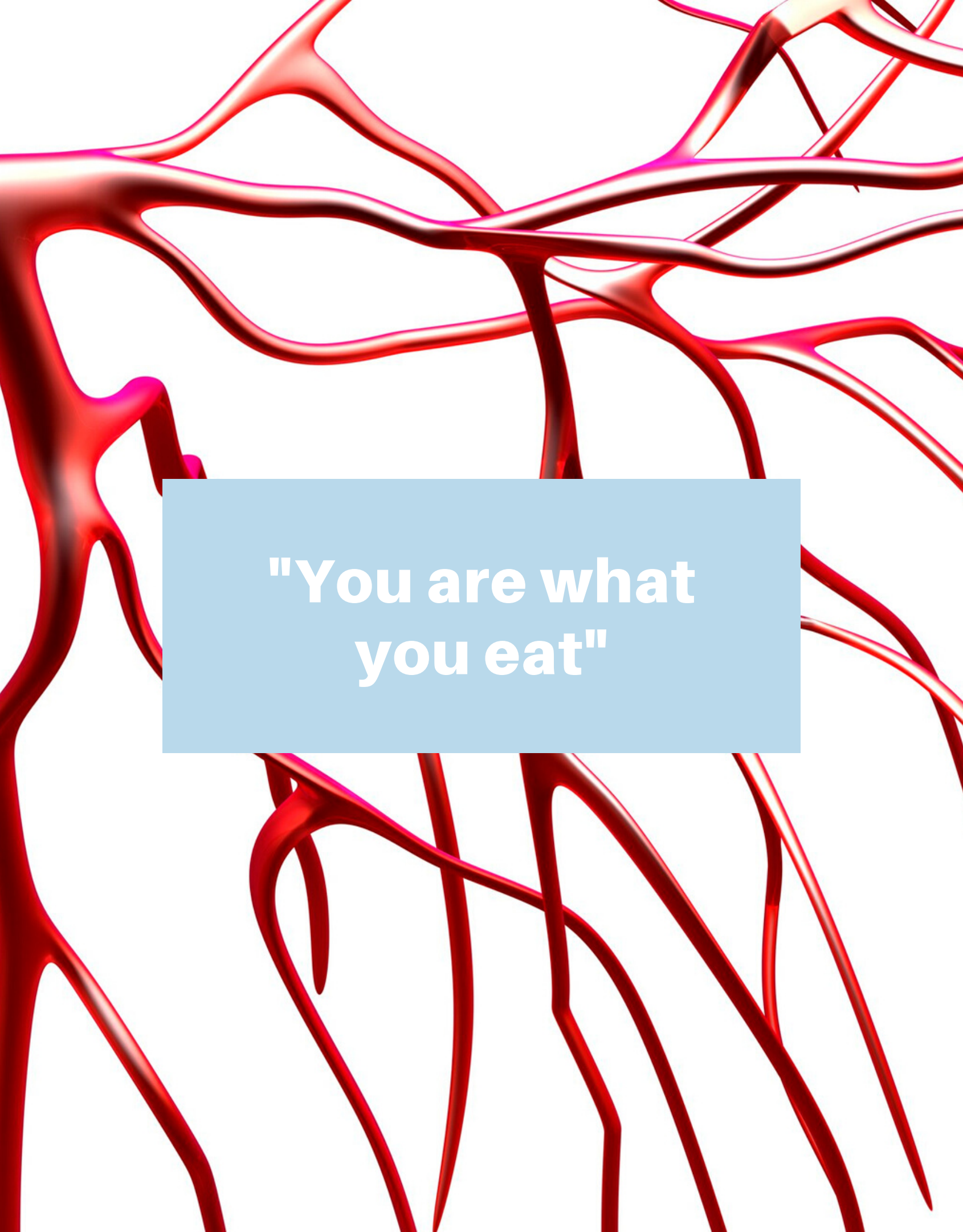
The Outer Root Sheath, or “ORS”, of the hair follicle encloses the hair fiber and inner root sheath. It is continuous with the outer basal layer of the skin that we see, which is called the stratum corneum or “Horny Layer”. In other words, the outermost layer of the skin extends downwards to become the ORS. While the upper part of the ORS is keratinized, the lower part isn't. **The ORS has the important functions of conveying sensory information to the brain and acting as a watchdog for the skin's immune system, allowing it to resist infections from pathogens.**

As mentioned, the **Inner Root Sheath, or “IRS”**, is enclosed by the outer root sheath. It only reaches about two-thirds of the follicle’s length, ending near the sebaceous glands, or “oil ducts”, that are closer to the follicle base. Unlike the ORS, **the IRS will never keratinize.**

The **hair bulb** is the **largest part of the hair follicle** and can be found at the very bottom of the follicle base. It looks like an egg-shaped cavity that is filled with loose, connective tissue called the dermal papilla. From the base of the bulb, the hair and IRS begin growing upwards towards the outer skin. Also attached to the base of the follicle is the **dermal papilla, which nourishes the bulb, producing new growth at a rapid rate.**

Now, attached to the underside of each hair follicle lies a structure that is **responsible for producing goosebumps** – **the arrector pili muscle**. These muscles contract to pull the hair to an upright, vertical position whenever you're feeling cold or scared. As mentioned earlier, the follicle has sebaceous glands, or oil ducts located on each side. These ducts secrete oil to lubricate the hair and skin, keeping them healthy. But when the sebaceous glands are overactive, you can run into problems like acne or oily hair.



A detailed illustration of a network of red blood vessels, showing various sizes and branching patterns, set against a white background. The vessels have a glossy, three-dimensional appearance.

**"You are what
you eat"**

Blood vessels are also necessary to keep the hair and skin healthy. They transport the vitamins, minerals, and nutrients needed for strong and healthy hair straight to the follicles. **As the saying goes, “You are what you eat”.**

The hair shaft and follicle, as small as they might seem, are clearly quite complex and have many important functions. **In the next lesson, we’re going to study the way hair grows.**