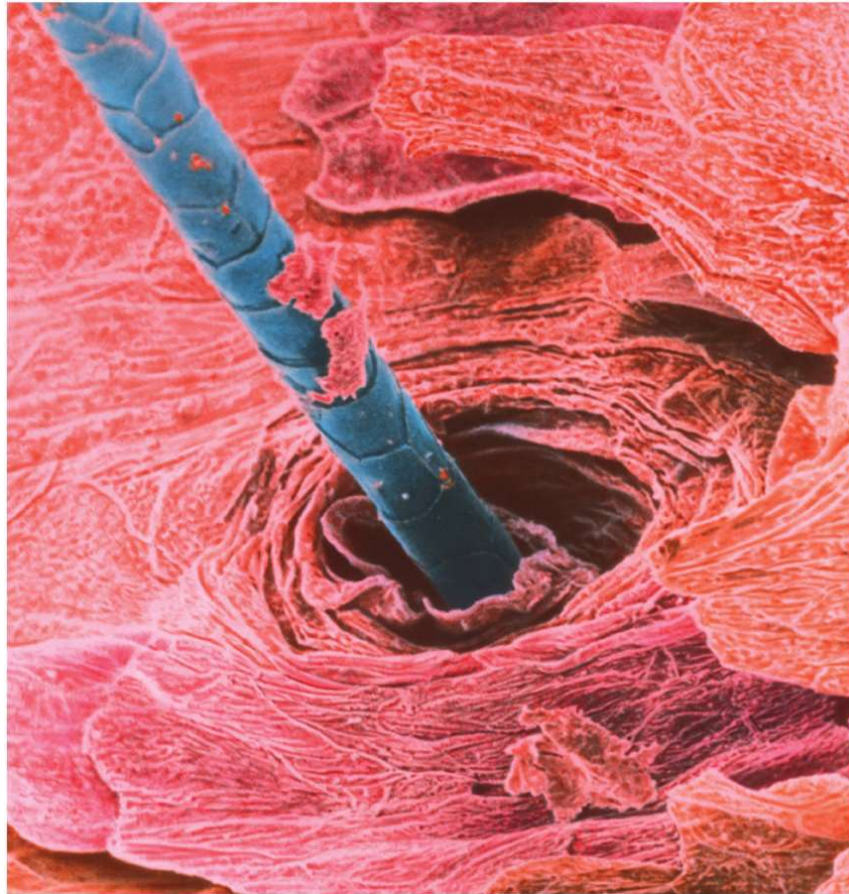


## Chapter 5.4

# Hair & Nails



# Hair and Nails

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- **hair, nails, and cutaneous glands** are **accessory organs of the skin**
- **hair and nails** are composed of mostly dead, keratinized cells
  - pliable **soft keratin** makes up stratum corneum of skin
  - compact **hard keratin** makes up hair and nails  
/// tougher and more compact due to numerous cross-linkages between keratin molecules

# Functions of Hair

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- most hair on trunk and limbs is vestigial
  - little present function
  - provided warmth in ancestors
- hair receptors alert us of parasites crawling on skin
- Hair on scalp helps retain heat /// scalp protects against sunburn
- gender identification
- pubic and axillary hair signify sexual maturity and aids in transmission of sexual scents
- Protection: guard hairs (vibrissae) in nostrils and ear canals /// eyelashes and eyebrows
- nonverbal communication

# Distribution of Human Hair

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- **Hair** is a slender filament of keratinized cells that grows from an oblique tube in the skin called a **hair follicle**
- Hair is found almost everywhere on the body
- Hair not found on
  - palms and soles
  - ventral and lateral surface of fingers and toes
  - distal segment of the finger
  - lips, nipples, and parts of genitals
- Limbs and trunk have 55 – 70 hairs per cm<sup>2</sup>
  - face about 10 times as many
  - 30,000 hairs in a man's beard
  - 100,000 hairs on an average person's scalp
  - number of hairs does not differ much from person to person or even between sexes /// differences in appearance due to texture and pigmentation of the hair
- **Pilus** – another name for hair /// **pili** – plural of pilus

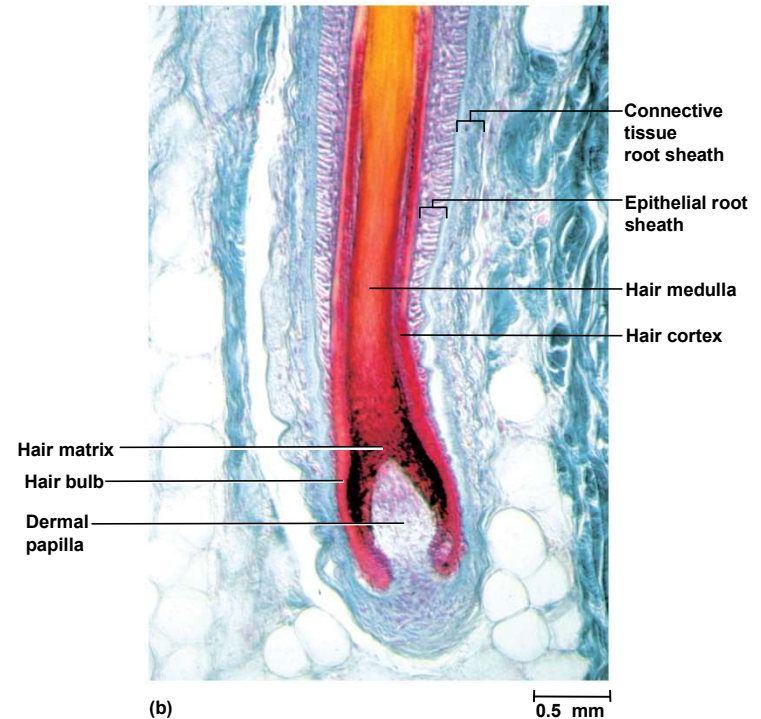
# Types of Human Hair

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- Three kinds of hair grow over the course of our lives
  - lanugo – fine, downy, unpigmented hair that appears on the fetus in the last three months of development
  - vellus – fine, pale hair that replaces lanugo by time of birth
    - two-thirds of the hair of women
    - one-tenth of the hair of men
    - all of hair of children except eyebrows, eyelashes, and hair of the scalp
  - terminal – longer, coarser, and usually more heavily pigmented
    - forms eyebrows, eyelashes, and the hair of the scalp
    - after puberty, forms the axillary and pubic hair
    - male facial hair and some of the hair on the trunk and limbs

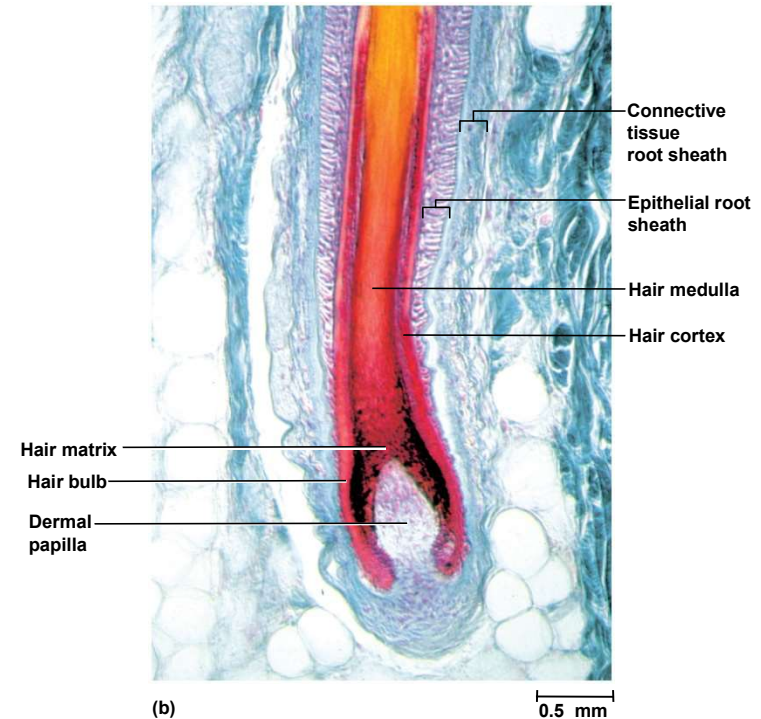
# Structure of Hair and Follicle

- Hair is divisible into three zones along its length
  - **bulb** – a swelling at the base where hair originates in dermis or hypodermis /// only living hair cells are in or near bulb
  - **root** – the remainder of the hair in the follicle
  - **shaft** – the portion above the skin surface



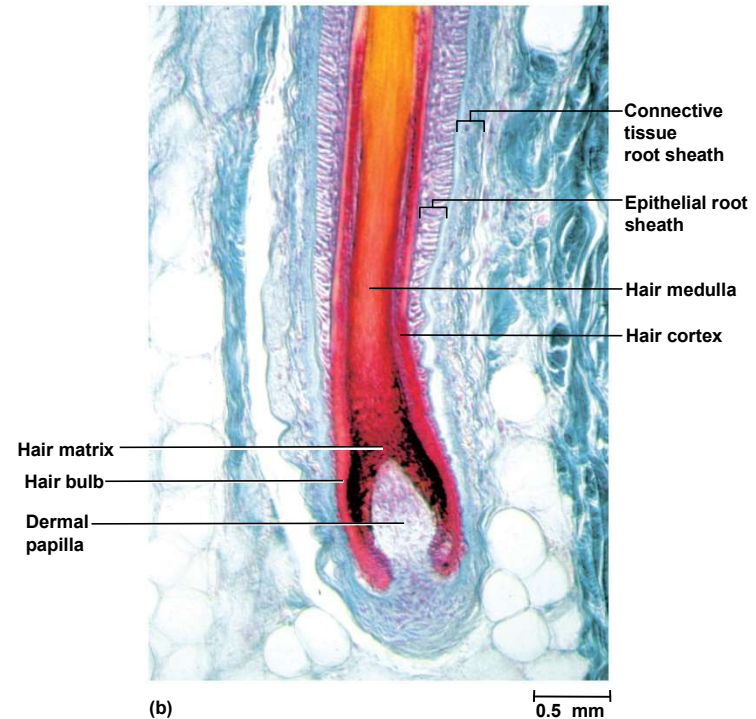
# Structure of Hair and Follicle

- **dermal papilla** – bud of vascular connective tissue encased by bulb
  - provides the hair with its sole source of nutrition
- **hair matrix** – region of mitotically active cells immediately above papilla /// hair's **growth center**



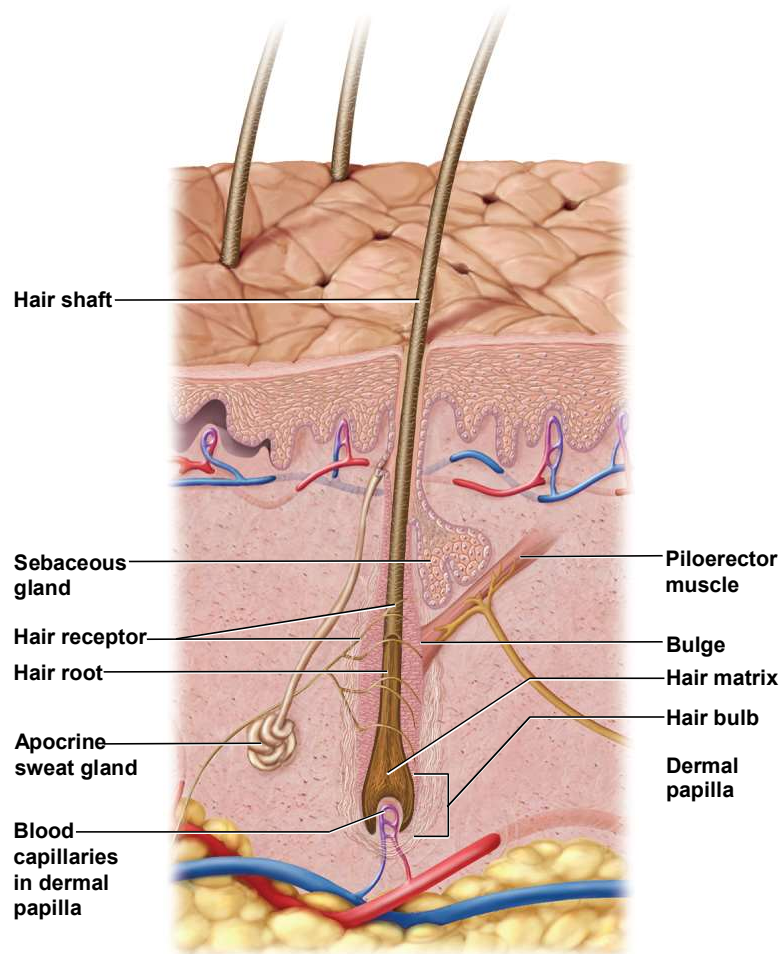
# Structure of Hair and Follicle (cont.)

- Three layers of the hair in cross-section from inside out
  - **Medulla** /// core of loosely arranged cells and air spaces
  - **Cortex** /// constitutes the bulk of the hair - consists of several layers of elongated keratinized cells
  - **Cuticle** /// composed of multiple layers of very thin, scaly cells that overlap each other - free edges directed upward





# Structure of Hair Follicle



**Hair follicle** – diagonal tube that dips deeply into dermis and may extend into hypodermis

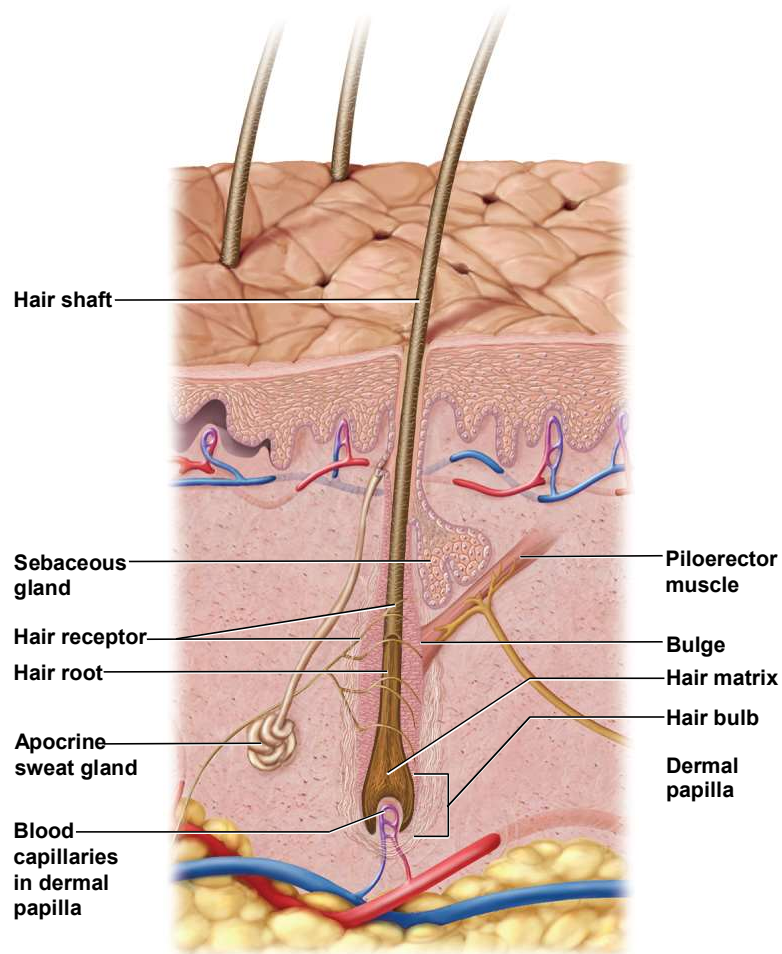
## – epithelial root sheath

- extension of the epidermis
- lies immediately adjacent to hair root
- toward deep end widens into **bulge** - a source of stem cells for follicular growth

## – connective tissue root sheath

- derived from dermis
  - surrounds epithelial root sheath
  - denser than adjacent connective tissue
-

# Structure of Hair Follicle



- **Hair receptors**
  - nerve fibers that entwine each follicle
  - respond to hair movement
- **Piloerector muscle (arrector pili)**
  - bundles of smooth muscle cells
  - extends from dermal collagen to connective tissue root sheath
  - goose bumps

# Hair Texture and Color

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- **Texture** related to differences in cross-sectional shape
  - **straight hair** is round
  - **wavy hair** is oval
  - **curly hair** is relatively flat
- **Color** due to pigment granules (eumelanin and/or pheomelanin) in the cells of the cortex
  - **brown** and **black hair** is rich in eumelanin
  - **red hair** has a slight amount of eumelanin but a high concentration of pheomelanin
  - **blond hair** has an intermediate amount of pheomelanin and very little eumelanin
  - **gray** and **white hair** results from scarcity or absence of melanin in the cortex and the presence of air in the medulla

# Hair Color and Texture



# Hair Growth and Loss

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- **Hair cycle** – consists of three developmental stages
  - **anagen** - growth stage
  - **catagen** - degenerative stage
  - **telogen** - resting stage
- Anagen - growth stage - 90% of scalp follicles at any given time
  - stem cells multiply and travel downward
  - pushing dermal papilla deeper into skin forming epidermal root sheath
  - root sheath cells directly above dermal papilla form the hair matrix
  - sheath cells transform into hair cells, synthesize keratin, and die as they are pushed upward - new hair grows up the follicle – often alongside of an old club hair from the previous cycle

# Hair Growth and Loss

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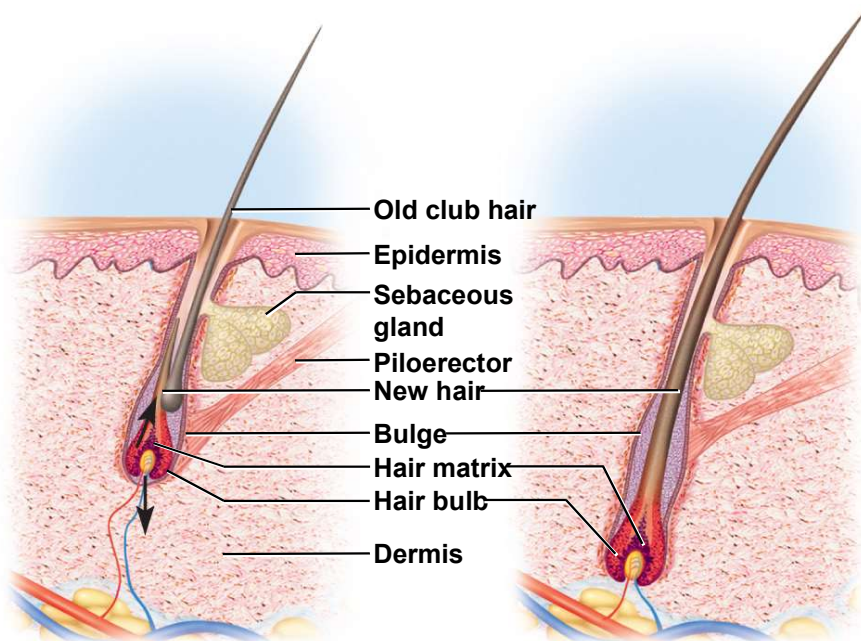
- **Catagen** - degenerative stage - mitosis in the hair matrix ceases and sheath cells below the bulge die
  - the follicle shrinks and the dermal papilla is drawn up toward the bulge
  - base of hair keratinizes into a hard club, and hair is now known as **club hair** /// loses its anchorage /// easily pulled out by brushing
- **Telogen** - resting stage - when papilla reaches the bulge

# Hair Growth and Loss

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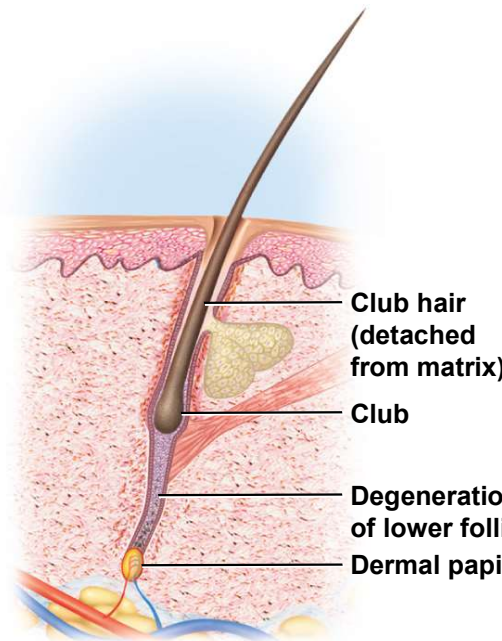
- **club hair** may fall out during catagen or telogen
  - or pushed out by new hair in the next anagen phase
- we lose about 50 – 100 scalp hairs daily
- in young adult the scalp follicles spend:
  - 6 – 8 years in anagen, 2 – 3 weeks in catagen, 1 - 2 months in telogen
- **hair growth** - scalp hairs grow at a rate of 1 mm per 3 days (10 -18 cm/yr)
- **alopecia** – thinning of the hair or baldness
- **pattern baldness** – the condition in which hair loss from specific regions of the scalp rather than thinning uniformly
  - combination of genetic and hormonal influence
  - baldness allele is dominant in males and expressed only in high testosterone levels
  - testosterone causes terminal hair in scalp to be replaced by vellus hair
- **hirsutism** – excessive or undesirable hairiness in areas that are not usually hairy

# Hair Cycle

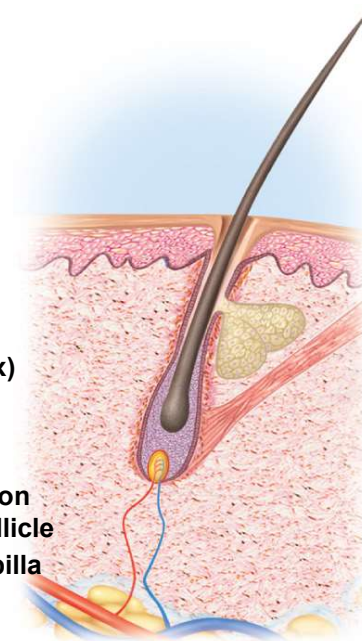


- 1 Anagen (early)**  
 (Growing phase, 6–8 years)  
 Stem cells multiply and follicle grows deeper into dermis; hair matrix cells multiply and keratinize, causing hair to grow upward; old club hair may persist temporarily alongside newly growing hair.

Anagen (mature)



- 2 Catagen**  
 (Degenerative phase, 2–3 weeks)  
 Hair growth ceases; hair bulb keratinizes and forms club hair; lower follicle degenerates.

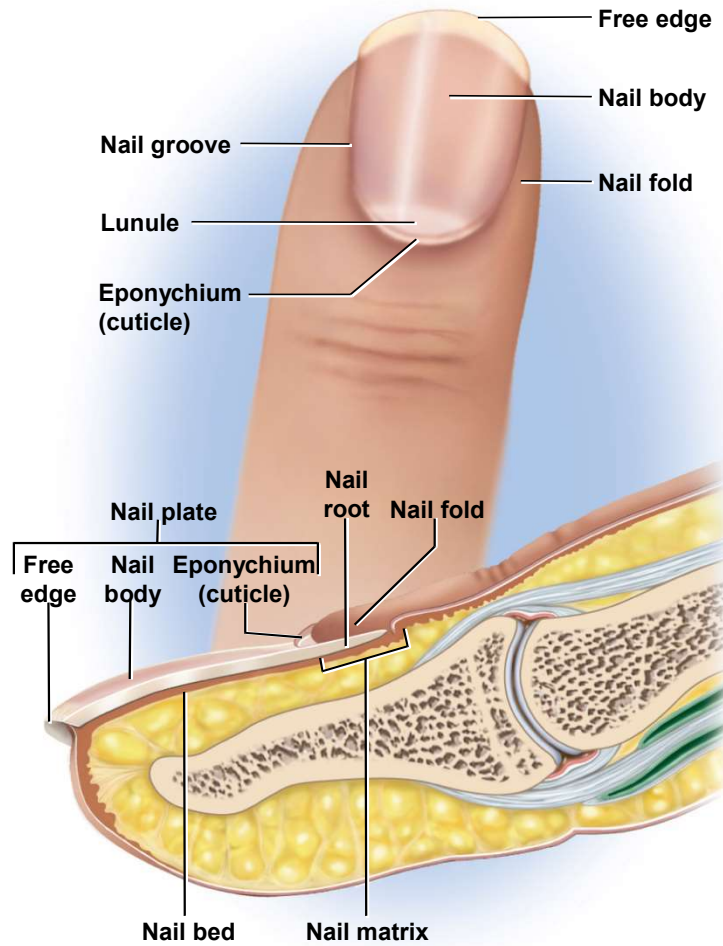


- 3 Telogen**  
 (Resting phase, 1–3 months)  
 Dermal papilla has ascended to level of bulge; club hair falls out, usually in telogen or next anagen.



# Fingernail Structure

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# Nails

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- **fingernails and toenails** - clear, hard derivatives of the stratum corneum
- composed of very thin, dead cells packed with **hard keratin**
- **flat nails** allow for more fleshy and sensitive fingertips /// tools for digging, grooming, picking apart food, and other manipulations
- **nail plate** – hard part of the nail
  - **free edge** – overhangs the finger tip
  - **nail body** – visible attached part of nail
  - **nail root** – extends proximally under overlying skin
- **nail fold** – surrounding skin rising a bit above the nail

# Nails

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- **nail groove** – separates nail fold from nail plate
- **nail bed** – skin underlying the nail plate
- **hyponychium** – epidermis of the nail bed
- **nail matrix** – growth zone of thickened stratum basale at the proximal end of nail /// mitosis here accounts for nail growth - 1 mm per week in fingernails, slightly slower on toenails
- **lunule** – an opaque white crescent at proximal end of nail
- **eponychium (cuticle)** – narrow zone of dead skin commonly