



EXOSKELETON DERIVATIVES OF MAMMALS

B.sc. 3rd Semester Zoology Hons.
BB

Integumentary System

- the word INTEGUMENT comes from a LATIN word that means “to COVER”

-the integument as an organ, and is an alternative name for skin

- SKIN and its accessories such as-the HAIR, NAILS, and a VARIETY OF GLANDS, make up the integumentary system

Functions of the integumentary system

1. Serves as a barrier against infection and injury.
2. Helps to regulate body temperature
3. Removes the waste products from the body
4. Provides protection against ultraviolet radiation from the sun.
5. Generates vitamin D

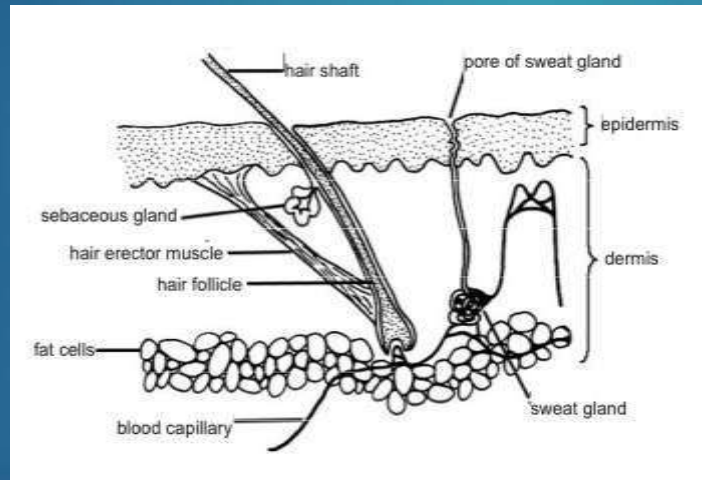
Define Vertebrates:

- Animals that have backbones

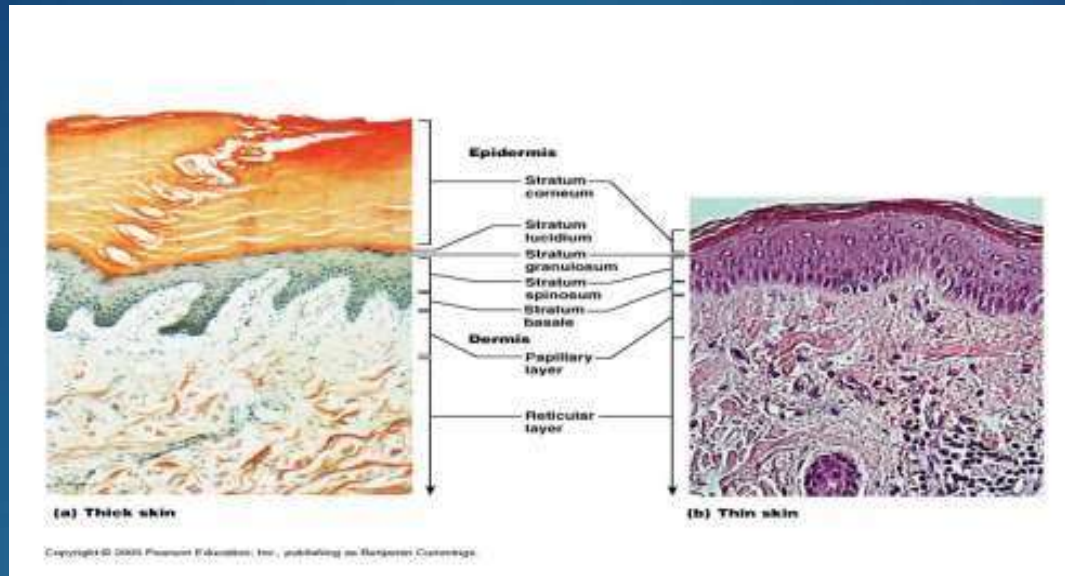
1. Mammals (Humans)

Skin

Skin is one of the largest organs of the body, making up 6-8% of the total body weight. It consists of two distinct layers. The top layer is called the **epidermis** and under that is the **dermis** (see diagram 5.1).



Cross section through the skin



The skin is composed of three tissues or layers of cells:

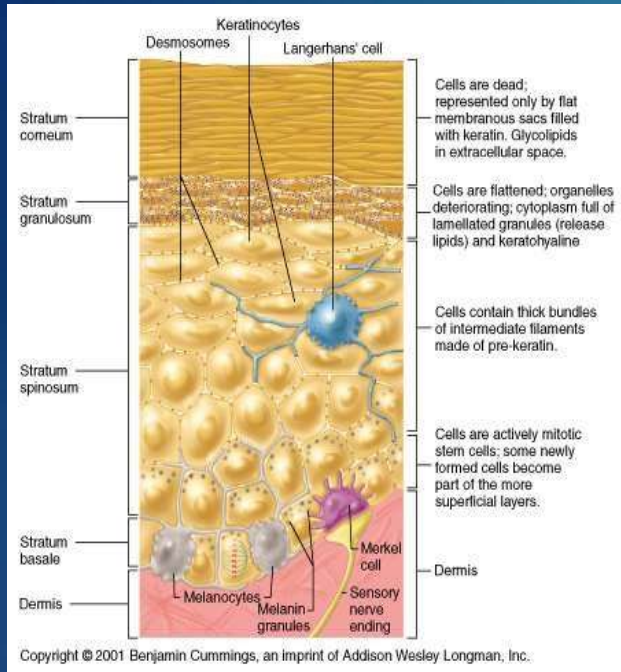
- a. Epidermis
- b. Dermis

a. Epidermis

- the OUTER most layer of Skin is known as the EPIDERMIS. It is composed of many sheets of Flattened, Scaly Epithelial Cells. This is a thin outer layer of skin.

- Its layers are made of mostly DEAD CELLS.

There are five distinct sub-layers of the Epidermis:



a. Stratum corneum: the outermost layer, made of 25-30 layers of dead flat keratinocytes. Lamellar granules provide water repellent action and are continuously shed & replaced.

b. Stratum lucidum: Only found in the fingertips, palms of hands, & soles of feet. This layer is made up of 3-5 layers of flat dead keratinocytes.

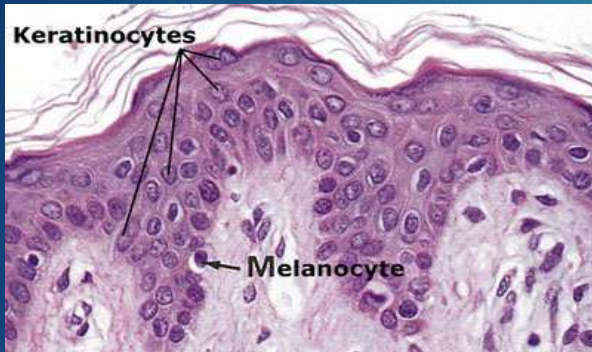
c. Stratum granulosum: made up of 3-5 layers of keratinocytes, site of keratin formation, keratohyalin gives the granular appearance.

d. Stratum spinosum: appears covered in thornlike spikes, provide strength & flexibility to the skin.

e. Stratum basale: The deepest layer, made up of a single layer of cuboidal or columnar cells. Cells produced here are constantly divide & move up to apical surface.

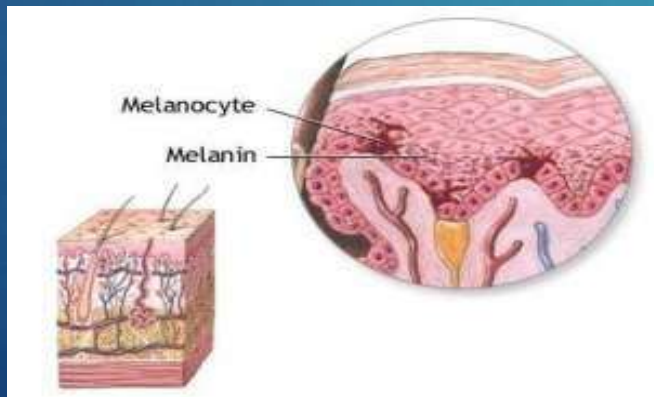
iThe epidermis smade up of 4 cell types:

- (A) **Keratinocytes** – Produce keratin protein a fibrous protein that helps protect the epidermis

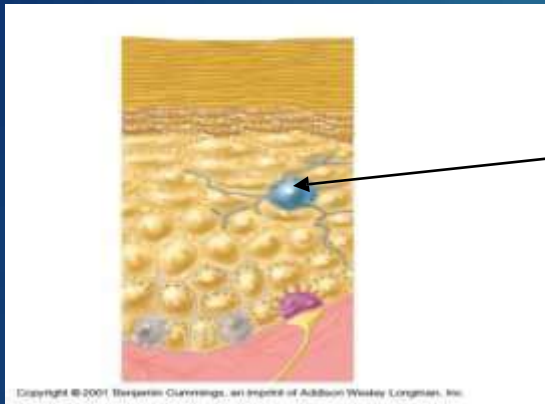


- (B) **Melanocytes** - produces the brown pigment melanin

These are cells located in the bottom layer of the skin's epidermis and in the middle layer of the eye, the uvea. Through a process called melanogenesis, these cells produce melanin, a pigment in the skin, eyes, and hair.

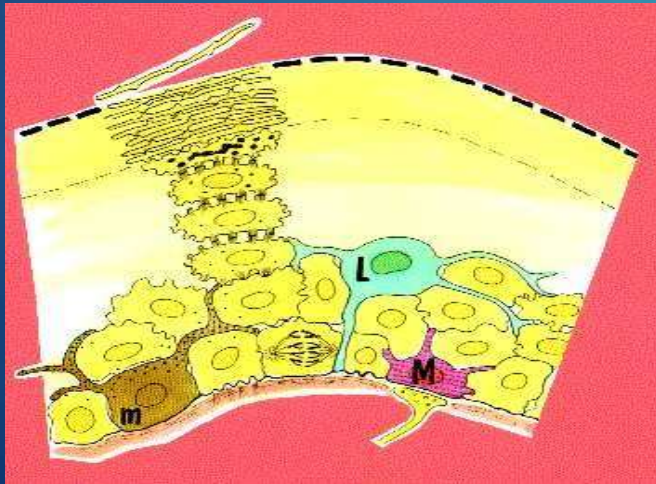


- (C) **Langerhan Cells** – participate in immune response
 - Formed in bone marrow.
 - Move to the skin

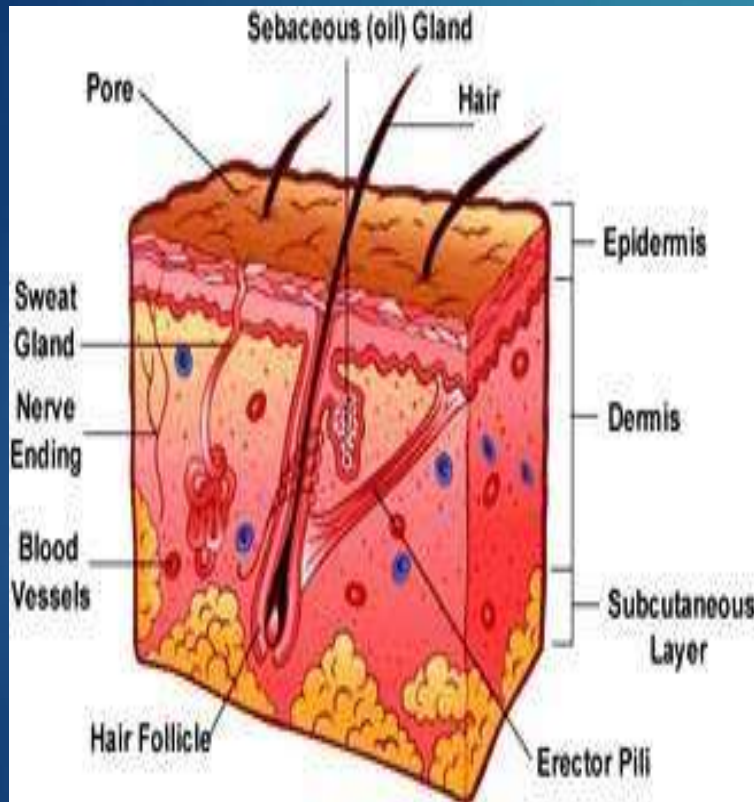


Langerhan Cells

- (D) **Merkel cells** - participates in the sense of touch.
 - Connected to nerve cells from dermis



2. Dermis- the innermost thick layer of the skin composed of living cells
-the Dermis lies beneath the Epidermis and contains BLOOD VESSELS, NERVE ENDINGS, GLANDS, SENSE ORGANS, SMOOTH MUSCLES, AND HAIR FOLLICLES.



The arrector pili muscle is a minute muscle found in the dermal layer of the skin. It is attached at the root of the hair, inside the hair's follicle. Under the control of the autonomic nervous system, these tiny muscles aid the body in temperature regulation. Sensory nerves in nerve endings of the skin send messages to the brain, which, if necessary, triggers contraction and relaxation of the muscle, or shivering, which generates heat. This action also makes the hair stand erect, causing "goose bumps".

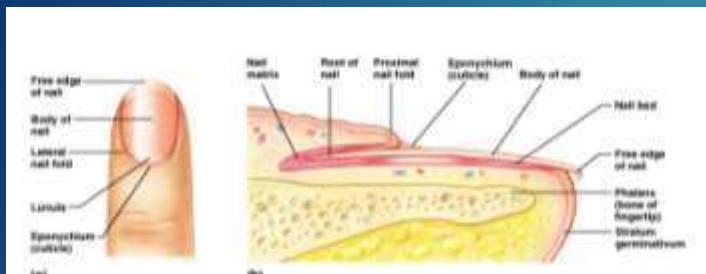
Hypodermis or Subcutaneous

The hypodermis is not part of the skin, and lies below the dermis. Its purpose is to attach the skin to underlying bone and muscle as well as supplying it with blood vessels and nerves. It consists of loose connective tissue and elastin. The main cell types are fibroblasts, macrophages and adipocytes

- (the hypodermis contains 50% of body fat). Fat serves as padding and insulation for the body. Another name for the hypodermis is the subcutaneous tissue

Nails

- Nails act as protective plates over the fingertips and toes.
- The area under your nail has many nerve endings, which allow you to receive more information about objects you touch
- As the nail grows, more cells are added at the nail bed. Older cells get pushed away from the nail bed and the nail grows longer. There are no nerve endings in the nail, which is a good thing, otherwise cutting your nails would hurt a lot



Nail Structure

The structure we know of as the nail is divided into six specific parts - the root, nail bed, nail plate, eponeychium (cuticle), perionychium, and hyponychium.

- Root** The root of the fingernail is also known as the germinal matrix. This portion of the nail is actually beneath the skin behind the fingernail and extends several millimeters into the finger. The fingernail root produces most of the volume of the nail and the nail bed. This portion of the nail does not have any melanocytes, or melanin producing cells.
- Nail Bed** It extends from the edge of the germinal matrix, or lunula, to the hyponychium. The nail bed contains the blood vessels, nerves, and melanocytes, or melanin-producing cells.

•**Nail Plate** The nail plate is the actual fingernail, made of translucent keratin. The pink appearance of the nail comes from the blood vessels underneath the nail.

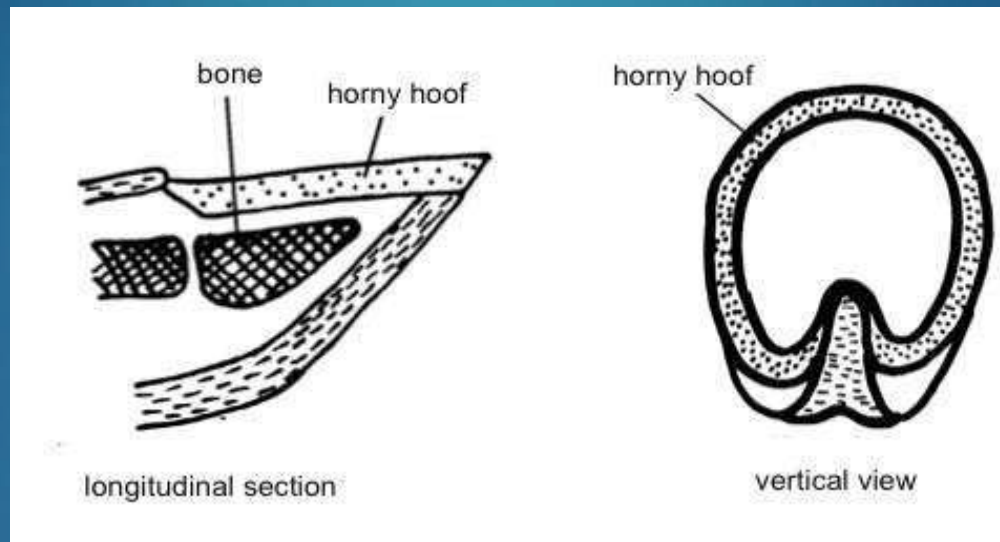
•**eponychium** The cuticle of the fingernail is also called the eponychium. The cuticle is situated between the skin of the finger and the nail plate fusing these structures together and providing a waterproof barrier.

•**Perionychium** The perioncyhium is the skin that overlies the nail plate on its sides. It is also known as the paronychial edge. The perionychium is the site of hangnails, ingrown nails, and an infection of the skin called paronychia.

•**Hyponychium** The hyponychium is the area between the nail plate and the fingertip. It is the junction between the free edge of the nail and the skin of the fingertip, also providing a waterproof barrier.

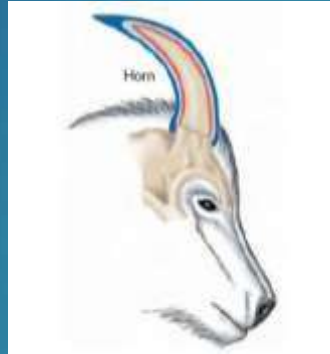
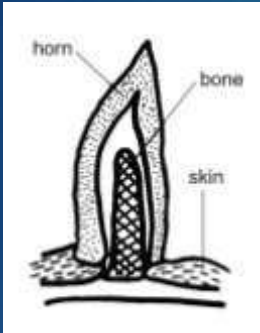
HOOFS

• **Hoofs** are found in sheep, cows, horses etc. otherwise known as **ungulate mammals**. These are animals that have lost toes in the process of evolution and walk on the “nails” of the remaining toes. The hoof is a cylinder of horny material that surrounds and protects the tip of the toe (see diagram 5.3).

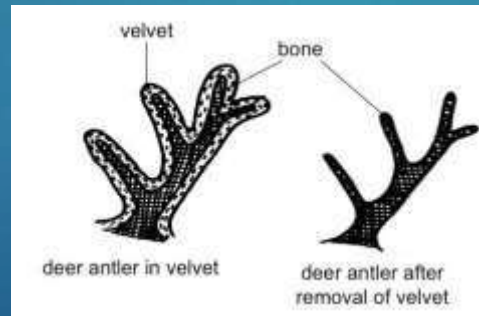


Horns And Antlers

• **True horns** are made of keratin and are found in sheep, goats and cattle. They are never branched and, once grown, are never shed. They consist of a core of bone arising in the dermis of the skin and are fused with the skull. The horn itself forms as a hollow cone-shaped sheath around the bone (see diagram 5.4).



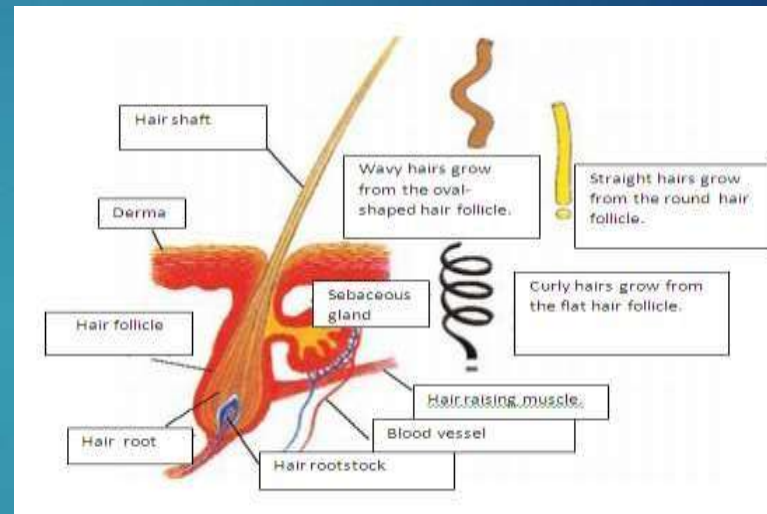
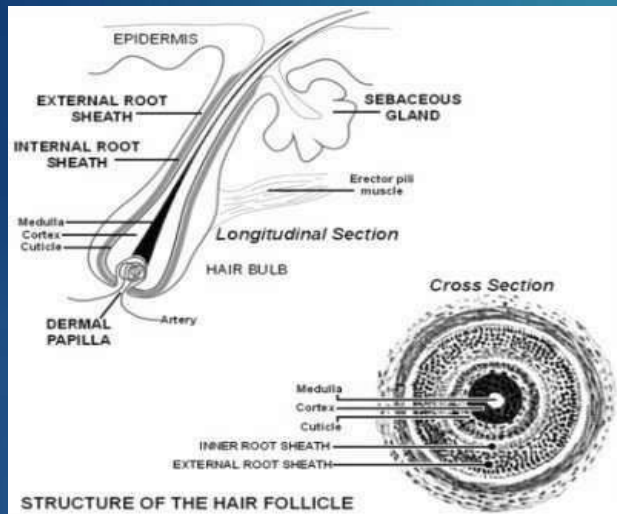
• The **antlers** of male deer have quite a different structure. They are not formed in the epidermis and do not consist of keratin but are entirely of bone. They are shed each year and are often branched, especially in older animals. When growing they are covered in skin called **velvet** that forms the bone. Later the velvet is shed to leave the bony antler. The velvet is often removed artificially to be sold in Asia as a traditional medicine (see diagram 5.5).



Deer antler

Hair structure

•Hair consists of the shaft, which grows and rises above the skin surface, and the root, which is located in the small fossa within the derma thickness and is anchored into a special follicle (hair follicle).



•HAIR FOLLICLE

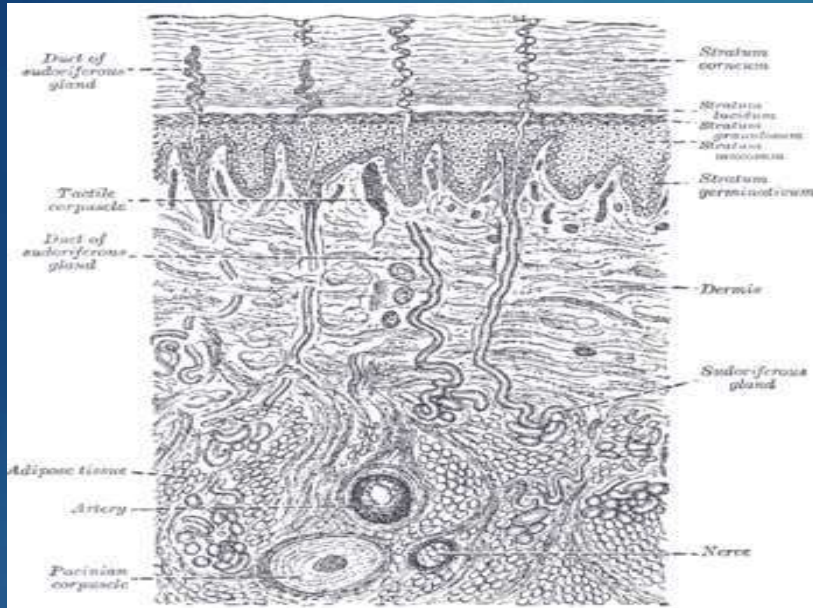
•The hair follicle is the point from which the hair grows. It is a tiny cup-shaped pit buried in the fat of the scalp.

•HAIR SHAFT

•The part of the hair seen above the skin is called the hair shaft. The hair shaft is made up of dead cells that have turned into keratin and binding material, together with small amounts of water. This structure explains why we do not feel any pain while our hair is being cut.

KINDS OF Glands

a. Sweat Glands or Sudoriferous

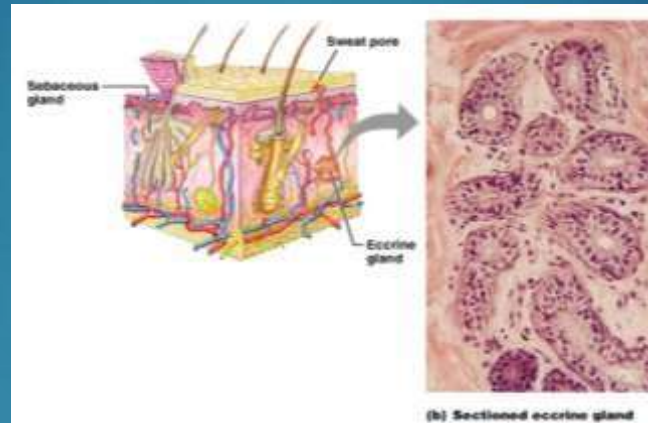


- These are **large lumen glands** associated with **hair follicles**.
- They **develop** from the same **down growths** that give rise to **hair follicles**.
- The **connection is retained** and they are **coiled tubular glands**, sometimes **branched**.
- The **secretory portion** is in the dermis or **upper hypodermis**
- The **secretory product** is **stored in the lumen**.
- **Myoepithelial cells** facilitate the **expulsion** of

There are **2 types** of sweat glands:

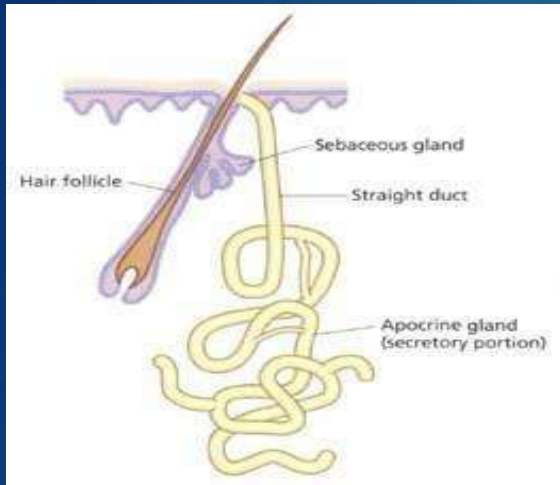
- **Ecocrine sweat glands**, all over body except **lips** and **part of external genitalia**;
- **Apocrine sweat glands**, only in **axilla**, **areola**, **nipple of mammary gland**, and **circumanal region** and the **external genitalia**. The **ceruminous glands of ear** and **glands of Moll of eyelid** are also apocrine.
- Both the **ecocrine** and the **apocrine sweat glands** are innervated by the **sympathetic nervous system**.
- **Ecocrine glands** respond differently to **heat** and **nervous state**.
- The **apocrine glands** respond to **emotional** and **sensory stimuli** but **not heat**.

• **Ecocrine Sweat Glands**



- These are **simple coiled glands** that **regulate body temperature**.
- The **secretory segment** is deep in the **dermis** or **upper hypodermis**.
- Its duct leads to surface.
- In the **secretory region** there are **clear cells** that produce the **watery component** of **sweat** and **dark cells** that produce a **proteinaceous secretion**.
- There are also **myoepithelial cells** that are responsible for the **expression of sweat** from the gland.
- **Duct cells** form the **walls** from the secretory portion to the area near the surface where the epidermal cells form the wall.
- The duct is **stratified cuboidal**.
- There is both **thermoregulatory sweating** and **emotional sweating**.
- **Resorption** of **some minerals** take place in the duct.
- **Myoepithelial cells** are present in the duct.

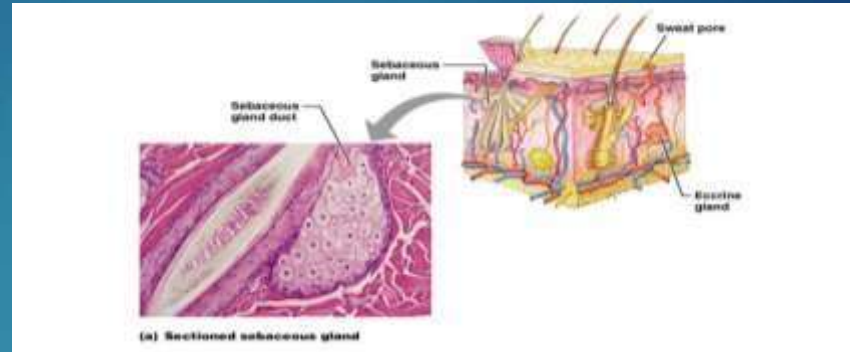
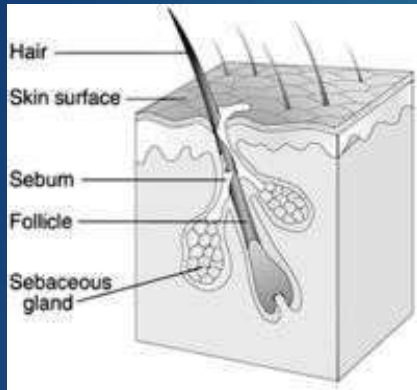
•Apocrine SweatGlands



- the **secretory product** from the gland.
- The **duct** has a **narrow lumen**.
- Apocrine** secretions contain **protein, carbohydrate, ammonia** and **lipid**.

b. Sebaceous Glands or Oil Glands

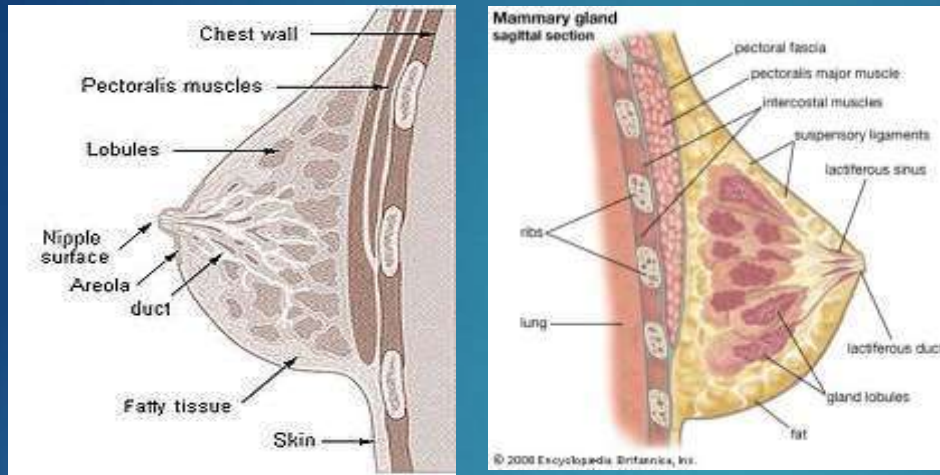
- Found in the skin of mammals and these glands secrete sebum.



- **sebum** (Latin, meaning *fat* or *tallow*) that is made of fat (lipids) and the debris of dead fat-producing cells.
- These glands exist in humans throughout the skin except in the palms of the hands and soles of the feet.
- Sebum acts to protect and waterproof hair and skin, and keep them from becoming dry, brittle, and cracked. It can also inhibit the growth of microorganisms on skin.

D. Mammary glands

•are the organs that, in the female mammal, produce milk for the sustenance of the young. These exocrine glands are enlarged and modified sweat glands and are the characteristic of mammals which gave the class its name.



•The human mammary glands are modified sweat glands and are developed from two sources --the parenchyma (alveoli and ductules) from the surface ectoderm ,the fibrofatty stroma from the underlying endoderm.

•At birth mammary glands of both sexes remain in infantile form .This condition persists throughout life in normal male.
•First change is seen at puberty in females ,in the form of deposition of fat and increase in size and attain hemispherical outlines. With the start of reproductive cycle after puberty ,glandular tissue show changes with the alteration in concentration of oestrogen and progesterone in each cycle.

•Ultimately during pregnancy final maturation of the glands takes place and they are ready for milk secretion under the influence of oestrogen ,progesterone ,prolactin and probably hCG..

•Some milk is secreted into the ducts as early as 5 months but the amount is less compared to large amount secreted at child birth.Milk is secreted within an hour of child birth and first formed milk is called **colostrum** which is yellowish in colour and rich in protein and antibodies and provide immunity to the baby.Normal milk production starts 2-3 days after child birth.