

## DERIVATIVES OF INTEGUMENT

The integument or skin in mammals as well as in all vertebrates is continuous with the mucous membrane of mouth, rectum, urinogenital organs, nostrils and eyelids. The skin is made up of two distinct and embryo-logically different layers.

The outer layer is epidermis and it is ectodermal in origin and the inner layer is dermis which is mesodermal in origin. The two layers are separated by a basement membrane (Fig. 1).

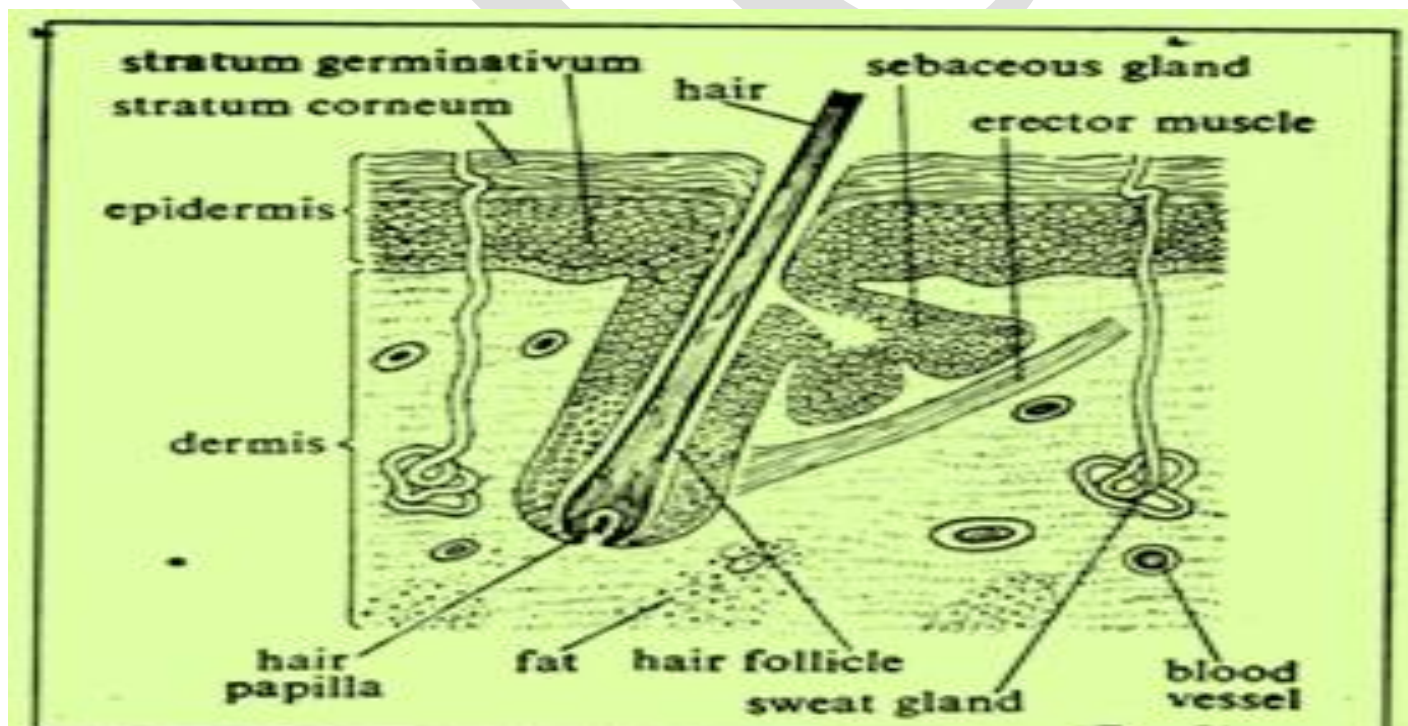


Fig.1 T.S of mammalian Skin.

The outer layer or the epidermis is again divided into a number of distinct strata. The innermost layer of the epidermis is called stratum **germinativum or Malpighian** layer. This layer is made up of tall and columnar cells arranged perpendicular to the dermis.

The cells divide mitotically and continually. The new cells thus formed tend always to reach the surface and on their sojourn become flattened and show poor stain ability.

The layer formed by these flat cells is known as transitional layer. The outermost layer of the epidermis is called **stratum corneum or horny layer**. The cells of this layer are flat and dead. The chief constituent of these cells is **keratin** which is a very hard, tough and insoluble protein.

The epidermis in certain parts of the body of man is a bit different. In the thick skin on the soles of the feet and palms of the hands the transition from Malpighian layer to corneal layer is not so abrupt. The transitional layer in these parts of the body is further subdivided into an inner stratum **granulosum and an outer stratum lucidum**.

The thickness of the epidermal part of the skin remains fairly constant because the rate of proliferation of the

stratum germinativum is nearly equal to the loss of corneal cells. **The dermis or corium** is thicker than the epidermis and is made up of connective tissue fibres, smooth muscle fibres, blood vessels, nerves and glands.

In whales and seals the fat forms a thick layer, called **blubber** which acts as food reservoir and also helps in maintaining body temperature. The pigments of the skin or melanin in mammals never remain confined in specialised cells but they remain in the cells of the deepest layer of the epidermis.

### **Functions of the Integument in Vertebrates:**

#### **1. Protection:**

- i) The integument or skin protects the body from the entry of foreign bodies and prevent from the mechanical injuries.
- ii) The hard dermal and epidermal scales that protect the skin from surface abrasion and also the soft tissues which lie beneath it.
- iii) Hair, bristles and spines are employed for offensive and defensive purposes.

iv) The impervious integument helps the body from loss of water.

## 2. Thermoregulation:

The integument of warm-blooded animals regulates the body temperature. Feathers of birds, sweat glands and blubber of mammals help in the regulation of body temperature. Deep covering of the hairs help in the conservation of heat, specially during winter.

## 3. Storage of food:

In whales, seals and sea cows, a sub-dermal fat layer forms a thick layer, called blubber, which acts as food storage.

## 4. Excretion:

The integument of some aquatic vertebrates (e.g., aquatic amphibians) serves as an organ for excretion. During ecdysis the waste material which is stored in the corneal layer of the skin is shed. Sweat of the sweat glands aids in removing nitrogenous wastes from the body.

## 5. Respiration:

The moist skin of common eel, mud skippers and swamp eels help in respiration. The skin of amphibians is moist

and highly glandular that help air in contact with the skin to be interchanged and thus performs accessory respiration. In plethodontid salamanders, the lungs are absent, so rely totally on cutaneous respiration.

## 6. Secretion:

The skin acts as an organ of secretion. The different glands are located in the skin those help the vertebrates in different ways for survival. Fishes possess numerous mucous glands in the skin that secrete abundant mucous.

The slimy mucus of the fish on the skin reduces resistance during swimming. The poison glands of fishes, amphibians and snakes are used for protection and predation. Mammary glands, scent glands, and sebaceous glands are present in the skin and serve different functions.

## 7. Locomotion:

Various types of integumentary derivatives sub-serve different types of locomotion's. The fins of fishes, web in aquatic amphibians, terrapins and aquatic birds, scutes in snakes, adhesive pads in climbing lizards, feathers in birds and patagium in flying lizards help in different modes of locomotion.

## Structure of skin Mammalia:

- The skin (Fig.2) is elastic and waterproof and is much thicker than in other vertebrates, especially the dermis is very thick and tough and is used for making leather.
- The epidermis is thickest in mammals and is differentiated into five layers- stratum corneum, stratum lucidum, stratum granulosum, stratum spinosum and stratum germinativum or Malpighian layer.

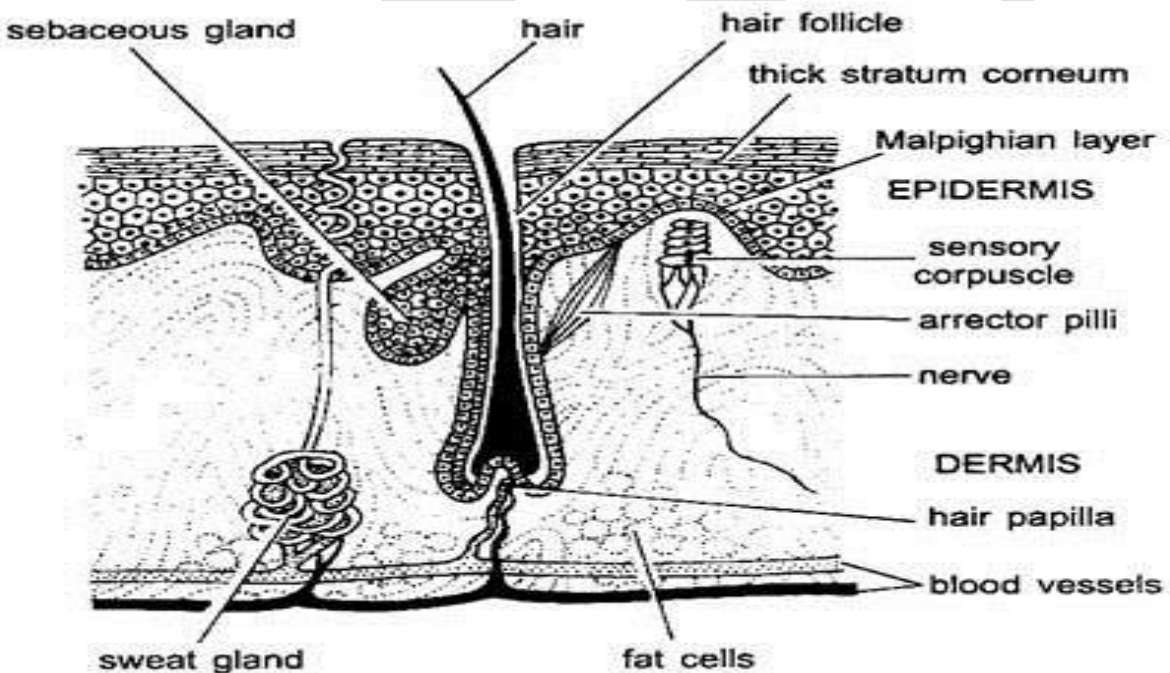


Fig.2 V.S. Skin of Mammals.



- The outer layer of stratum corneum containing keratin, its cells lose their nuclei, but the cells are not dead as believed before.
- They secrete several hormones, one of which represses the mitotic activities of the Malpighian layer.
- In places of friction, such as soles and palms, the stratum corneum is very thick.
- **Stratum corneum** is variously modified in various mammals to form epidermal scales, bristles, hairs, claws, nails, hoofs and horns etc.
- Below the stratum corneum is a refractive stratum **lucidum** in certain regions only.
- The **stratum lucidum** is now known as a barrier layer because the electron microscope has shown that its cells become compact and closely united to form a region which prevents passage of substances into or out of the body.
- Stratum lucidum contains a chemical known as **eleidin**.
- **Keratohyalin and eleidin are intermediate products in the formation of keratin.**
- Below this is a stratum granulosum which is having darkly-staining granules of keratohyalin.

- Below the stratum granulosum is a stratum spinosum whose cells are held together by spiny intercellular bridges, each bridge has two arms in close contact, one arm arising from each cell.
- Lastly there is a **stratum germinativum or Malpighian** layer which rests on a thin basement membrane.
- The Malpighian layer forms new cells continuously which move towards the surface and become flat and keratinised till the stratum corneum has flat, cornified cells made only of keratin.
- This layer is sloughed off continuously and replaced by new cells.
- There are **no mucous glands in the epidermis** of mammals.
- The keratin from the epidermis at ends of digits forms claws, nails or hoofs.
- The dermis is best developed in mammals.
- The upper part of the dermis in contact with the epidermis is the papillary layer which is made of elastic and collagen fibres with capillaries in between.
- It is thrown into folds to form rows of dermal papillae, especially in areas of friction. The greater



lower part of the dermis is a reticular layer having elastic and collagen fibres.

- In both layers there are blood vessels, nerves, smooth muscles, certain glands, tactile corpuscles, and connective tissue fibres extending in all directions.
- Below the dermis the subcutaneous tissue has a layer of fat cells forming adipose tissue which helps to maintain body heat.
- In making leather only the dermis is used. Dermal scales are not found in mammals except armadillos.
- In the lowest layer of the epidermis are pigment granules but there are no pigment-bearing chromatophores in mammals.
- In man some branching dendritic cells or melanoblasts lie between the epidermis and dermis, they contain pigment.
- The epidermis forms hairs, sudorific glands, sebaceous glands and mammary glands.
- Hairs form an epidermal covering.
- Shafts of hair project above the skin and their roots are embedded in hair follicles, into each of which opens a branching sebaceous gland.

- Hairs form an insulating layer which prevents a loss of body heat, thus, hairs keep up the body temperature.
- **Sebaceous glands** are outpushings of the wall of hair follicle and produce an oily substance which keeps the hair supple and prevents its wetting in water.
- It also lubricates the skin. In the dermis are present coiled **sudorific or sweat glands, which occur all over except lips and glans penis.**
- Mammary glands are modified sebaceous glands, but in monotremes they are modified sudorific glands.
- They are functional only in females for producing milk for the young. Mucous glands are not found in mammals.

## **DERIVATIVES:**

Both layers of integument have given rise to various types of derivatives. The epidermis gives rise to integumentary glands, epidermal scales, horns, digital structures, different corneal structures, feathers, and hairs.

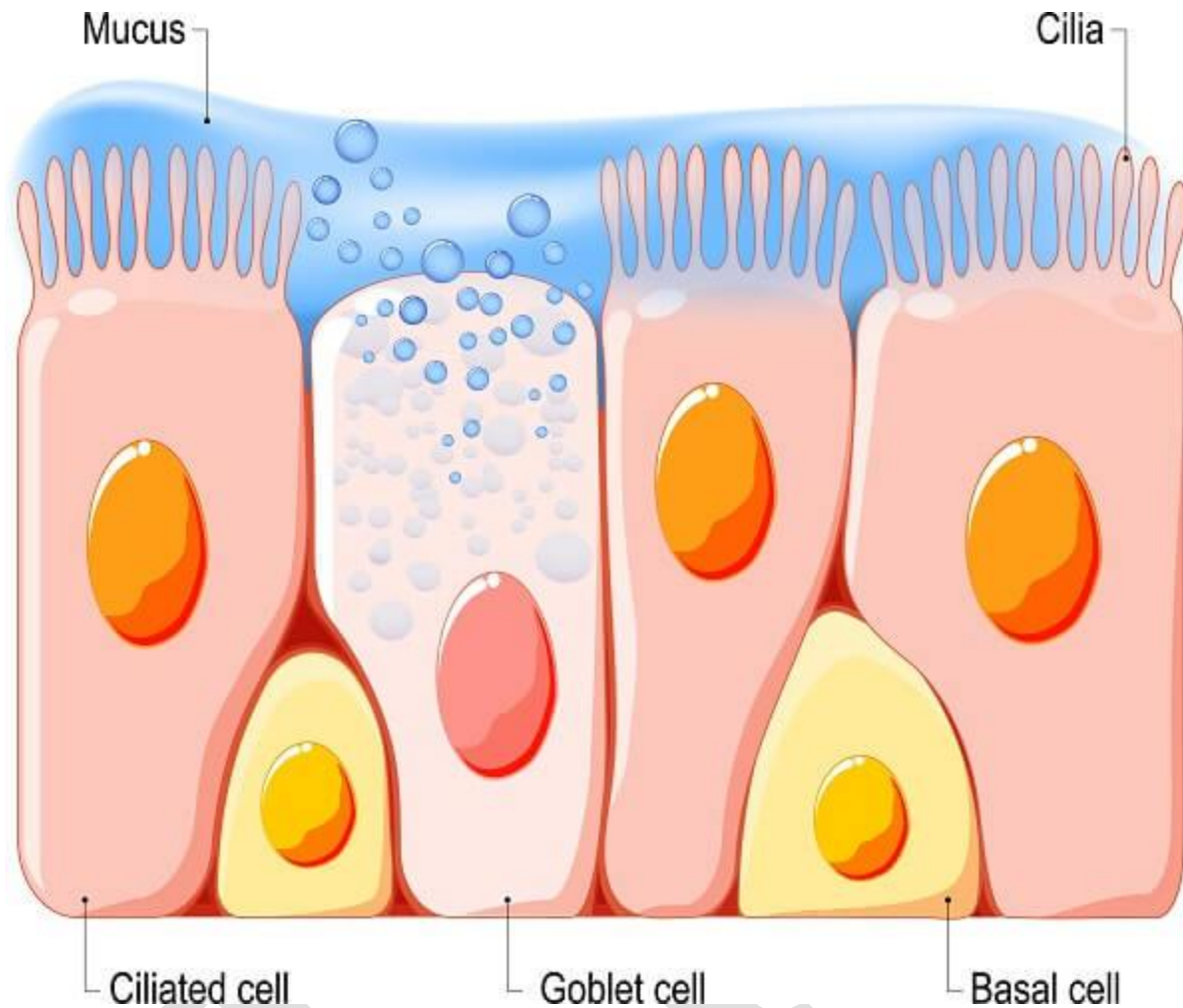
## **Epidermal Derivatives:**

Epidermal derivatives are epidermal glands (unicellular and multicellular), epidermal scales and scutes, horns, digital structures (claws, nails and hoofs), feathers and hairs.

### 1. Epidermal Glands:

Epidermal glands are formed from the Malpighian layer of the epidermis. They arise from the epidermis and often penetrate the dermis. According to their structure they are unicellular or multicellular, tubular or alveolar and simple or compound (branched) glands. These are lined by cuboidal or columnar cells.

(a) Unicellular glands are single modified cells found among other epithelial cells, they are present in amphioxus, cyclostomes, fishes and larvae of amphibians. Unicellular glands are known as **mucous cells or goblet cells**. They secrete a protein **mucin** which combines with



water to form mucus which lubricates the surface of the body. Other unicellular glands are granular cells and large beaker cells of cyclostomes and fishes, they also secrete mucus.

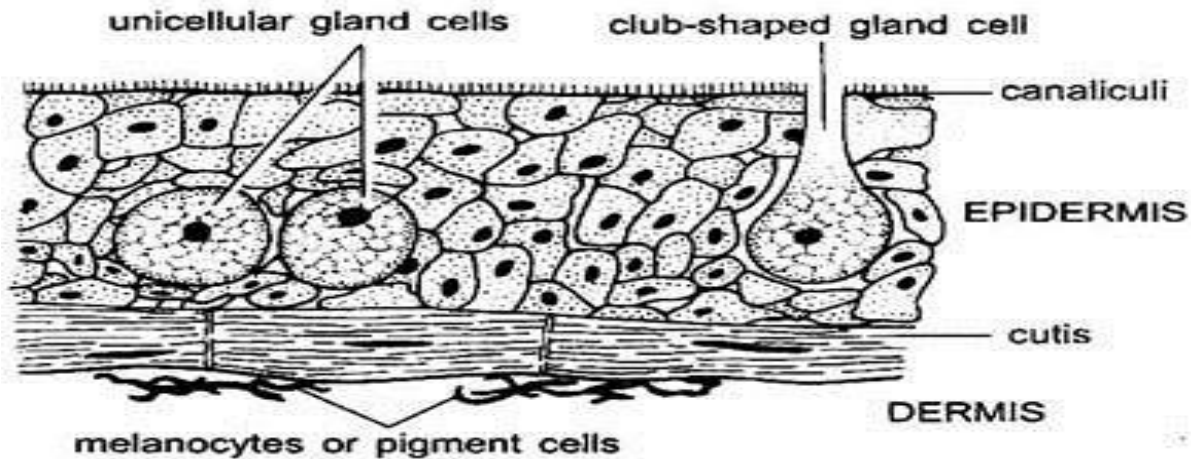


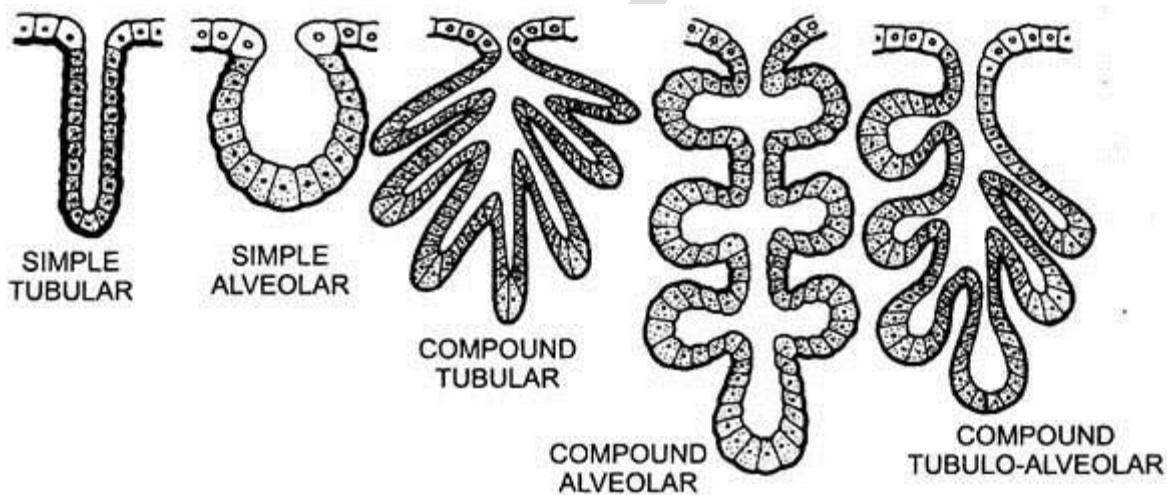
Fig. V.S of Skin of larval Cyclostomes.

**(b) Multicellular glands are of two types:**

1. Tubular glands are multicellular tubes of uniform diameter formed as ingrowths of the Malpighian layer into the dermis, e.g., **glands of Moll on the margin of the human eyelids.**
2. Tubular glands may become coiled at the base deep in the dermis, e.g., **sweat or sudoriferous glands** of mammals,
3. Tubular glands may divide into many tubules which are then called compound tubular glands, e.g., mammary glands of females and of males in monotremes and primates, etc., and gastric glands in stomach.
4. Alveolar or saccular glands are multicellular downgrowths of the Malpighian layer into the dermis,

having a tubular duct whose terminal parts form a rounded expansion to become flask-shaped, e.g., mucous and poison glands of amphibians.

5. Alveolar glands may branch into many lobules which finally open into a common duct, they are then called compound alveolar glands, e.g., mammary glands of eutherians, and salivary glands.



**Fig.2 Different types of epidermal gland.**

### **Kinds of Epidermal Glands:**

According to function, the epidermal glands of vertebrates are of the following types:

### **Integumentary Derivative:**

#### **1. Glands:**

A large variety of epidermal glands is present in the skin of mammals. These glands are tubular or alveolar in nature and are always multicellular.

The principal glands are:

### A. Sudorific or sweat glands:

- These are long and coiled tubular glands.
  - The lower part of the gland lies embedded in the dermis and the upper part is constituted by a duct which opens to the outside through a pore.
  - The distribution of sweat glands in different mammals is not uniform.
  - In case of man the sweat glands are more numerous on palm, sole and arm pits.
  - In cat, dog and rat sweat glands are found in the sole of the feet.
  - In rabbits the glands are found around the lips.
  - The ruminants have sweat glands located on the muzzle and on the inter-digital fold of skin.
  - In hippopotamus the pinna houses the sweat glands.
- Sweat glands are absent in Tachyglossus, Mus, Talpa, Cetacea and Sirenia.



- The sweat is watery in appearance but its colour is red in certain mammals like hippopotamus and Macropus.

### Function:

1. The secretion of sweat glands is known as sweat.
2. Sweat aids in removing nitrogenous wastes and helps in the regulation of body temperature.
3. It is believed that the glands of Moll in the eye margin of man are modified sweat glands and similar is the case with ceruminous or wax- secreting glands in the external ear passage.

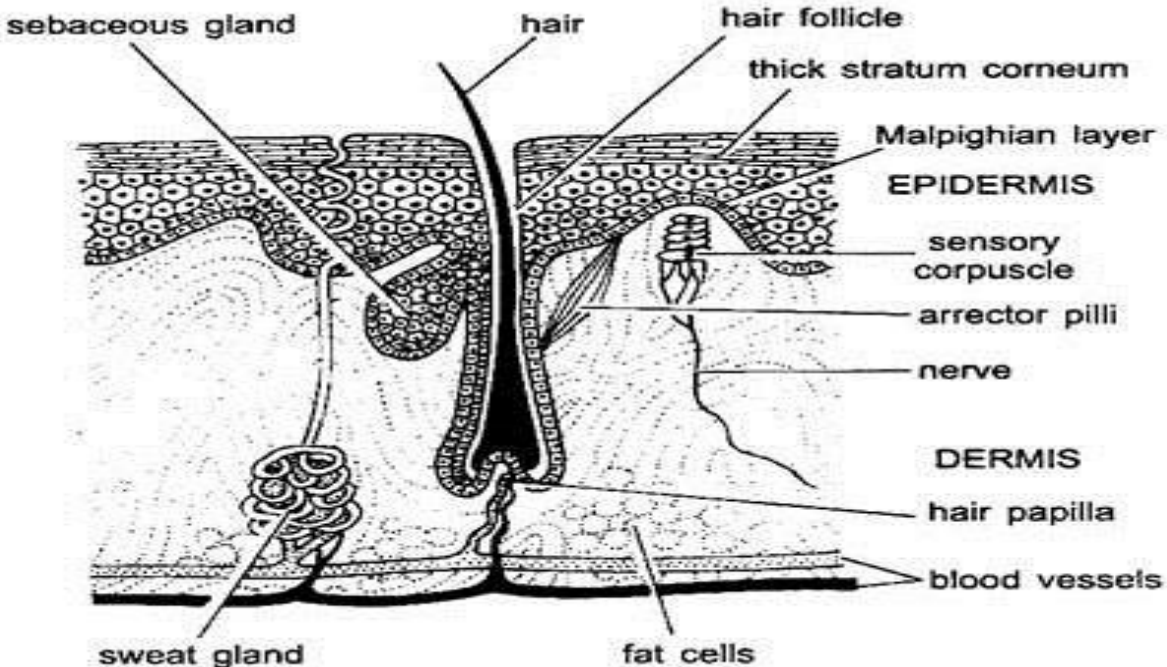


Fig: Sweat gland and Sebaceous gland.

## B. Sebaceous glands:

- The glands are alveolar in nature and are generally associated with the hair.
- But they occur in hairless parts of the body, i.e., around the genital organ, tip of the nose and border of lips, independently.
- These glands are absent in Pangolin, Cetacea and Sirenia.

### Function:

1. The secretion of the gland is known as sebum. It is oily in nature and helps in keeping the body oily.
2. Meibomian glands in the eyelids are modified sebaceous glands. It secretes an oily film on the surface of the eyeball.
3. Scent glands too are modified sebaceous glands.
4. The secretion of scent glands is sex attractants. They are situated on the different parts of the body.
5. In the deer family scent glands are located near the eyes. In carnivores scent glands are found near the anus.
6. The pigs and goats have scent glands in between their toes.