Integumentary System

The skin and associated structures make up the integumentary system. The skin protects land-dwelling organisms from desiccation and from loss of heat. skin is a mammal's largest organ. Its protects the body against physical, chemical and biological attacks, it helps to regulate body temperature. it is used to communicate to other individuals, and a skin derivative provides nourishment for the young.

Like the integuments of other vertebrates, mammalian skin is composed of two layers, the dermis and the epidermis. Identify and locate the structures underlined in the following test.

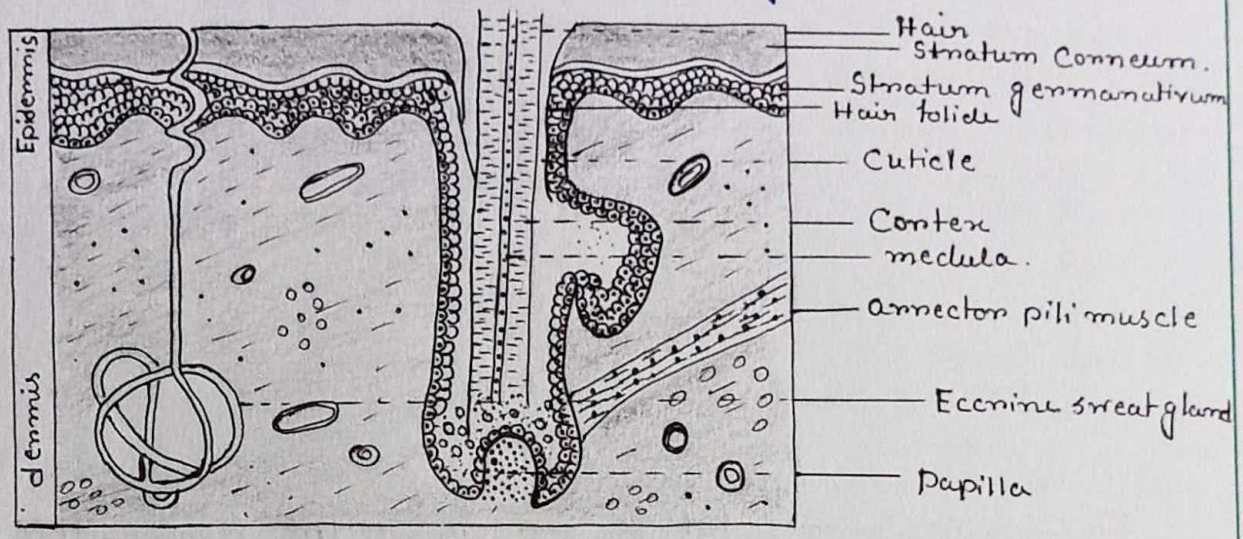


Fig - Cross-Section diagram of Skin-Surface.

EPIDERMIS : The epidermis consists of several layers, representing successive stages of development. The oldest part of the skin is the outer layer of tough, protective cells. The cells which are dead are continually worn off at the surface and replaced from the below. As the cells age and mature, they eventually lose their nuclei and most of the cells contents and converted to keratin. Keratin is a protein that's make's up the protective layer of skin and also such structures as nails, hooves, hair and Horns — evolutionary and developmental derivaties of skin.

The outermost layer of epidermis is the stratum Corneum. The epidermis on the soles of feet and the palms of hands is thick. Hair, Horn, claws and epidermal scales are all made off modified keratinized cells of epidermal Origin.

DERMIS : The dermis lines below the epidermis. It is a thick layer of connective tissue with associated muscles, nerves and blood vessels. The connective tissue consists largely of Colagen. Colagen is the most abundant protein in the body being present in skin, bones, tendons, cartilage and ligaments. It is form a Greek word meaning 'glue-maker'. Colagen and the other fibres in the dermis

Fig :- Fingerprint of human (Homo sapiens). We may have an opportunistic sample (eg. last year hack a pine marten).

become toughened and hardened during the process of tanning when a skin is transformed into a leather. Unlike the epidermis the dermis is well supplied with blood vessels and nerves for sensation of touch, pressure, temperature and pain. Beneath the dermis is a layer of fatty tissue, variably thick that provides insulation and energy storage. In many species, the extend of subcutaneous fat varies dramatically with season.

SKIN GLANDS: Associated with the skin are two kinds of glands, sweat glands and sebaceous glands. The epidermal sebaous glands lubricate the hair and are described below. Sweat glands (sudoriferous glands) are coiled tubes in the dermis connected with the surface by narrow ducts. They are well supplied with blood vessels, secrete mostly water and salts, and function largely in thermoregulation. In humans and some ungulates, sweat glands are distributed over much of the body. Some mammals such as rodent and lagomorphs (rabbit) do not have sweat glands. Cats (Felidae) and dogs (Canidae) and perhaps other Carnivores, have sweat glands in the pads of the feet. It is thought that mammary glands evolved from sweat glands as discussed below.

HAIR: Hair is uniquely mammalian feature. The developing epidermis invaginates into the dermis to form a follicle. As the deepest point of the follicle, the dermis pushes back and forms a small structure called the papilla. The papilla is well supplied with blood vessels. Each hair consists of 3 parts. The center is the medulla (Latin-Marrow) This is surrounded by a denser cortex (Latin.-bark) Cointaining most of the pigments granules that give each hair its characteristic colour. The cortex is covered with a thin layer called the cuticle. (Latin-little skin). Cuticular scales are never pigmented.

GLANDS: Sebaceous glands open into each follicle. They secrete only substances (sebum) that continually lubricate the condition the skin and hair. Cells inside these glands gradually fill with grease and then break away, becoming part of the secretion themselves. Sebum makes beavers waterproff and prevents undue drying of the pelage of tessestrial mammals. Glands that secrete cellular debris as well as molecular products are termed apocrine glands. These glands empty into or near a hair follicle.

There are many examples of skin glands that haved moved beyond their roles in lubrication to serve other function. In skunks protective and communicative functions are both present. we have a skunks study skin in the laboratory but do not have the anal sac from which the skunk sprays. Note the warning colouration of the skunk. Some shrews has glands on their sides that advertise reproductive condition. Many species use glandular

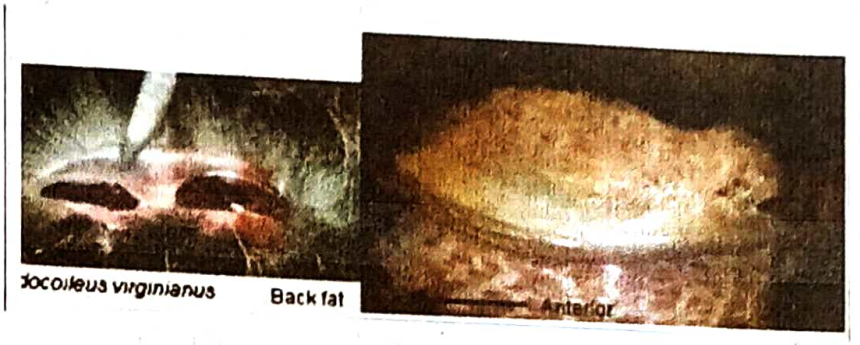


Fig:- Subcutaneous fat in a deer in the winter. This picture is is of the subcutaneous fat of a yearling doe (nearly 2 years old) that was hit by a car on 2/08/04. On the left is in image from just anterior to the tail cut through the tissue, and on the right is mush of the back with the skin peeled back.

(order Carnivora).

HAIR MUSCULATURE : Hair doesnot grow vertically from the skin but emerges at an angle, which can be altered to regulate the depth of the pelage. A small arrector pili muscle is attached to each follicle. As that muscle contracts, it increases the thickness of the insulating layer of hair. Hair "standing on end" increases the insulative value by increasing the dead air space. It can also increase the apparent size of an individual, such as the neck fur of a defensive dog.

KINDS OF HAIR :- Hair with continuous growth (human head hair or a horse's mane) is called angora hair. It continues to grow throughout the life of the animal and is not molted. Definitive hair ceases to grow at a certain point and is replaced periodically when the animal molts.

The pelage (or coat) that we usually see in the body hair, or guard hair. There are three different types of guard hairs. Guard hair are frequently long, stiff hairs, they serve mostly for protection. Bristles show angora growth. The manes of lions and horses and bristles. In certain mammals hairs are so stout and strong that they formes spines, as in hedgehogs and porcupines. The North American porcupine (Erethizon dorsatum) has barbs on the tips of its spines that break of at their base if touched by a predator and worx into the flesh. Examine the quill under the microscope in the lab. The third type, which is most common is arms. Arms are guard hairs with definitive growth and the most noticeable hairs on most mammals.

Examine skins of a variety of mammals - such as porcupine, hare (Lepus americanus), ermine (Mustela erminea), otter (Lutra Canadensis) and moose (Alces alces). Identify the types of hair found on each. what is the function of each kind of hair ? what differences do you see among these different animals that might be associated with the habitats they normally live in ? why might moose or deer hair have the character that it does, while snowshoe hare hair is different in nature.

Underhairs are shorter and finer hairs growing around the guard hairs often is much greater numbers. Their function is to insulate. Underhairs with angora growth are called wool. In domestic sheep, guard hairs have been eliminated through selective breeding and the growth rate and density of the wool has been increased.

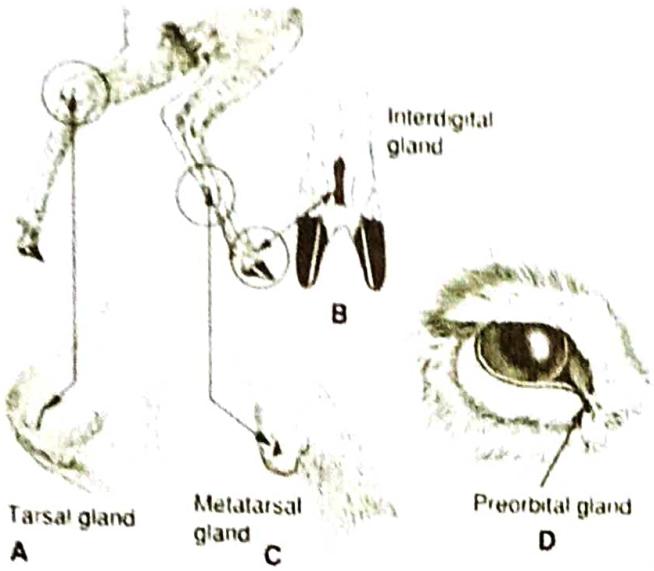


Figure 4.9 Scent glands in white-tailed deer, *Odocoileus virginianus*. (A) Tarsal gland; (B) interdigital gland; (C) metatarsal gland; (D) preorbital gland.
(After Feldhamer et al. 1999:107)

Fig:- Scent glands in the white-tailed deer. (Odocoileus Virginianus). Legs from a deer may be available in class to find these glands.

Figure 4.6 Enlarged view of a quill tip of a New World porcupine (*Erethizon dorsatum*). Note presence of barbs.
(Shadle and Chedlev 1949:172)

Fig:- Tip of spine of porcupine quill.

The pelage of an animal is the combination of longer guard hairs and the underfur (underhairs) fine and relatively short hair with difinitive growth that densely covers most mammals.

Special tactile hairs, the vibrissae, are found not only on a mammal face (mystacial vibrissae) but may occur also on the legs or elsewhere of the body. Nerves at the base of vibrissae communicate response to the brain. Vibrissae are especially prominent on the muzzles of nocturnal and burrowing mammals. Humans do not have vibrissae.

Note the location of the vibrissae on specimens of a variety of mammals in relation to the habits and/or habitat of each species. Among the animals you could look at are the woodchuck (Marmota monax) pocket gopher (Geomys bursarius), muskrat (Ondatra zibethicus) and otter (Lutra canadensis)

Color – Mammalian hair and skin coloration serves 3 basic functions
1) Protection from electromagnetic radiation (ultraviolet light)
2) Concealment (Crypsis) by camouflage, (countershading or disruption, and 13) Communication, such as the "warning" color patterns in skunk (Mephitis mephitis).

Bright colors are rarely found in mammals, most mammals are nocturnal and most are color blind. Primates are exceptions, they have color-vision and many display brightly coloured pelage and brilliantly pigmented areas of bare skin. The Squirrels are another diurnal and somewhat colourful group, but they donot match birds in colouration.

The colour of an individual hair depends on the kind and concentration of pigments, granules in the cortex. Surface textures, the thickness of the hair and the amount of air space in the medulla, also influence its appearance. The different pigments are not evenly distributed over the length of each hair. Most hair show a pattern called agouti. They have black tip followed by successive bands of different pigments. The good examples of this is the woodchuck on the front table. Look at some of these hairs under the microscope or with the eye.

HAIR REPLACEMENT: The pelage must be maintained to maintain its functionally. Hair cannot be repaired when damaged because it is non living. Most hair is of definitive growth and is replaced periodically. This process is called molting. Two kinds of molts are recognized. Maturational molt (from juvenile to subadult to adult pelage) and seasonal molt, which usually occurs once for twice a year and often follows a regular spatial pattern

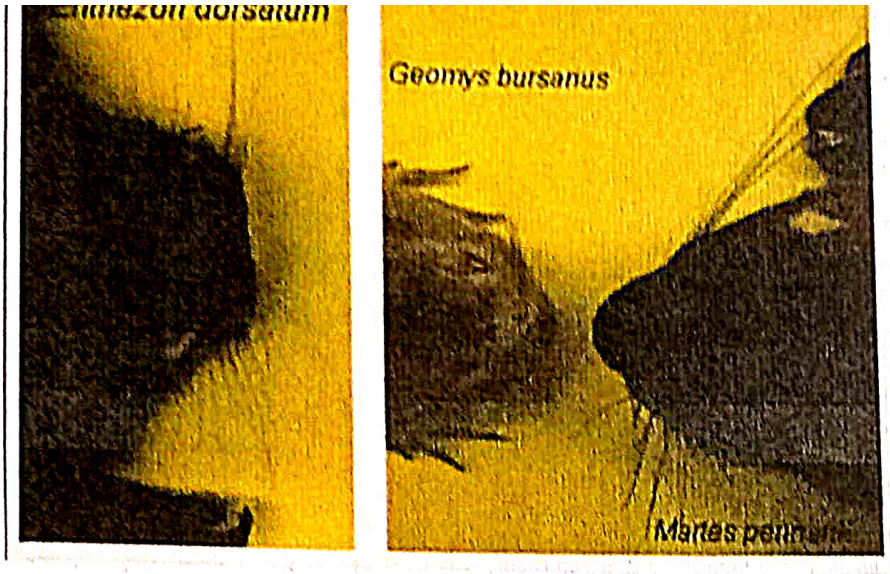


Fig:- Vibrissae on the porcupine and the pocket gopher (Geomys bursarius) and the fisher. Look at other mammals in the lab for presence or absence of vibrissae.

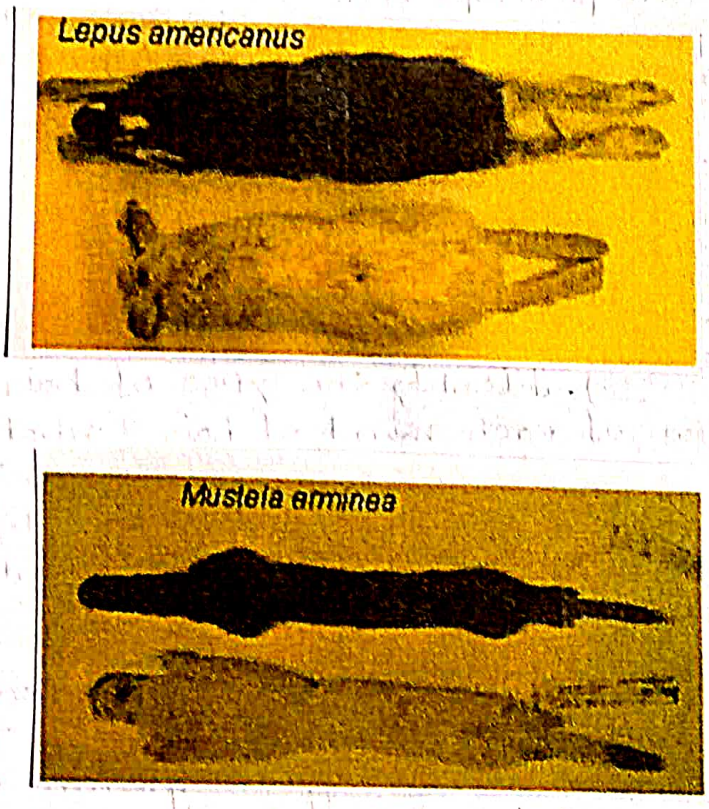


Fig:- Compare winter and summer pelts of the ermine (Mustela erminea) and the snowshoe hare (Lepus americanus) that are present in the lab.

within a particular species. Species subjected to seasonal changes generally have a longer pelage with good insulating abilities in winter. Some northern species have white coats for winter & brown coast for summer.

In many mammals there is a distinctly juvenile pelage that distinguishes young animals from adults (in addition to other clues such as body size). Members of a deer family are a good example of this. Moose calves are reddish in color, for example. There is the skin of a white tailed deer fawn in the laboratory, Compare its hair to that of the adult deer (see the legs).

SCALES: The scales on the more or less naked tails of rats, mice, and beavers are protective, epidermal thickenings of the skins made of keratinized cells. The pangolin is covered with epidermal scales of a different kind. They consists of keratinized cells and are in structure and development basically equivalent to hairs.

The armadillo has both epidermal scales and dermal bones. The epidermal scales resembles the scales on the tails of the rats and beavers. The dermal bone is unique among mammals. It is true bone within the dermis, forming a shell constructed somewhat like the armor of a medieval knight. Dermal bone also arose in ancient fishes, the ostracoderms. Total dermal bones are found in some modern fish, in the shells of turtles, and in the skin of many lizards and crocodilians.

Examine the nine-banded armadillo (Dasypus novemcinctus). Note the arrangements of dermal bone and epidermal scales. How do the size and the shape of the two layers compare? How is the shell constructed to allow for flexibility?

HORNS and ANTLERS Horns and Antlers are found today only in two mammalians orders, Artiodactyla and perissodactyla. Extinct mammals from other orders (including the Rodentia) also had cranial ornamentations. Five different kinds of head ornamentations are recognized, each occuring in a different family.

HORNS :- True horns are found only in the family Boridae (order Artiodactyla). True horns are always unbranched and permanent and are composed of two parts. The bony horncone and the horn itself. The cone extends upwards or outwards from the frontal bones. Horns are covered by a sheating layer of keratinized epidermis, the horn. The horns grows from its base throughout the adult life of the animal.

Examine horns and horncones of the available bovids (cow, Bos taurus, and on wall bighorn sheep, Ovis canadensis and mountain goat, Oreamnos americana). There are no cross-section of horns in the UMD collection. Size, length and curvature of horns varies among species.

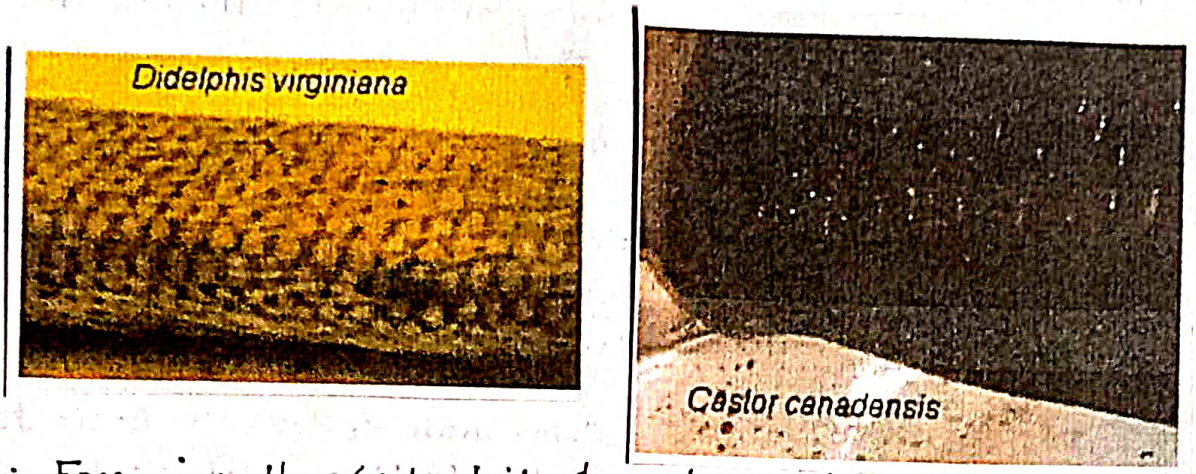


Fig: Examine the scaly tail of a beaver (Castor Canadensis) on rat (Rattus norvegicus) or opposum (Didelphis virginiana) and note the placement of hairs in relation to the placement of scales.

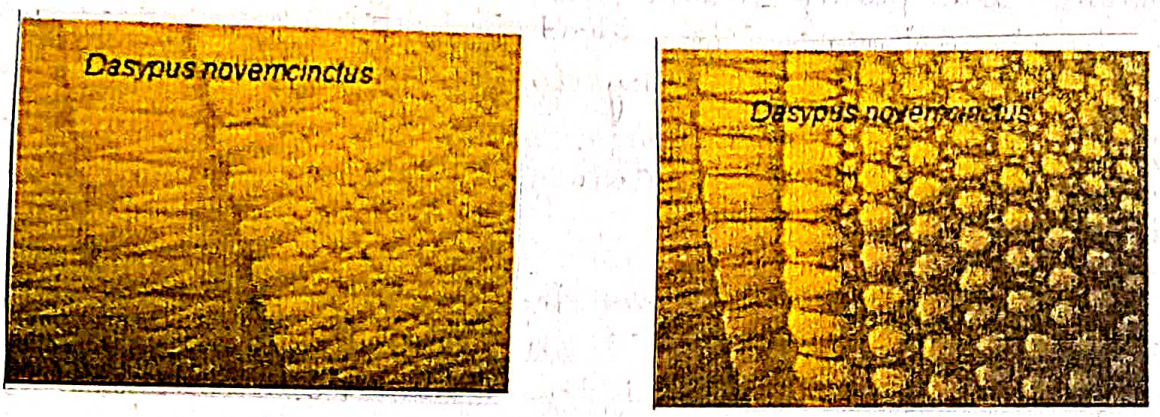


Fig:- Shell of a nine banded armadillo (Dasypus novemcinctus)

PRONGHORNS :- The pronghorns of western north america is the only living species of the family Antilocapridae (Artiodactyla) As in the Bovidae horn (Properly called a pronghorn) has a bony core covered by a keratinized sheath and serves a similar function. However unlike other horns, in pronghorns the sheaths are (1) branched and (2) deciduous. They are shed annually after the breeding season. The new sheath grows while the old one is still in place, and only pushes it off when its development is much advanced. Both sexes have pronghorns, but they are more prominent in the males. In females, the pronghorns sometimes are unbranched or absent altogether. Compare the diagrams of the pronghorns. with the diagram of the bovid horn.

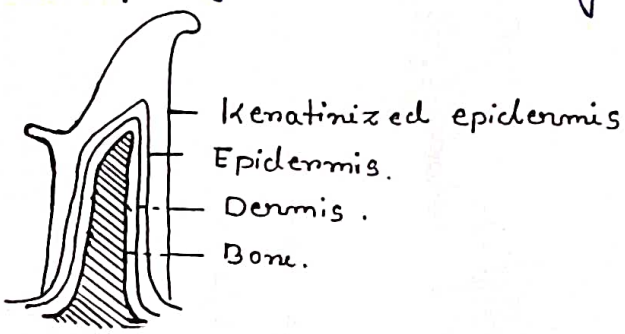


Fig :- Cross-Sectional diagram of a pronghorn (DeBlase and Martin, 1981)

ANTLERS :- Antlers are only found in family Cervidae (Artiodactyla). Antlers are present only in males, except for female Caribou (reindeer) in the genus Rangifer. Fully developed antlers are made completely of bone. They arise from bony stumps (pedicels) on the frontal bones. The pedicels are covered with skin. The antlers themselves are shed after the mating season. The point of seperation between antlers and pedicel is the burr. In spring a new set of antlers begins to grow. The developing antlers are covered with a layer of skin and short hairs. This 'velvet' carries blood vessels and nerves supplying the growing bone. when growth is complete the blood supply ceases and the velvet is shed or rubbed off. Antlers are usually used only during sparring matches and in displays to potential mates and rivals. Antlered animals tend to use their hooves for defence when attacked by predators.

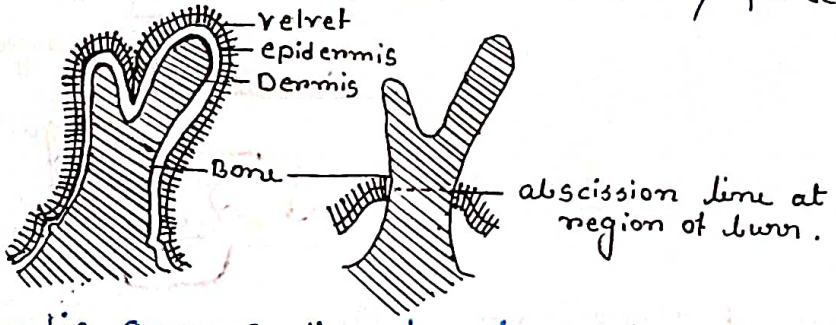


Fig :- Diagrammatic Cross-Section of a developing antler (DeBase & Martin, 1981)

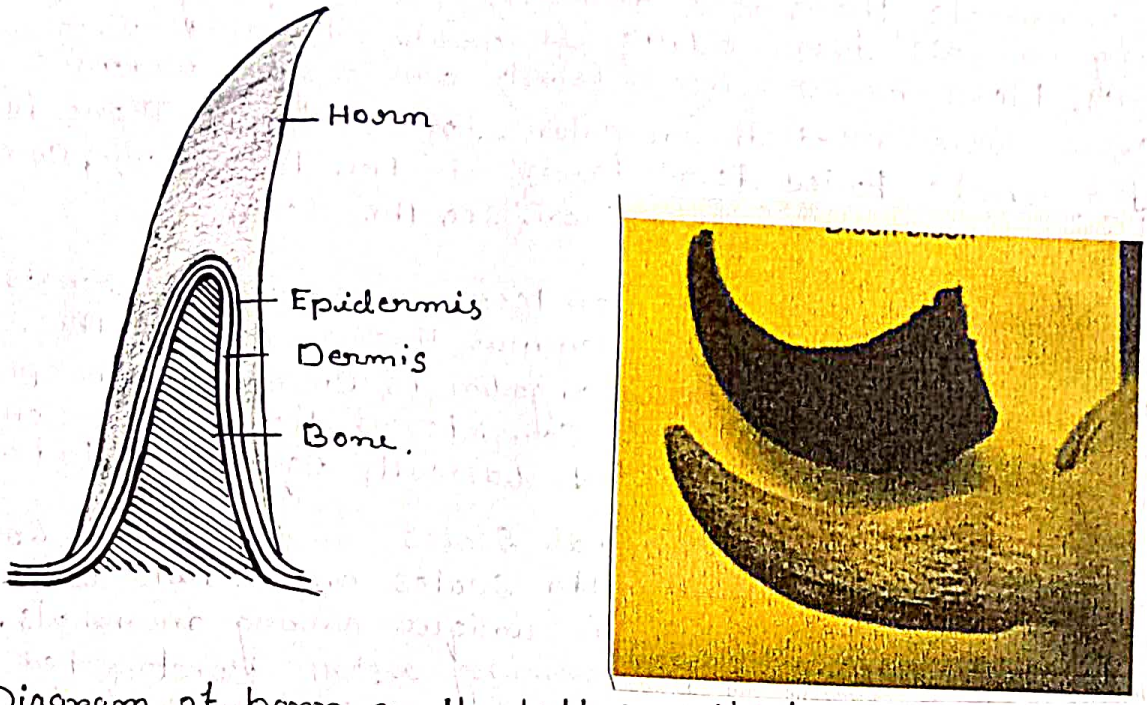


Fig:- Diagram of horn on the left and the horncore and horn of a bison on the right. This specimen is available in the laboratory.

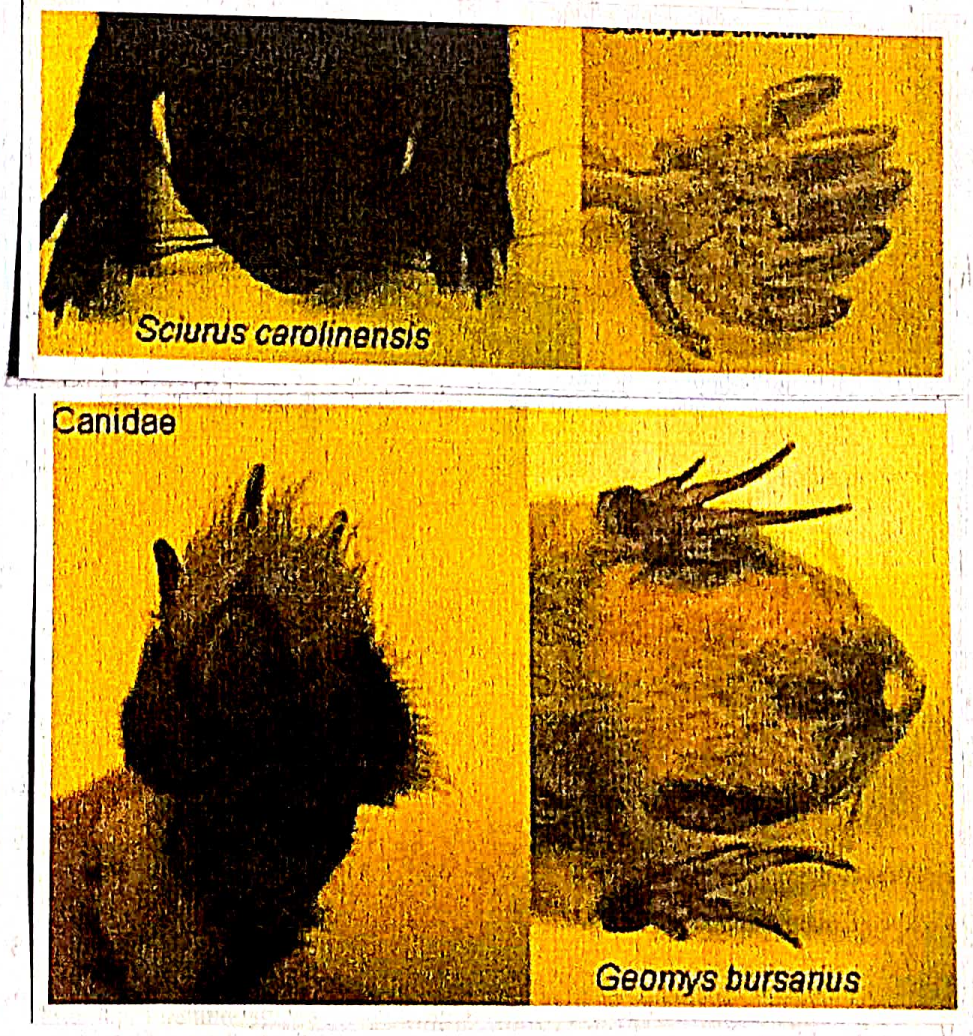


Fig: Pictures of claws of several species that are present in the lab.

Be able to distinguish to species the antlers of available Cervids and white tailed deer odocoileus virginianus, wapiti (elk) Cervus elapus, moose, Alces, alces and Caribou Rangifer tarandus. Moose antlers are palmated, while Caribou antlers have a small amount of palmiton and the brow line. wapti antlers are larger than deer antlers and have a single beam that branches. white-tailed deer antlers typically curve forward and around, while mule deer antlers appear to branch rather than curve around. The mule deer antlers present in the laboratory are not the best examples of this type of branching.

Look at the skulls of male and female moose, and also at the skulls of male and female deer.
Note the abscission line and /or the pedicel. Claws, hooves, Nails.

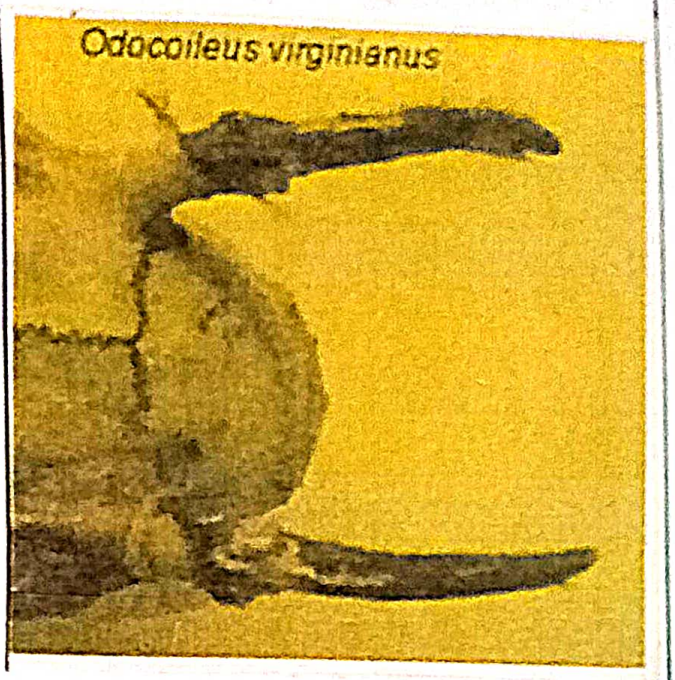
Objectives :- In this section we learn about claws, hooves and nails of mammals. you should be able to identify and apply correctly all underlined terms.
The ends of most digits of mammals other than whales and most Sirenians are protected by hardened plates of the protein Keratin (also present in hair). These plates take the form of claws, nails, or hooves. They are formed by the epidermis in a process similar to the growth of hair.

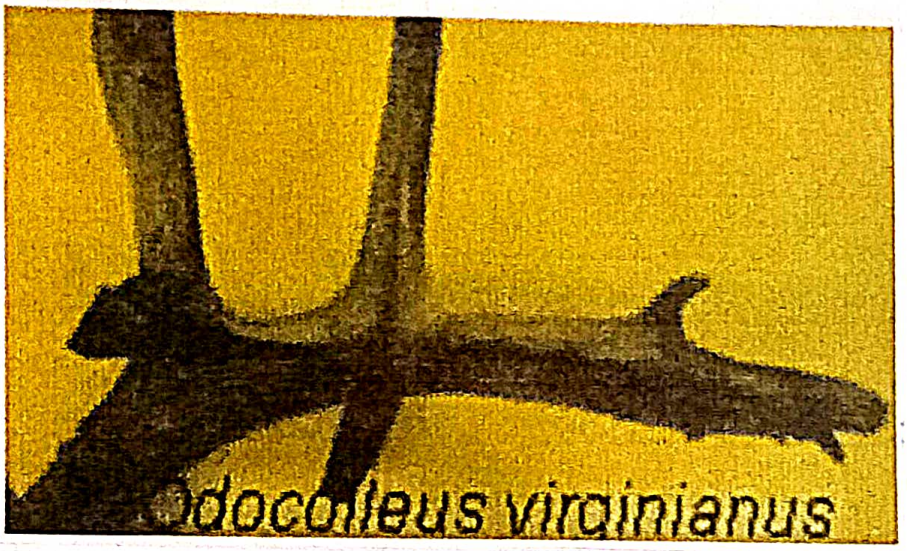
CLAWS :- The claw is the ancestral form of digital covering. Mammalian claws are similar to claws of reptiles and birds. A claw is composed of a harden dorsal plate called the unguis and a softer ventral plate termed the Subunguis. The Subunguis is continued by the cushion like pad. Mammals like dogs, cats walk on these pads. In cross section unguish and Subunguish form a U-shaped structure withe the unguish enclosing the Subunguish. The downward curve is caused by a higher growth rate of the upper surface of the unguis. Claws are used in many ways for climbing, hanging, grasping and even killing prey.

Examine claws of an arboreal Squirrel, cat, dog and a badger or mole. Locate the unguis and Subunguis on each. what is the Principle function of the claws in each of these mammals?

NAILS :- A nail is a simplified derivative of a claw covering only the dorsal surface of the digit. Compared to a claw, the nails wide unguis is thinner and less rigid and the Subunguis is very much reduced. A nail offers less protection than does a claw but exposes the end of the digit to permit more precise manipulation of objects.

Examine your own fingernail and locate the unguis & Subunguis.





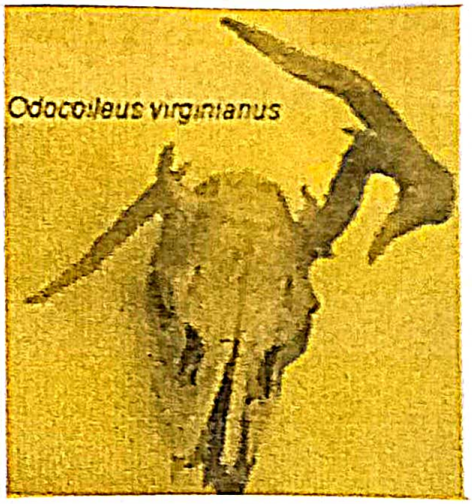


Fig:- Sample skulls of deer (Cervidae) in the laboratory showing different aspects of antler growth.

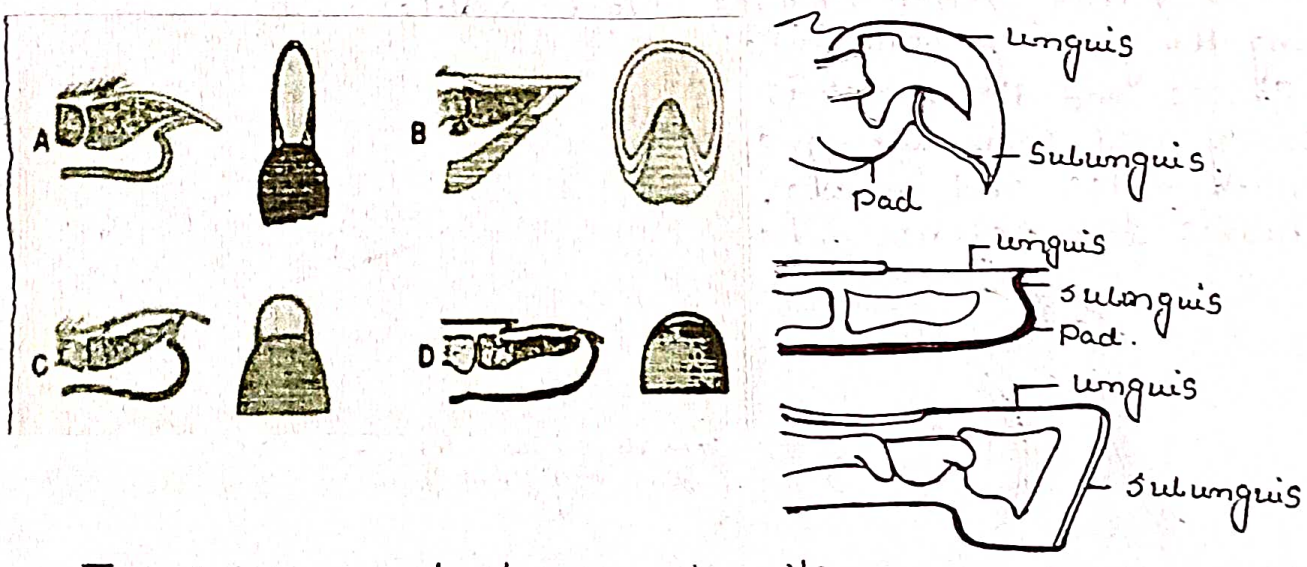
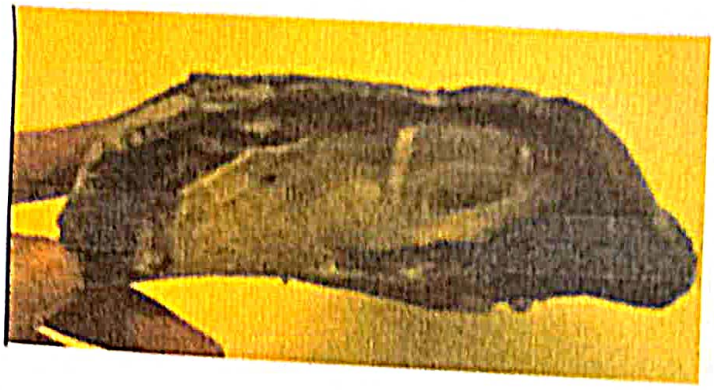


Fig:- Diagram of claws and nails.

Compare with the nail of other primates, Contrast with the claws observed below.

Hooves :- well- developed hooves are found among extant mammals only in ungulates. They are further modified claws in which the unguis encloses both the end of the digit and the Subunguis. The pad lies just behind the hoof and is called the frog. In ungulates normally the only hoof, not the frog, is in contact with the ground.

Examine the hooves of the cow, white tailed deer, and horse hooves in the laboratory. Locate the unguis, Subunguis and frog.



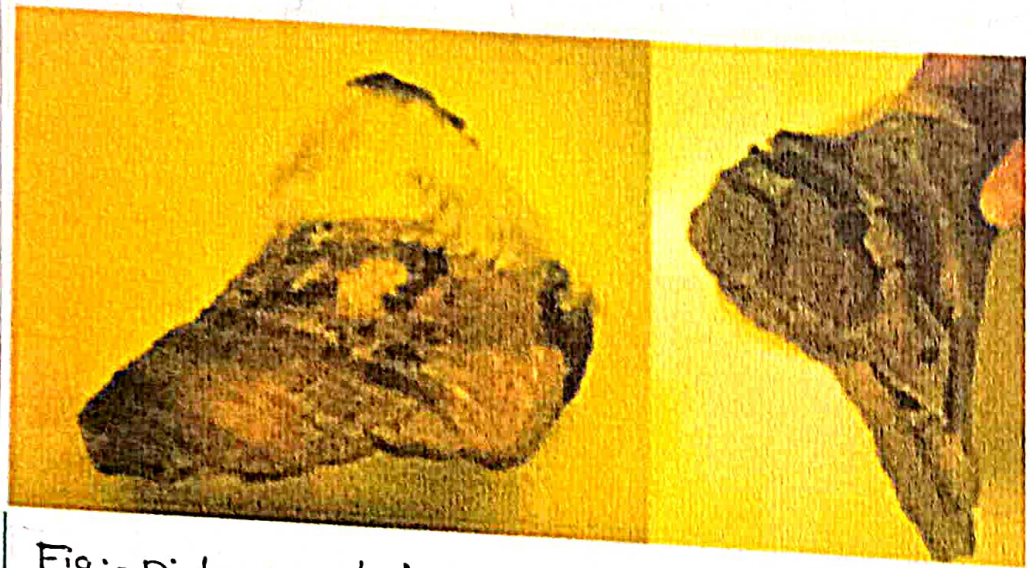


Fig:- Picture of horse hoof (Equus Caballus) in laboratory.

Fig:- Finger nail of a human (Homo sapiens) and the hand skeleton of a monkey, species unknown. Compare your finger nail to the monkey present in lab.

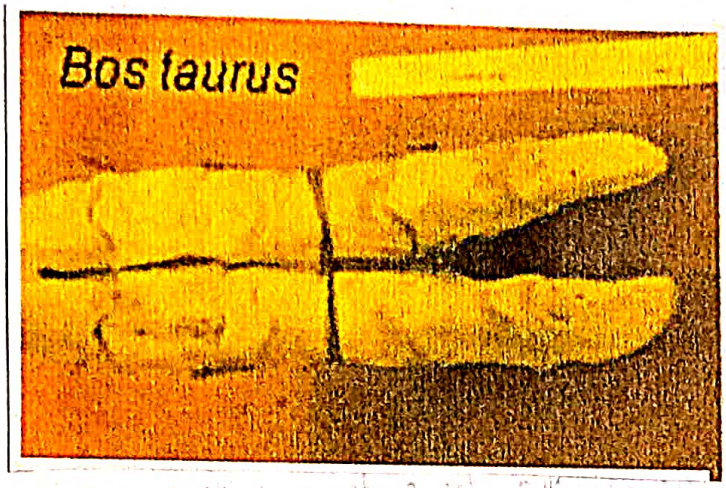


Fig:- Picture of Bos taurus hoof in laboratory.

Fig:- Picture of Odocoileus virginianus hooves that are available in the laboratory.

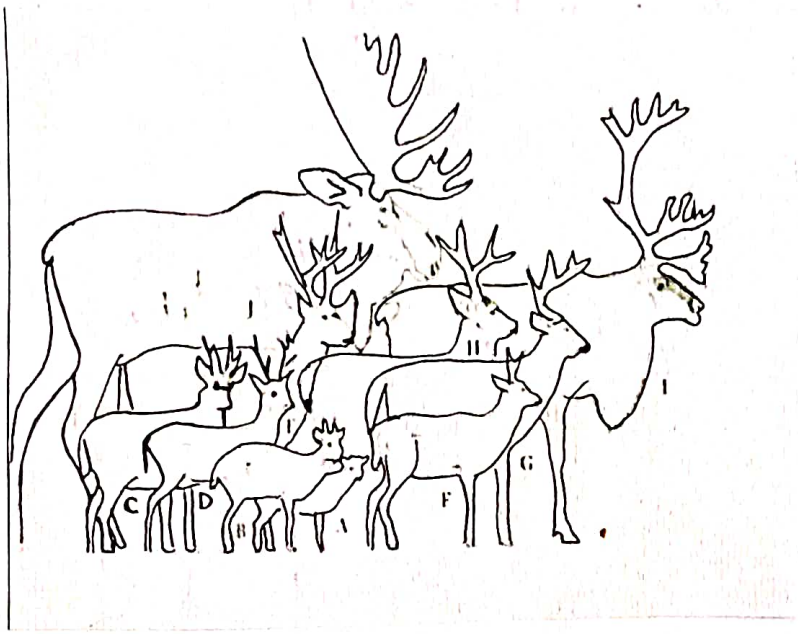


Fig :- Drawing of different antler shapes and body sizes of extant members of the deer family in north and south america.