

UNIVERSITY OF DELHI
SHIVAJI COLLEGE
ZOOLOGY DEPARTMENT
COMPARATIVE ANATOMY OF
VERTEBRATES ASSIGNMENT
ON "INTEGUMENTARY SYSTEM"

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B.Sc. ZOOLOGY (H)

2nd Year; IVth SEM.

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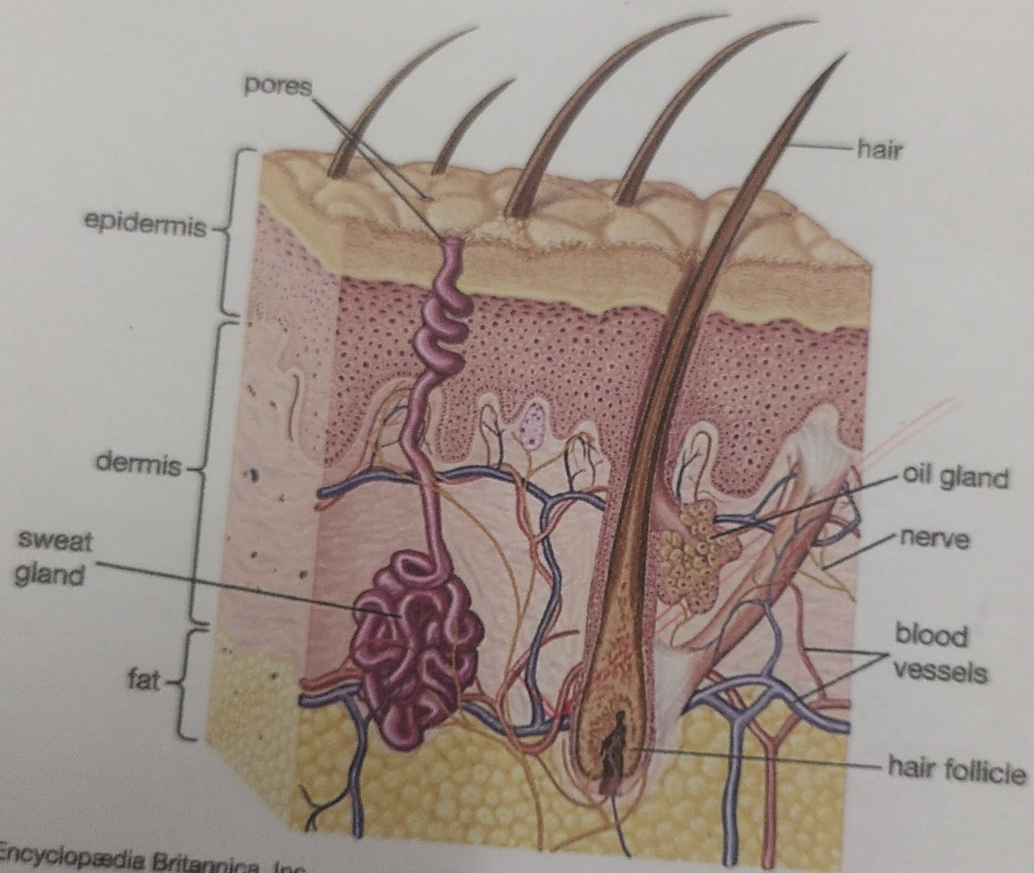
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Integumentary System

Overview - Meaning & Definition of Integument

Integument comes from the Latin word "Integumentum", which means a covering. Integumentary is the adjective form of integument. Below are definitions of the term integument according to anatomy & botany.

In anatomy, the largest organ in humans & vertebrates is the integument. It carries out a variety of essential tasks, such as insulation, thermoregulation, secretion, sensation, & protection against viruses, chemicals & abrasive damage.

In botany, the ovule's integuments are its outer layer(s), & when the ovule matures after fertilisation, they turn into the seed coat. Angiosperms typically have two layers of integument, whereas gymnosperms often have one.

INTRODUCTION

- Comparative anatomy is the study of the anatomical structures of different organisms, with the aim of identifying similarities & differences between them.
- The purpose of this study is to better understand the evolutionary relationships between different species, as well as the adaptations that have allowed them to survive & thrive in their environments.
- One of the key concepts in comparative anatomy

is homology, which refers to the similarity of structures that are derived from a common ancestor.

The forelimbs of mammals, birds, reptiles & amphibians are all homologous structures, despite their different functions, because they are all derived from the same ancestral structure.

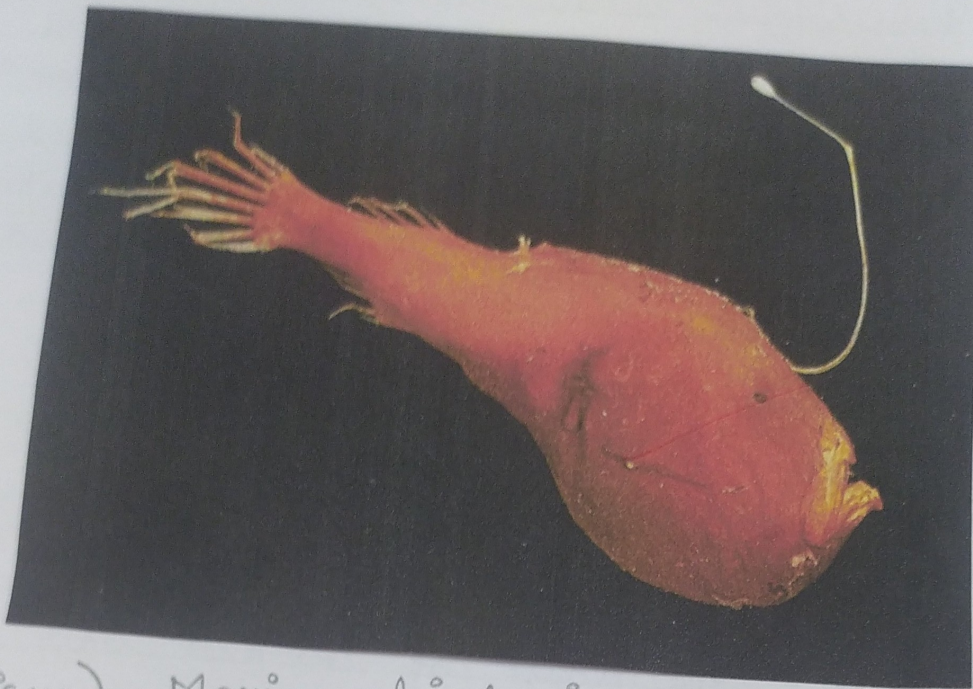
Another important concept is convergence, which refers to the development of similar structures in different organisms as a result of similar selective pressure.

For example, the wings of birds & bats are an example of convergence, as they have similar functions but are structurally different.

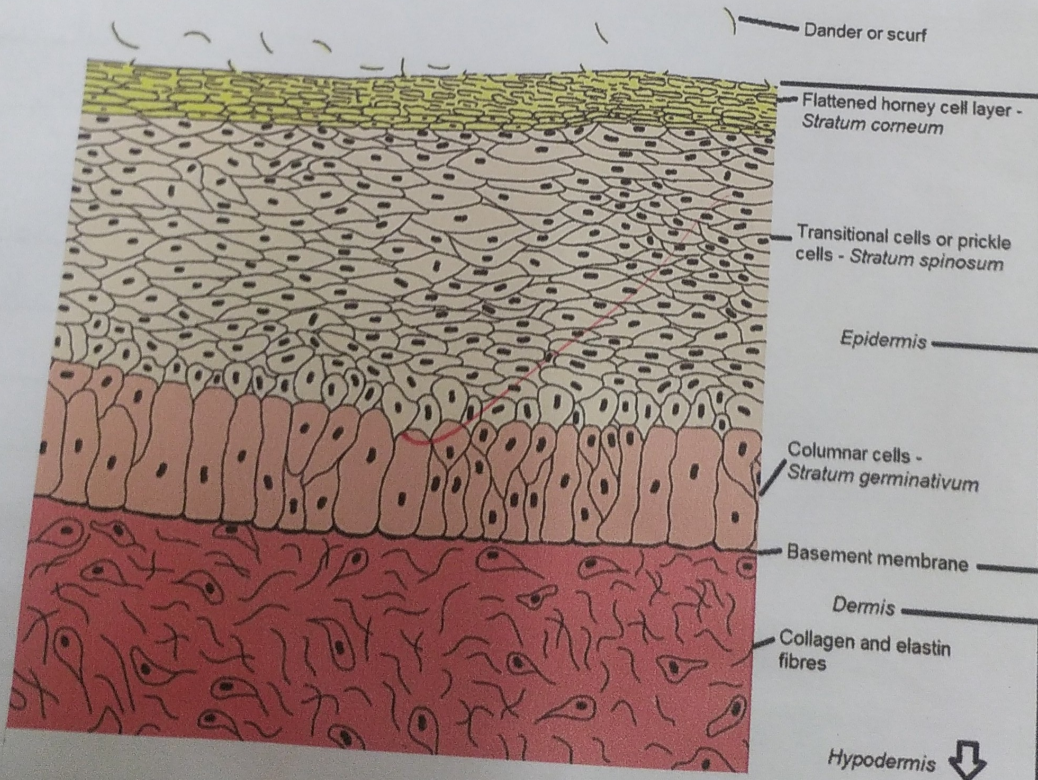
Comparative anatomy can provide insights into the evolutionary history of organisms, as well as their adaptations & relationships to one another.

It can also be used to identify new species or classify existing ones based on their anatomical characteristics.

Comparative anatomy is the study of similarities & differences in the anatomy of different species. In vertebrates, there are several anatomical features that are shared among different groups, as well as some unique features that distinguish them from one another. Here are some examples:-



(In Pisces) Marine-bioluminescence in photophores

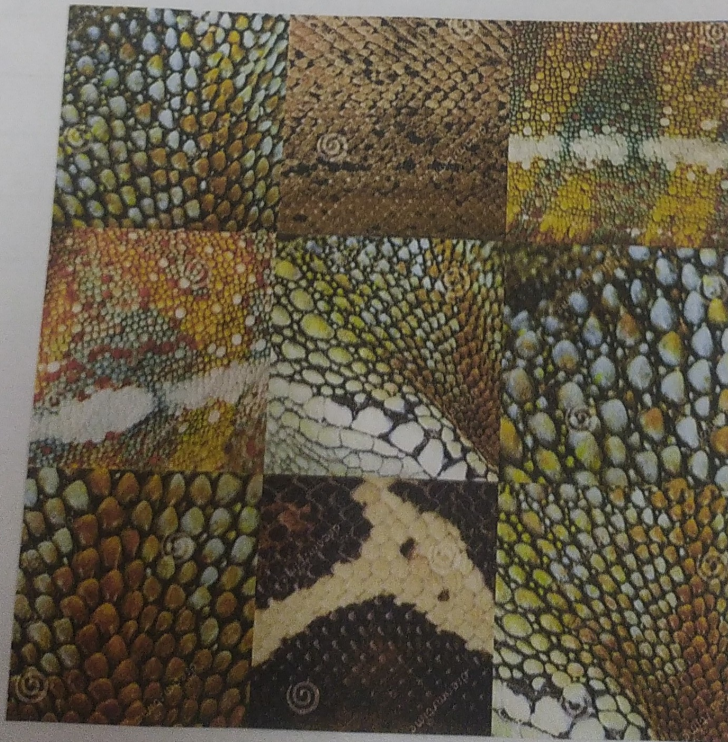


Integumentary System of Birds

- * **Skeletal System** - Vertebrates have an internal skeleton made up of bones, which provide support & protection for their bodies. However, the structure of the skeleton can vary significantly between different groups. For example, mammals have a skull with a single lower jaw bone & a set of specialized teeth while reptiles have a skull with multiple bones in the lower jaw & teeth that are not as specialized.
- * **Respiratory System** - All Vertebrates have a respiratory system that allows them to exchange gases with the environment. However, the structures involved in this process can vary greatly. Fish have gills, which extract oxygen from water, while mammals have lungs that extract oxygen from air.
- * **Circulatory System** - Vertebrates have a closed circulatory system, which means that blood is pumped around the body in vessels. However, the structure of the heart & the number of chambers it has can vary among different groups. For example, fish have a two-chambered heart.
- * **Nervous System** - Vertebrates have a highly developed nervous system that allows them to sense & respond to their environment. However, the organization of the brain & the number of sensory structures can vary among different groups. For example, birds have a well-developed cerebellum, which is important for coordination movement during flight.



Skin of Pisces (Fish lamprey)



Skin of Reptiles (Scutes)

- * **Reproductive System** - Vertebrates have a variety of reproductive strategies, which can involve internal or external fertilization, & different types of eggs or live birth. For example, birds lay eggs with hard shells, while mammals give birth to live young.

INTEGUMENTARY SYSTEM IN VERTEBRATE

The integumentary system is the organ system that consists of the skin, hair, nails & glands.

* Skin

The skin is the largest & heaviest organ in the body. It weighs about six pounds (or more) & is approximately 2 millimeters thick - thinner on sensitive areas like eyelids, & thicker on surfaces that take more stress, like the soles of the feet. One inch of the skin contains nearly 19 million cells.

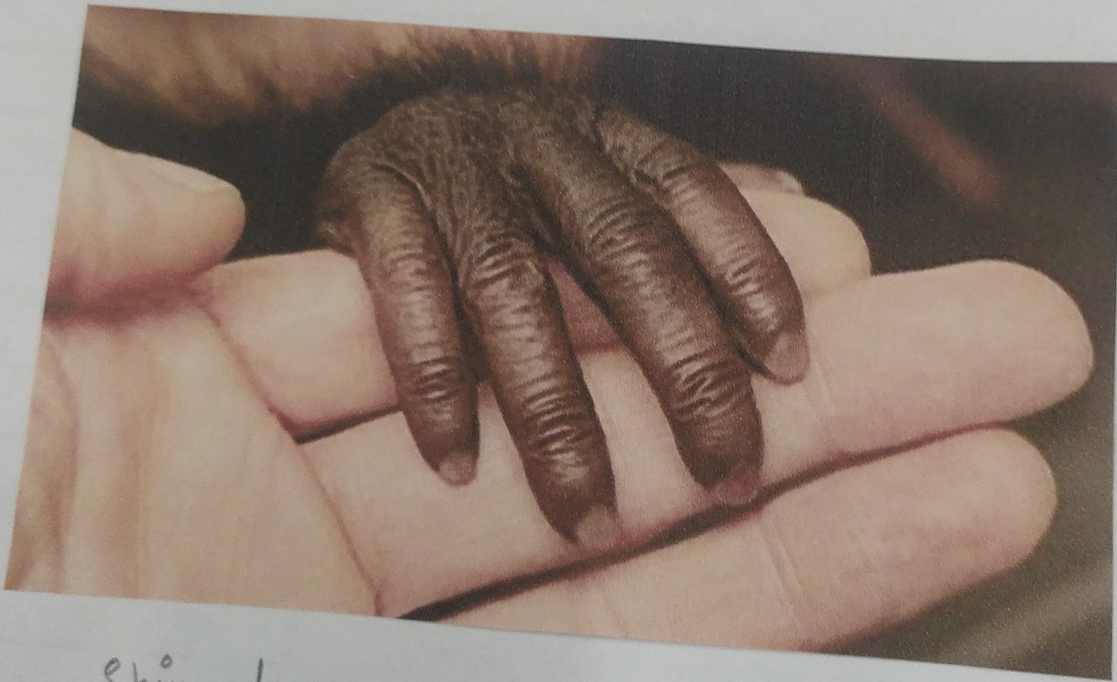
The skin is composed of three layers, with nerves that recognize different sensations in each layer:

* Epidermis

The top layer of the skin. This is the part of the skin that you can see & touch. It's made up of three types of cells: melanocytes, keratinocytes & Langerhans. It gives the skin its color & provides a waterproof barrier.

* Dermis

The middle layer of the skin. This layer is the



Skin of mammals (Human + Animal)

thickest It contains sweat and oil glands & hair follicles

* Hypodermis

The bottom layer of the skin It's the fatty layer of the skin that helps insulate the body.

* Hair

Hair is a thread-like outgrowth of the epidermis that covers the body & provides insulation, protection & sensory feedback. Hair growth & structure vary among species & can also be influenced by hormones & environmental factors. The hair is made of a protein called keratin. Hair consists of three parts -

* Hair shaft

The part of your hair you can see, touch & style

* Hair follicle

The tube-like structures that keeps your hair in your skin.

* Hair bulb

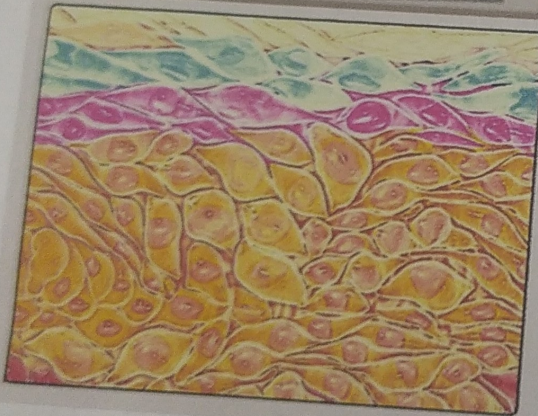
located under your skin & responsible for hair growth

Goosebumps are caused by your integumentary system. We all have hair erector muscles connected to our hair follicles & skin. When it contracts, it makes your hair stand up. The 'Goosebumps' are what we see when these tiny muscles contract.

EPIDERMIS



ANIMAL EPIDERMIS



PLANT EPIDERMIS



* Glands

* Sebaceous Glands

These glands produce sebum (oil) & give your face its oil.

* Ceruminous Glands

These are the glands in your ear that secrete ear wax.

* Mammary Glands

These are the glands on a person's chest. In people assigned female at birth (AFAB), mammary glands produce milk after giving birth.

STRUCTURE INTEGUMENTARY SYSTEM

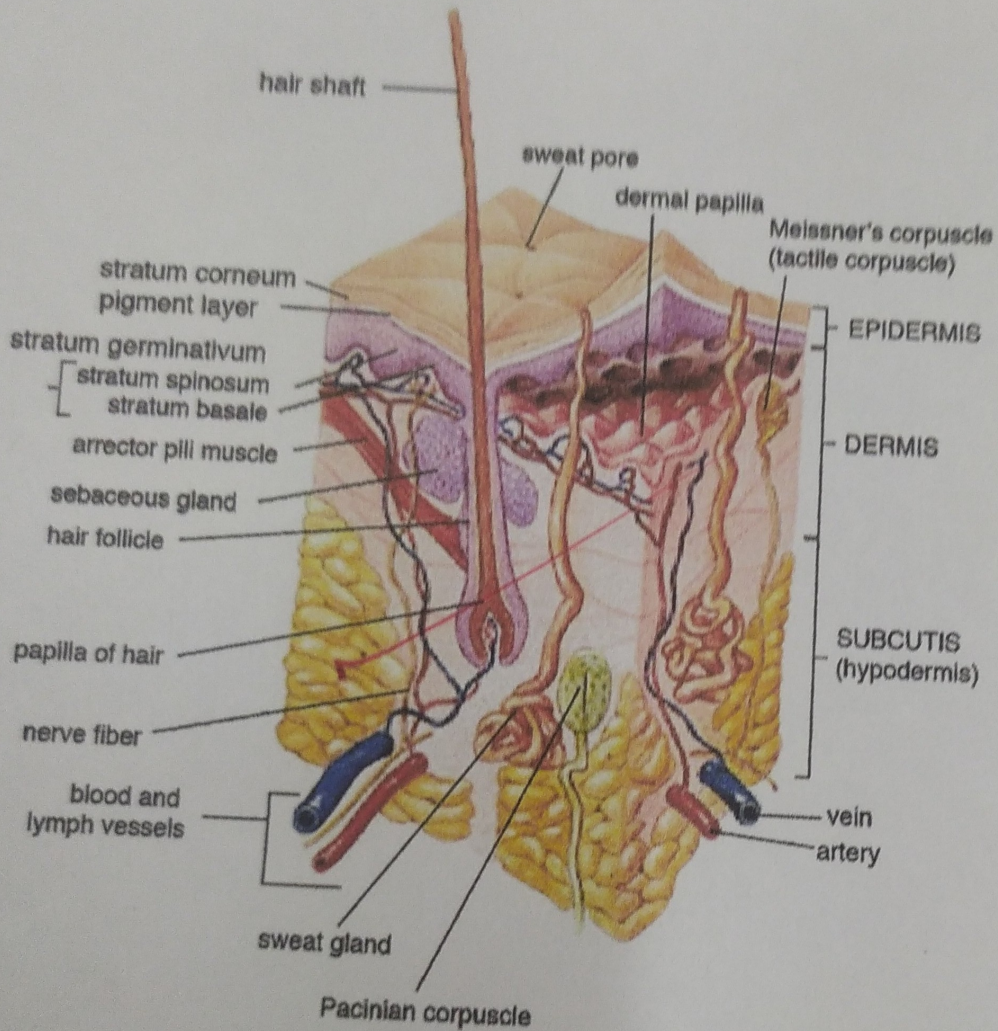
The structure of integumentary system is the organ system that covers & protects the body from external damage & harm. The skin of all vertebrates is multicellular & having two layers.

1. An outer epidermis developed from ectoderm.
2. An inner dermis derived from the mesoderm.

1. Epidermis

Epidermis is a stratified epithelium. It has 2 regions;

- a. The outermost region of many layers of dead, squamous cells from a horny, resistant covering or stratum corneum on the skin surface. Its cells



Dermis or Corium
in Vertebrates

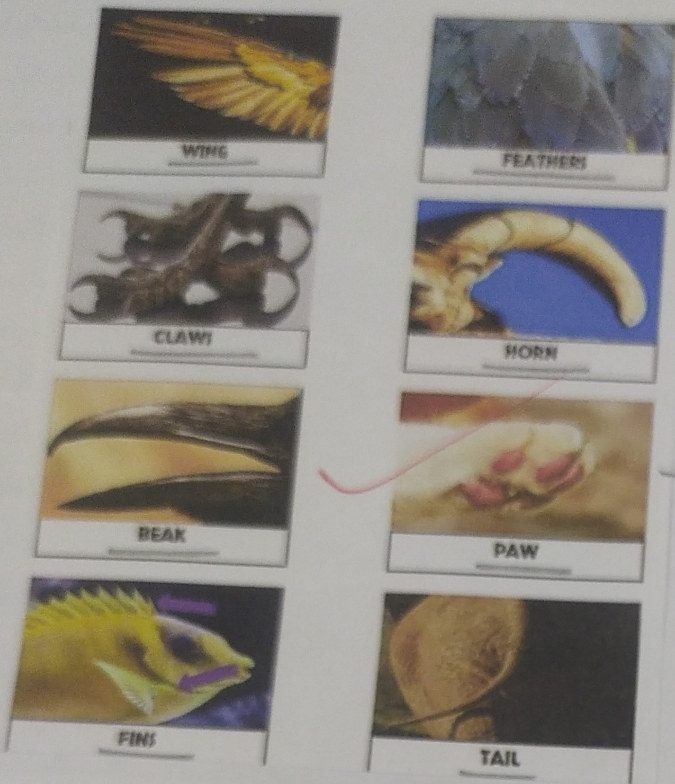
accumulate a horny protein called keratin, gradually die, and eventually wear off in the form of scurf or dandruff. Since keratin is tough & insoluble in water, the keratinised stratum corneum provides protection against mechanical injuries, fungal & bacterial attack, & loss of body moisture.

- b. The innermost or basal region of epidermis includes a single layer of living columnar cells, the Malpighian layer or stratum germinativum & it is separated by a basement membrane. The cell actively divides & continuously replace the worn-out cells of the cornified layer.

Epidermis is thin in aquatic vertebrates & rich with mucous glands. It is thicker in land vertebrates & structures such as - Scales, feathers, hairs, nails, claws, horns & enamel of teeth derived from the Malpighian layer.

2. Dermis or Corium

It is inner layer of skin. It is composed of fibrous connective tissue & contains many blood capillaries, lymph vessels, muscle fibres, nerve fibres & sense organs & elastic fibres which bring the skin back to its normal shape, melanin pigments & pigment granules are also found in epidermis. Fat may accumulate as reserve food in special cells called adipocytes, in deeper parts of dermis & in the subcutaneous tissue.



Epidermal derivatives



Hard + horny structure

Dermal Derivatives

(a)

(b)

(c)

(d)

fin rays ←

DERIVATIVES OF INTEGUMENT IN VERTEBRATES

Depending upon the layer of skin from which they are derived, they are Dermal derivatives & Epidermal derivatives.

A. Epidermal derivatives & B. Dermal derivatives

A. Epidermal derivatives comprise (1) epidermal glands and (2) hard horny structure including epidermal scales, Cuts, beaks, horns, claws, nails, hoof, feathers & hairs etc. all the hard horny structure together forms exoskeleton of an animal.

B. Dermal derivatives - Comprises bony or dermal scales plates or Scutes, fin rays & antlers etc.

A. Epidermal derivatives-

1. Epidermal glands - It is formed by the Malpighian layer of epidermis but often invade the dermis they may be Unicellular or multicellular. They are as follows-

a. Mucous glands - They secrete MUCIN which forms slimy or sticky mucous on coming in contact with water, it keeps the skin moist and slimy protect the skin from against harmful bacteria & fungi. Abundant in Amphibian skin.

b. Poison glands - They are modified multicellular Cutaneous glands larger but fewer than mucous glands. The parotid glands behind the head of toads are aggregation of poison glands. Secretion of poison glands

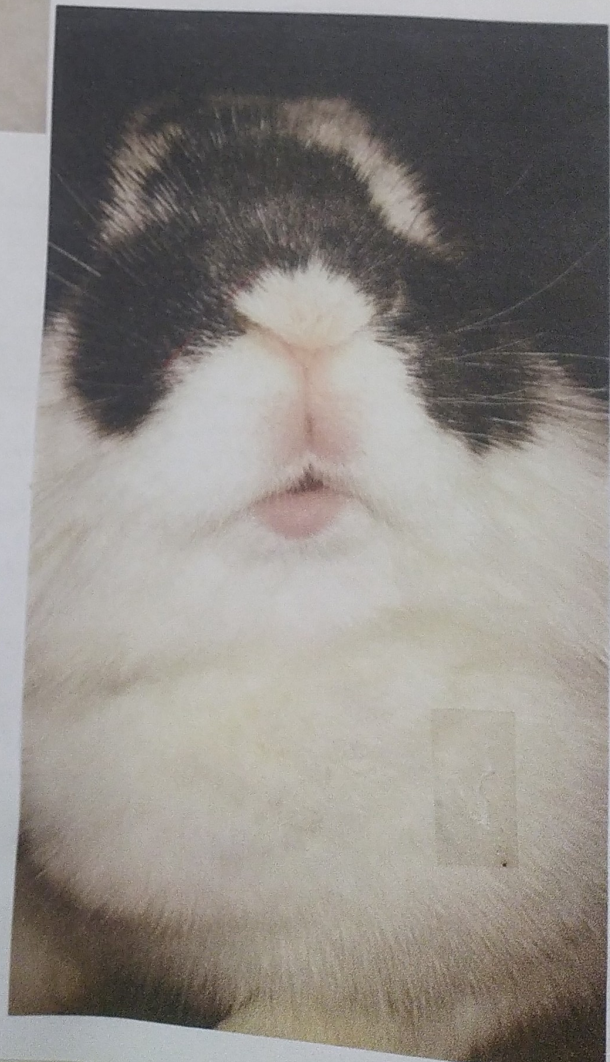
Luminescence
glands or
Photophores



Soles of feet (cats)

Sweet glands

Soles of lips
(Rabbit)



may be bitter, irritating, or even dangerous to the predator.

c. Luminescence glands or photophores - in deep sea luminous teleost fish's certain multicellular epidermal glands serve as light emitting organs known as photophores.

d. Femoral glands - These are found in lizards on the ventral side of both thighs. The sticky secretion hardens in air to form temporary tiny spines. That serve to hold the female at the time of copulation.

e. Sweat glands - It is abundant in most mammalian skin; they are slender coiled tubes embedded deep in dermis, with their long ducts opening on skin surface. It regulates the body temp. Sweat glands are absent in Scaly anteater & marine mammals. In some animals it is occurs in the soles of feet (cat), lips (rabbit) etc. Male giant kangaroo & hippopotamus secrete red coloured sweat. In eye lashes & long margin of eyelids are modified sweat glands.

f. Sebaceous glands - These are branched alveolar glands opening into the hair follicles of mammals. Their oily secretion, called SEBUM (grease) keeps the skin & hair soft, greasy, waterproof & glistening. In mammals it is absent, which are practically devoid of hairs, CERUMINOUS glands of external ear canals.



Scent glands → toes on feet (goat + horse)



(In Snakes) → on the Ventral
Surface Called Scent

modified Sebaceous glands, greasy secretion of this glands, called CERUMEN, helps to protect the ear from dust particles & trap the insects. MEIBOMIAN glands of eyelids are modified Sebaceous glands.

g. Scent glands - They are modified Sebaceous glands of mammals and their odor secretion serve as repel foes & attract the opposite sex. Scent glands may occur in between toes on feet (goat, rhino, horse) navel on abdomen (musk deer) etc.

h. Mammary glands - Characteristics of mammals, these are compound tubular glands that produces milk during lactation period for feeding the young ones. Usually, they are present only in female but in monotremes, primates & some other it presents in male also.

2. Epidermal Scales & Sutes - They are developed by the accumulation of a protein, known as KERATIN. All the stratum corneum cells are cornified & form horny hard exoskeleton like Scales, hairs, beaks, horns, claws, nails etc. in different Vertebrates.

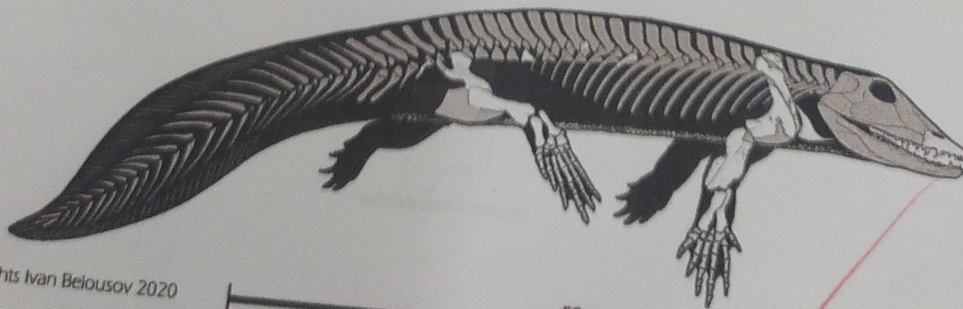
In reptiles having continuous outer covering of horny epidermal Scales that prevent water loss through the skin surface. In Snakes also the Scales are overlapping enlarged on head, called shield & on the ventral surface called Sutes, which aid in locomotion. Crocodiles and turtles have Sutes. In birds, small Scales are present on the long leg, foot &



Dermal Scales in fishes

Tulerpeton curtum

Holotypus: PIN, № 2921/7 partial skeleton.



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50 cm

Dermal Scales in Tetrapods

leak. In mammals like Scaly & caten. the large Scales on body. In armadillos, large body Scales become fused into plates & bands.

B. Dermal derivatives -

Dermal derivatives are i. dermal Scales & Scutes, ii. digital Cornification, iii. horns, iv. feathers & v. hairs

1. Dermal Scales & Scutes - Bony structures develop within the dermis & are mesodermal in origin.

a. Dermal Scales in fishes - in fishes Scales form the exoskeleton. 5 types of Scales are known depending on their structure, in fish. i. Cosmoid (extinct), ii. placoid Scales are characteristic of elasmobranch (chondrich-thyes), iii. Ganoid Scales in Ganoid fish (chondrosteans & holosteans). iv. cycloid & v. ctenoid Scales, characteristic of modern teleosts.

b. Dermal Scales & Scutes in Tetrapods - A few lizards exhibit small dermal Scales (crocodiles); alligators have many oval bony plates embedded in the dermis & turtle large bony plates are present.

Amongst the 'mammals' bony plates (osteoderm) occurs in armadillos & in whales.

c. Dermal fin rays - Supporting the fins of fishes are long, flexible fin rays embedded in the dermis.

ii. Digital Cornification - They are modification of stratum



Horn + True horn + Prong horn



Fish Horn

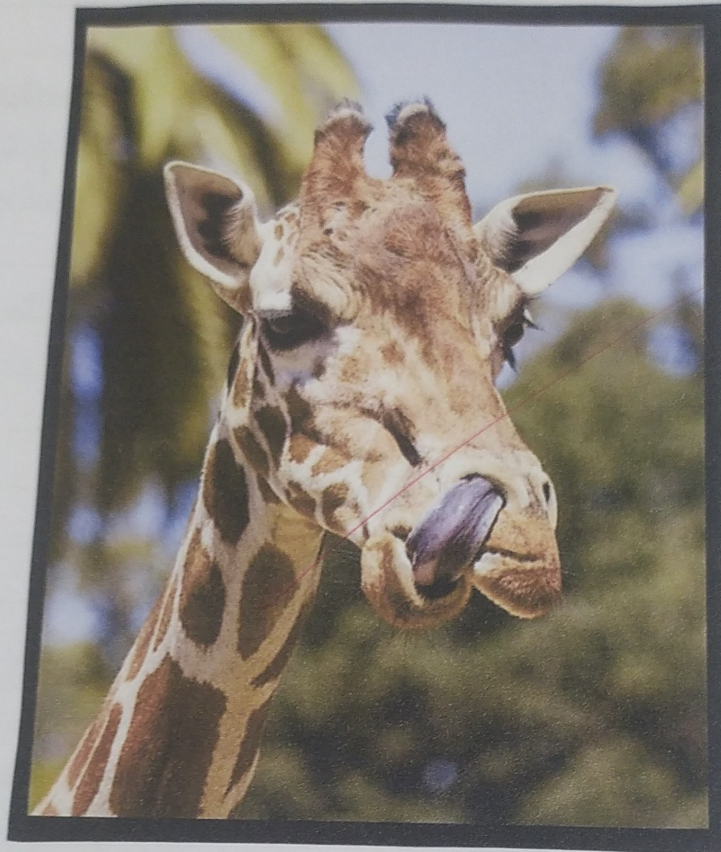
DATE: _____
Corneum at the tip of the digits & grow fused to the skin.

- a. claws - A claw is made by a hard pointed, narrow, horny, curved dorsal plates. It is found in reptiles, birds & mammals.
- b. Nails - claws are modified into nails which are characteristic of primates (Mammals).
- c. Hoofs - It is the characteristic of Ungulates (Hoofed Mammals).

i. Horns - Horn are found in hoofed mammals only. They are the organs of defense & offence. At least 5 types of horns are recognized but all are not true horns, that is the product of stratum corneum.

True horn - true horns or hollow horns are found in both sexes of goat, cattle, sheep & others. They are unbranched & cylindrical & tapering, permanent structures that continue to grow throughout life & never shed.

Prong horns - Prong horns are true horns but the horny sheath of prong horn bears 1-3 branches, & it sheds every year. The permanent body core become the base around which a new horn is developed.



Giraffe horns



Feathers

c. Antlers - It is the characteristic of deer family. They are only found on males. Antlers are annual growth & true horns.

d. Giraffe horns - It is stunted, unbranched & permanent antlers present in both sexes of giraffe. Each consists of a short bony dermal core, covered with simple unmodified skin or velvet which is never shed.

e. Hair horns - Hair horns or fibre horns are found in rhinoceros of both sexes, perched upon a roughened area of nasal bones. These horns are completely made of thick & keratinized epidermal fibres fused together. These are permanent structure, if broken they again grow out.

iv. Feathers - Feathers are found only in birds. They are dry, nonliving & cornified product of stratum corneum of epidermis. Generally, 3 types of feathers are recognized, contour, down (plumules) & filoplumes (hair like).

v. Hairs - Hairs are characteristic of mammals. They may cover entire body (furred animal) or may be reduced to patches (man) or to scattered hairs (whales).



Integumentary System in all
Vertebrates

(Animal World)

FUNCTION OF INTEGUMENTARY SYSTEM

function of integumentary system -

The integumentary system serves several important functions in the body including

Protection

The skin acts as a barrier between the body & the external environment, protecting the body from physical, chemical & biological damage.

Thermoregulation

The skin helps to regulate body temperature by controlling the amount of heat loss through sweating & blood flow to the skin.

Sensory Reception

The skin contains sensory receptors that respond to touch, pressure, temperature, & pain, allowing us to sense & respond to our environment.

Vitamin D Synthesis

The skin is capable of producing vitamin D when exposed to sunlight, which is important for bone health.

Immune Defence

The skin contains specialized immune cells that help to defend against pathogens & prevent infections.

TOPIC

DATE.....

Excretion

Sweat glands in the skin excrete waste products, including Urea & Salt.

Social Interaction

The appearance of the skin, hair & nails can be used for social communication, such as signalling attractiveness or social status.