

COMPARATIVE CHORDATE ANATOMY-I

Class: TYBSc 3+ 6 units Zoology
Paper I, Unit II

Dr. Rupali Vaity
Assistant Professor
SIES College of Arts, Science and Commerce (Autonomous)

UNIT II: COMPARATIVE CHORDATE ANATOMY-I

(15 Lectures)

Structure of integument and its derivative:

- ❖ General structure of integument.
- ❖ Comparative study of skin in different classes
- ❖ Study of derivatives of skin: Epidermal glands, Scales, Feathers, Hair, Beaks, Digital tips, Horns and antlers
- ❖ Special derivatives of skin: whale bone, Rattle in snakes, Liliac callosities in langur/ macaque and kneepads in camel

UNIT II: COMPARATIVE CHORDATE ANATOMY-I

(15 Lectures)

Digestive system:

- ❖ Evolution of digestive tube. Primary divisions of the tube.
- ❖ Tooth structure & position, teeth in lower vertebrates, mammalian dentition.
- ❖ Morphology of gut wall
- ❖ Comparative study of Esophagus, Stomach and Intestine in chordates

UNIT II: COMPARATIVE CHORDATE ANATOMY-I

(15 Lectures)

Circulatory System:

- ❖ Evolution of heart, Heart of gill breathing fishes, Heart of lung fishes and amphibians, Hearts of amniotes.
- ❖ Arterial channels and its modification: Aortic arches in fishes, Aortic arches in tetrapods
- ❖ Venous channels and its modification: Venous system in shark (Basic pattern) other fishes and tetrapods
- ❖ Lymphatic system in the vertebrates.

COMPARATIVE CHORDATE ANATOMY

Chordate



Comparative



Anatomy



CHORDATES

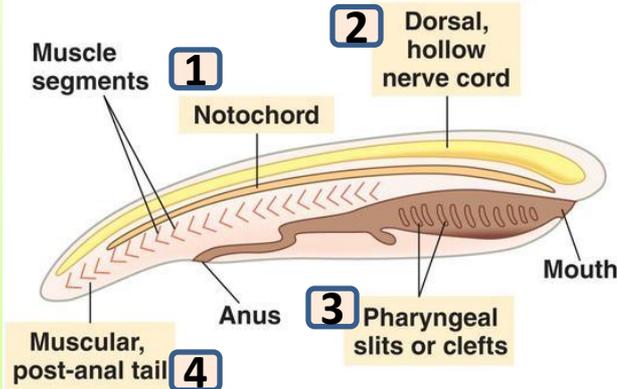
Organisms belonging to Phylum Chordata

Subphylum
Cephalochordata

Subphylum
Urochordates

Subphylum
Vertebrata

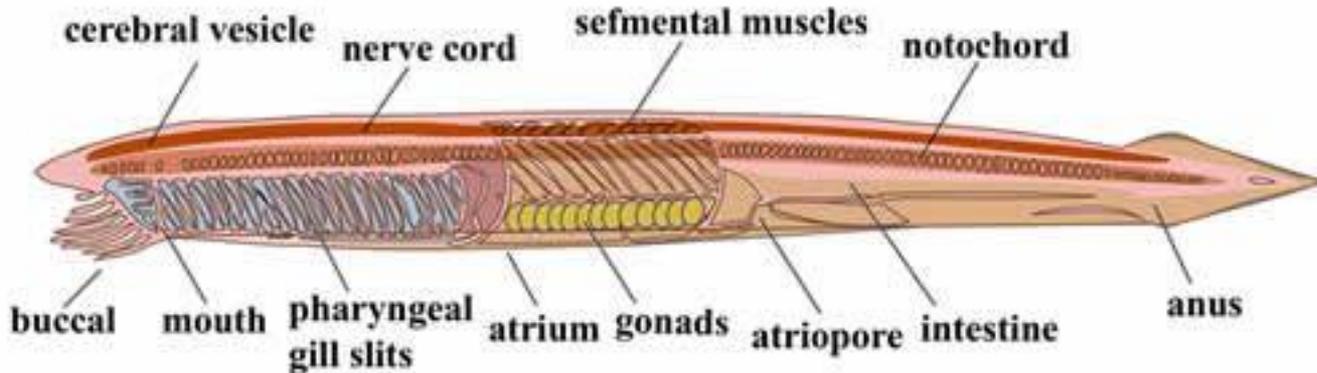
Class Myxini
Class Chondrichthyes
Class Osteichthyes
Class Amphibia
Class Reptilia
Class Aves
Class Mammalia



Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.

NOTOCHORD

- ❖ A cartilaginous skeletal rod supporting the body in all embryonic and some adult chordate animals.
- ❖ Notochord allows for more effective movement

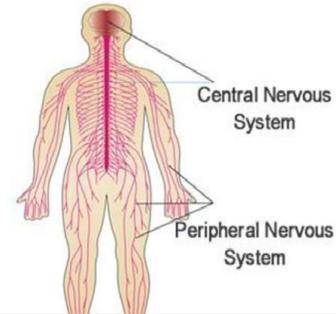
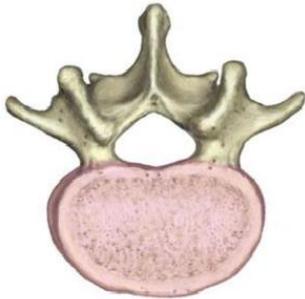


NOTOCHORD

- ❖ In modern bony fishes and some other tetrapods the **notochord** becomes an isolated pad of tissue between one vertebra and the next.
- ❖ In mammals the last vestige of the **notochord** may persist as a pulpy nucleus in the center of the intervertebral disks.

NERVE CHORD

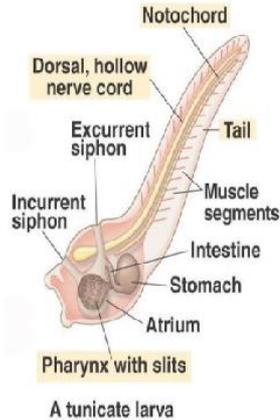
- ❖ Dorsal hollow Nerve Cord
- ❖ Below notochord
- ❖ Continuous with the brain
- ❖ Nerve cord coordinates the functions of the body.



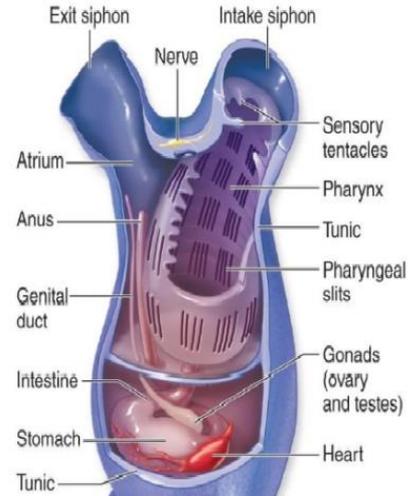
PHARYNGEAL SLITS

Pharyngeal slits are openings in the **pharynx**

Tunicate Larva- shows chordate characteristics



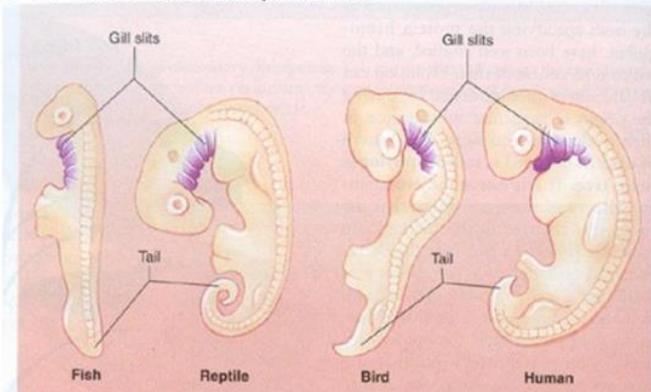
Tunicate anatomy



PHARYNGEAL SLITS

Pharyngeal Pouches

- All Chordates have pharyngeal pouches at some stage in their development.



Pharyngeal Pouches

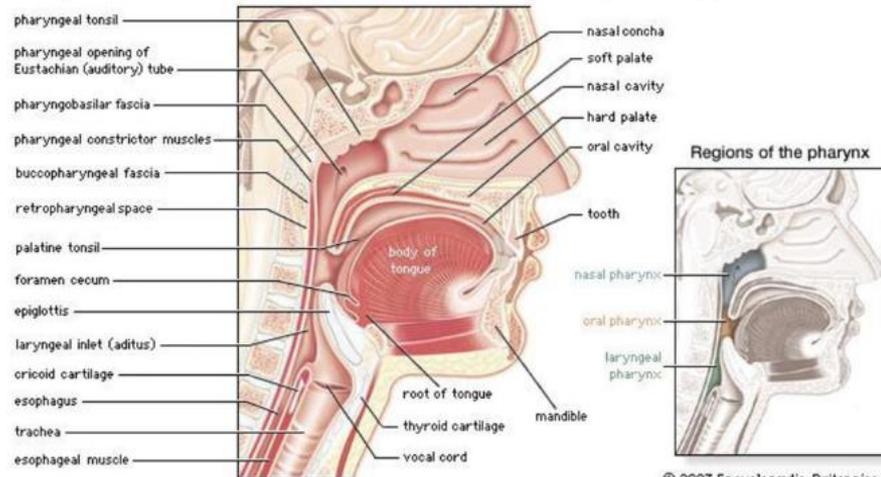
- In some aquatic chordates, such as fish, the pharyngeal pouches become gills.



PHARYNGEAL SLITS

Pharyngeal Pouches

- In humans the pharyngeal pouches become part of our ears, tonsils and thyroid glands.



POST ANAL TAIL

Post-anal Tail



- ❖ Skeletal extension of the posterior end of the body,
- ❖ Absent in humans and apes
- ❖ Present during embryonic development.

ANATOMY

Anatomy is branch of biology that deals with identification and description of the structures of living things.

WHY STUDY **COMPARATIVE** CHORDATE ANATOMY

To understand how the anatomy/ structure of certain parts of the body of chordates change with that of the habitat

To understand how the anatomy/ structure of certain parts of the body of chordates change with that of the habit

To study the development of specific parts or structures of the body from evolutionary point of view

Structure of integument and its derivative

Integumentary system

Organ system

Skin, hair, nails, and exocrine glands

Largest organ in the body

FUNCTIONS OF INTEGUMENT

Protection

Thermoregulation

Respiration

Fat storage

Excretion

Locomotion

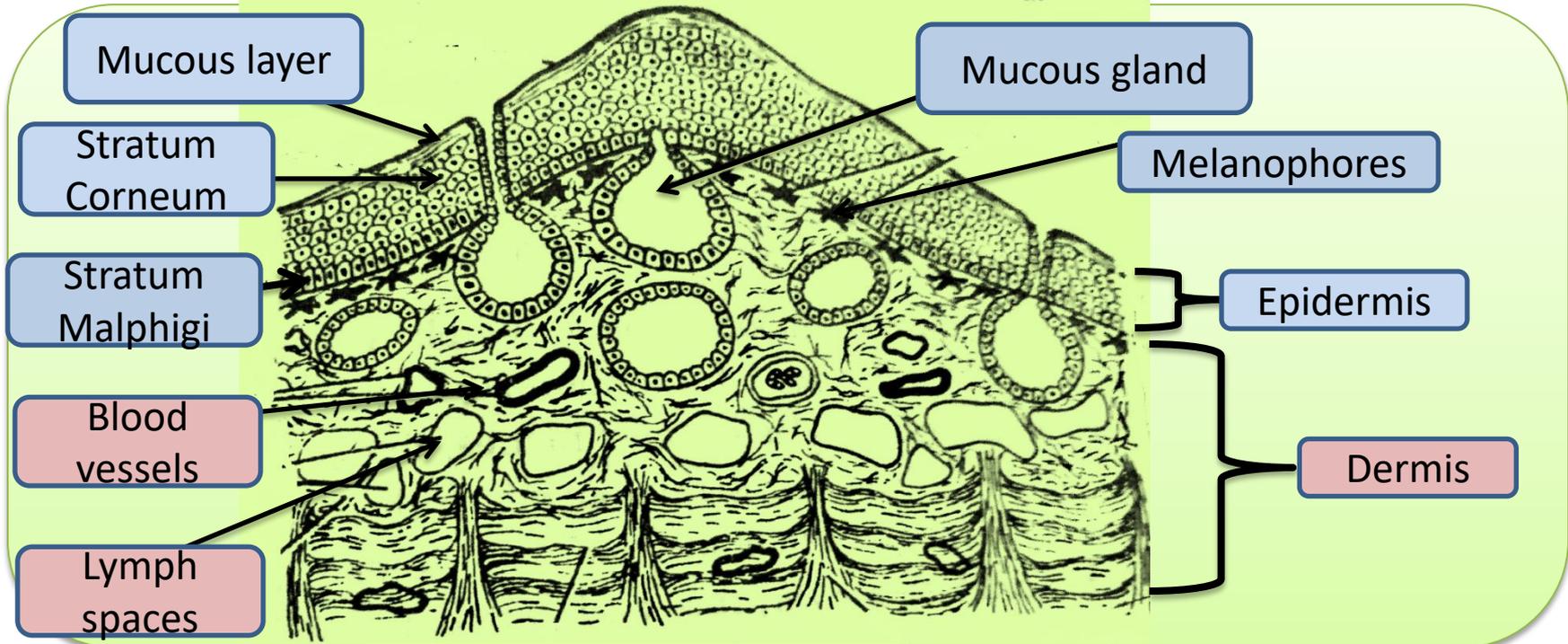
Secretions

Sense organ

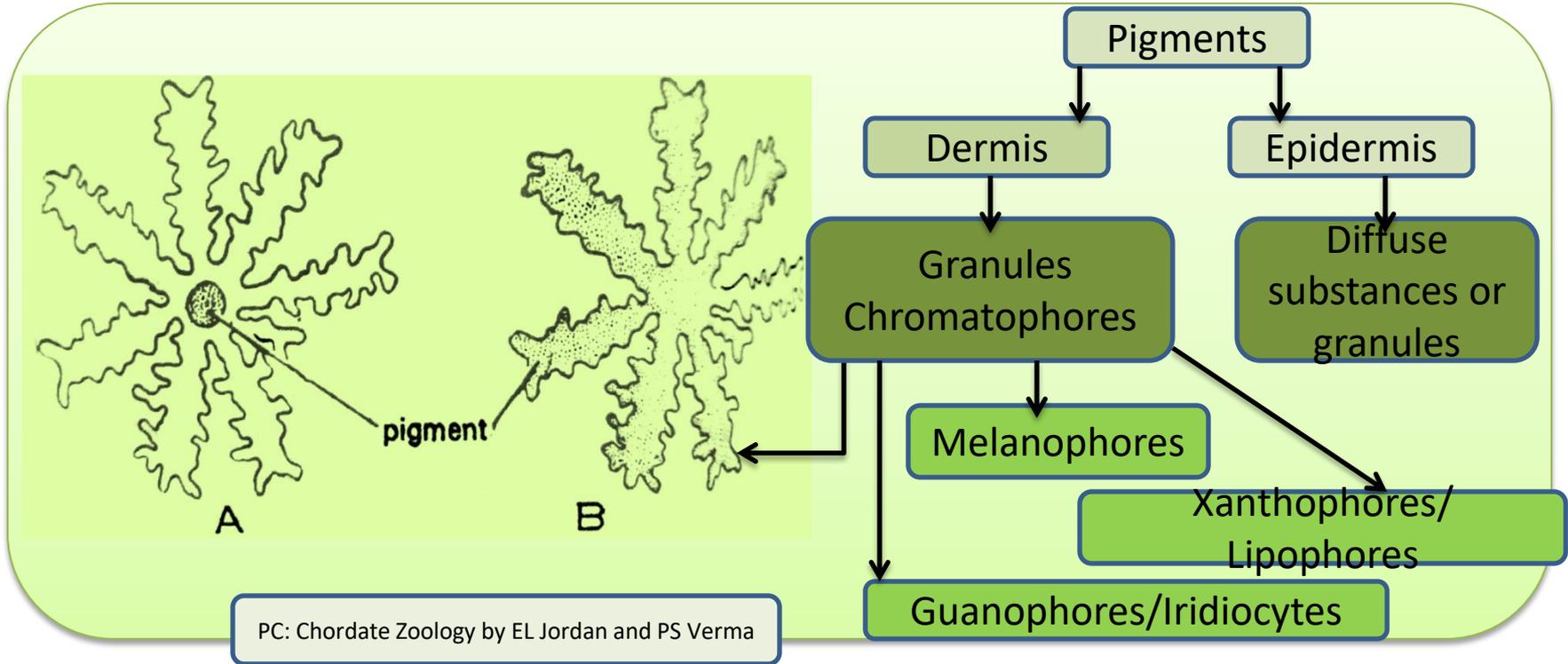
Skeleton

Sexual selection

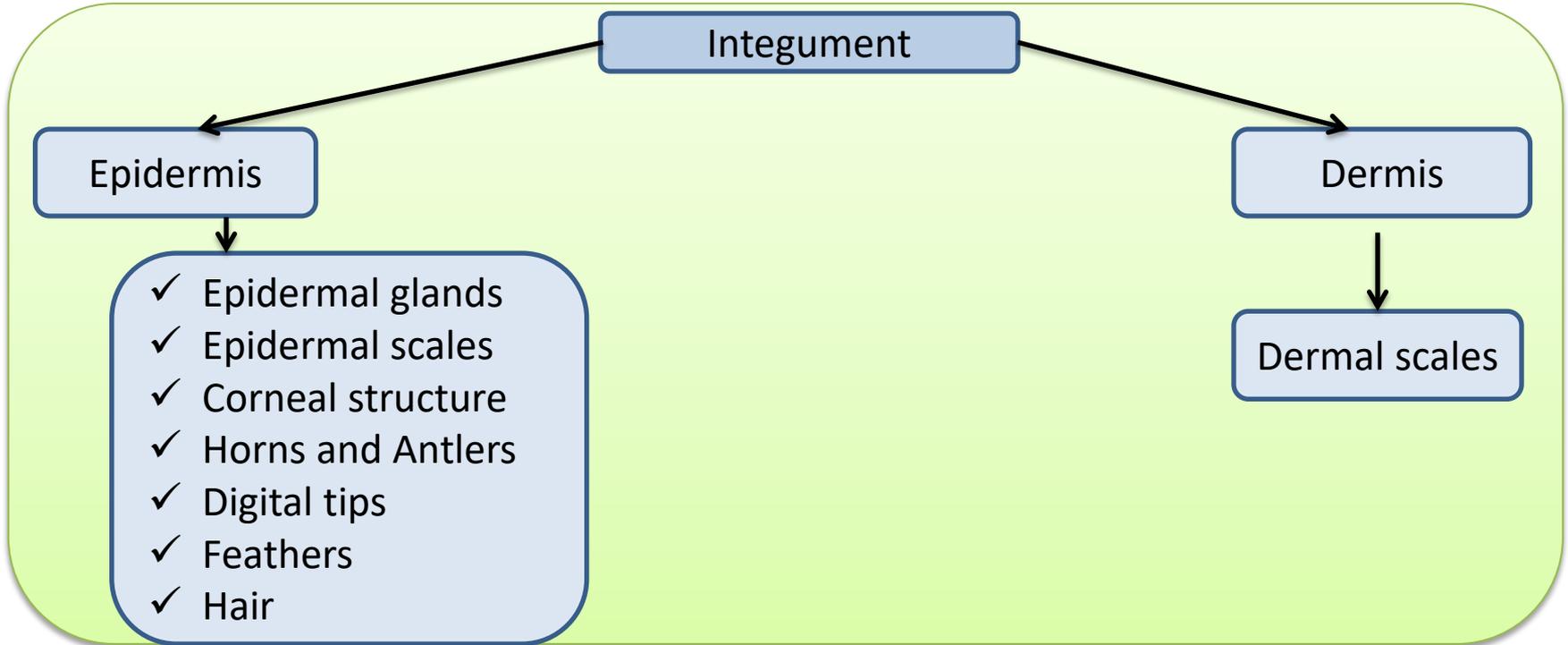
BASIC STRUCTURE OF SKIN



BASIC STRUCTURE OF SKIN



DERIVATIVES OF THE INTEGUMENT



COMPARATIVE STUDY OF INTEGUMENT OF VERTEBRATES

Fish

Amphibian

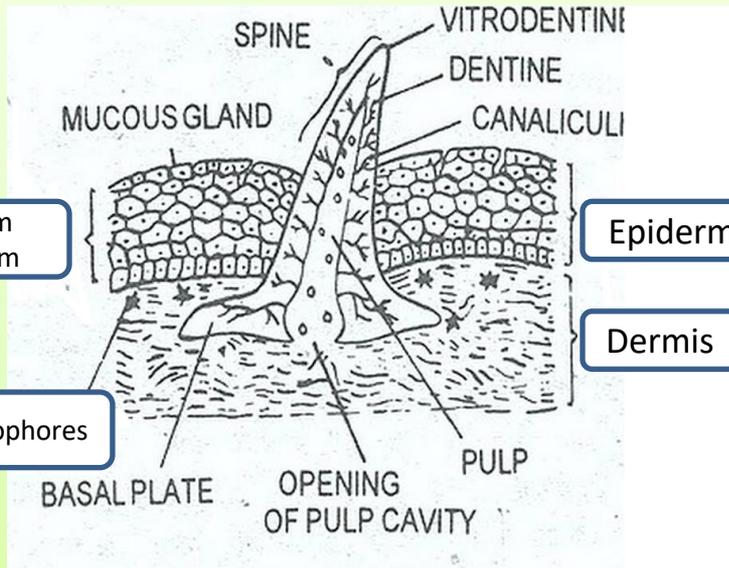
Reptile

Aves

Mammals

SKIN OF FISH

Skin of Elasmobranchs



Stratum
Corneum

Epidermis

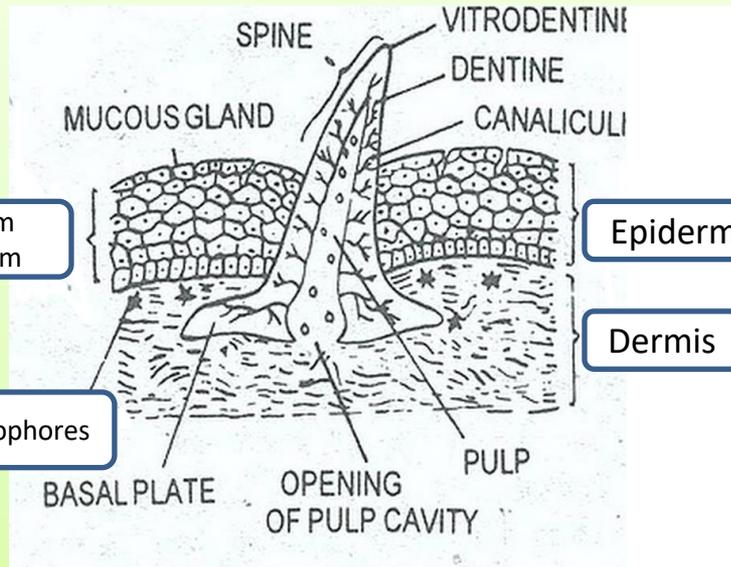
Dermis

Chromatophores

- ✓ Epidermis- More layers of cells
- ✓ Compactly arranged
- ✓ Unicellular glands less abundant
- ✓ Aggregates of goblet cells at the base of stinger of Sting rays– modified to secrete toxins
- ✓ Multicellular glands ---less in number
- ✓ Light emitting organs- Photophors-- dermis

SKIN OF FISH

Skin of Elasmobranchs



Stratum
Corneum

Epidermis

Dermis

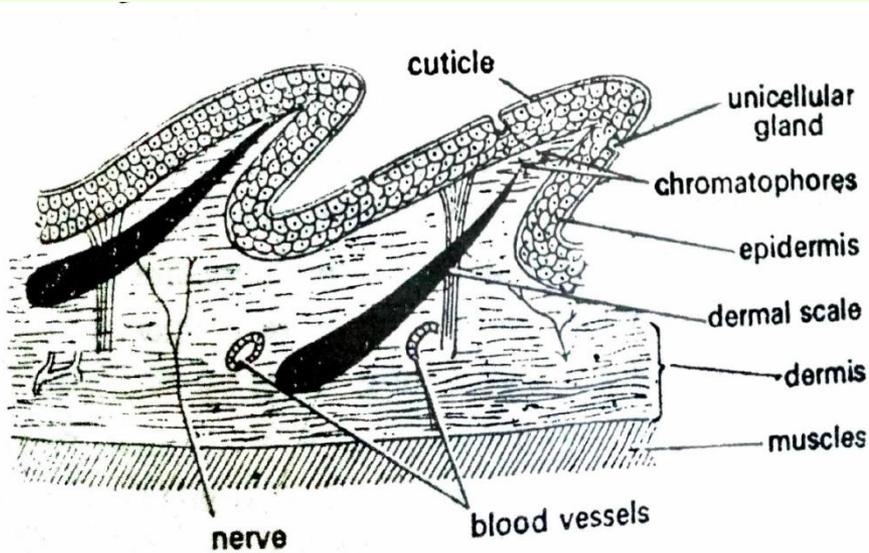
Chromatophores

Dermis

- ✓ Thicker than Epidermis
- ✓ Placoid scales
- ✓ Spinous process
- ✓ Melanophors
- ✓ Ceratotricha

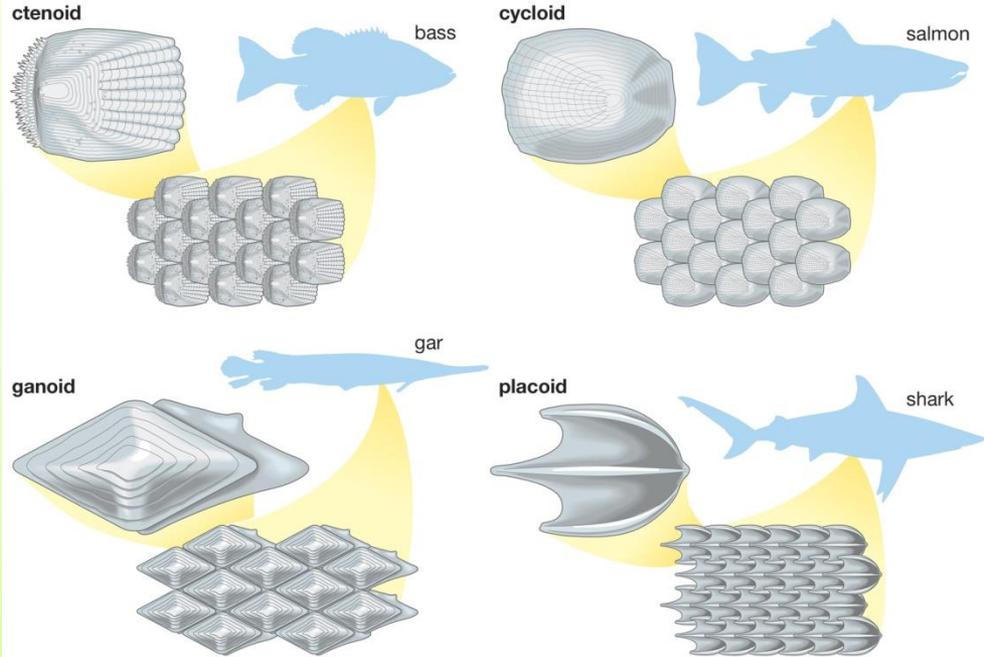
SKIN OF FISH

Skin of Bony fish



- ✓ Similar to Chondrichthyes
- ✓ Large number of mucous glands
- ✓ Epidermal glands – Unicellular
Goblet cells – Mucus
- ✓ Multicellular glands – sparse
- ✓ Mucoid cocoon – Lungfish
- ✓ Granular gland – irritating or
Poisonous alkaloid
- ✓ Deep sea fishes – Photophores
- ✓ Scales: Cycloid or Ctenoid
- ✓ Dermal fin rays – Flexible

SKIN OF FISH



© 2012 Encyclopædia Britannica, Inc.

Fish
Scales

SKIN OF FISH

Role of Chromatophores

Cryptic

Sematic

Epigamic

SKIN OF FISH



Cryptic colouration
in Lion fish

WWW.STUARTCOVE.COM

SKIN OF FISH



Sematic colouration
in Rays



<https://fishingbooker.com/blog/types-of-rays-a-quick-guide/>

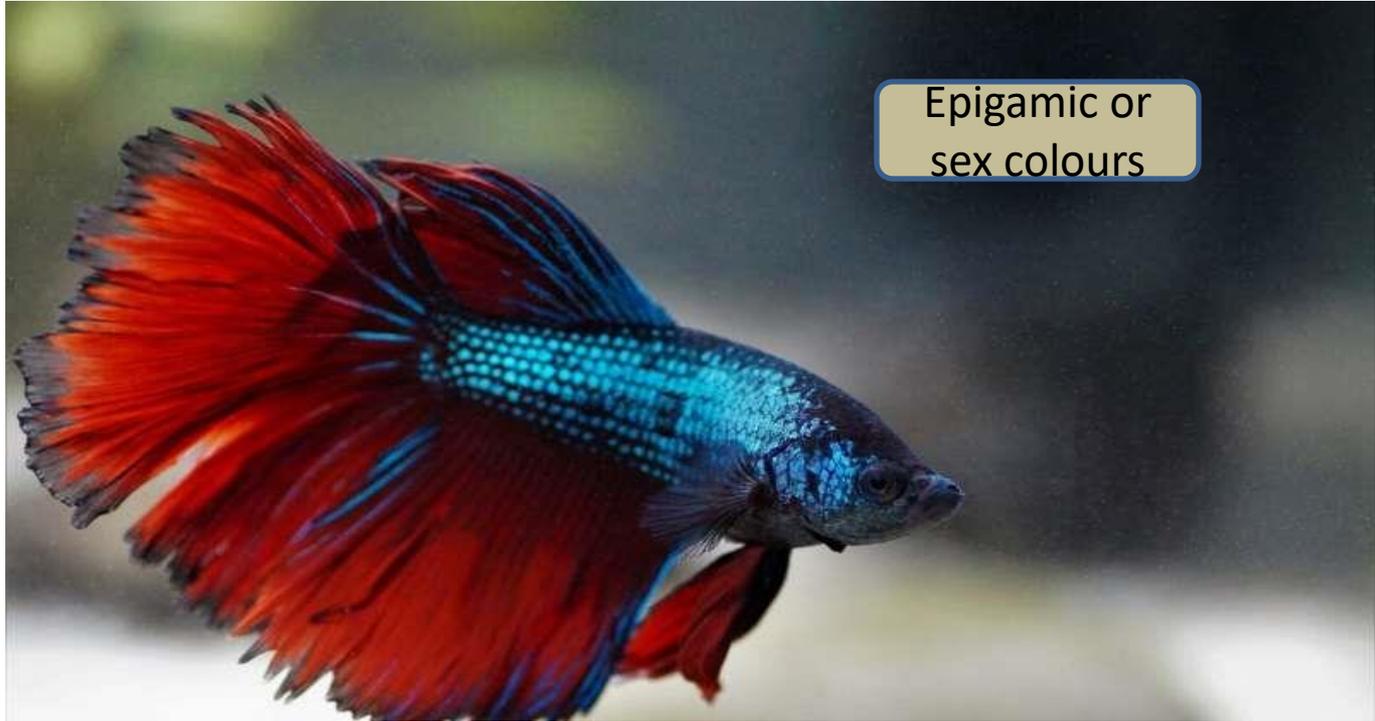
SKIN OF FISH

Sematic colouration
in Rays



<https://fishingbooker.com/blog/types-of-rays-a-quick-guide/>

SKIN OF FISH



Epigamic or
sex colours

<https://phys.org/news/2020-06-fish-synchronize-combat-gene.html>

SKIN OF AMPHIBIAN

Skin of Amphibians differ from that of fishes in three major respects

- ✓ Scales are absent in few species
- ✓ Epidermal **glands– Multicellular**
- ✓ Epidermis of **terrestrial species** exhibits **incipient corneum**

CLASS AMPHIBIA



Indian Bull frog
Hoplobatrachus tigrinus



Common Indian Toad
Duttaphrynus melanostictus



Caecilian
Ichthyophis beddomei



Salamander
Ambystoma tigrinum

CLASS AMPHIBIA

SKIN TEXTURE



Warty (a), Spiculate (b) and (c) with keratinized tips



Smooth (d), Shagreened (e) and Wrinkled (f)



Granular (g), Tubercular (h) and Glandular (i)

SKIN OF AMPHIBIAN

Glandular Epidermis

Few Unicellular glands and many Multicellular glands

Goblet cells

Mucus glands

Granular glands

Mucus

Parotid gland

Toxic alkaloids

- ✓ Keeps the body moist and slimy
- ✓ Cutaneous respiration
- ✓ Self defence

Self defence

SKIN OF AMPHIBIAN

Thick cornified epidermis

In species that spend more time on land

To avoid desiccation

Callus like cap at the ends of the digits

Urodeles

Moving in the mountain brooks

Horny teeth

Tadpoles

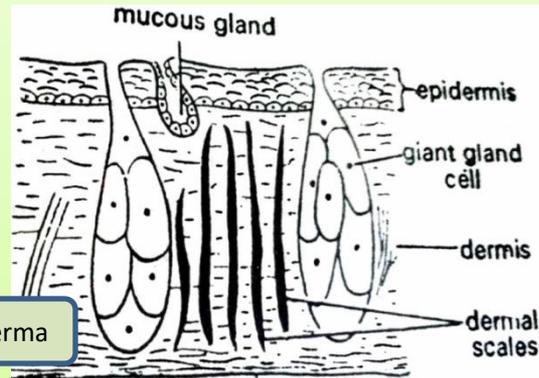
To rasp algae and mosses

SKIN OF AMPHIBIAN

Dermal Chromatophores

Bony scales

Dermis of Caecelians
Dermis of back of few tropical toads



PC: Chordate Zoology by Jordan and Verma

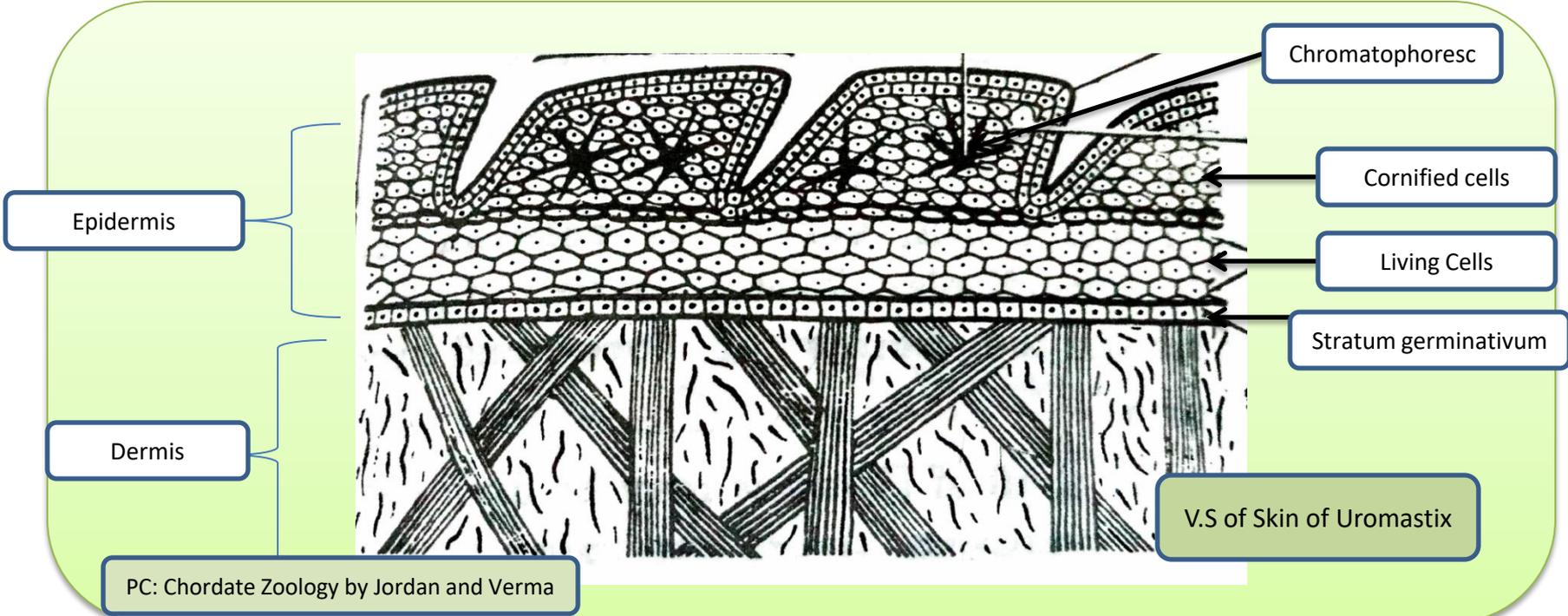
V. S of Ichthyophis

SKIN OF REPTILE

Skin of Reptiles differ from that of Fishes and Amphibians in following respects

- ✓ Skin exhibits relatively **thick stratum corneum**
- ✓ Body is covered with **epidermal scales**
- ✓ Possesses variety of unique **horny structures**
- ✓ Integumentary **glands are not abundant**
- ✓ Bony dermal scales are more abundant than in modern amphibians

SKIN OF REPTILE



SKIN OF REPTILE

Thick epidermis, water impervious stratum corneum

Many localized modifications

✓ Epidermal scales in all species

✓ Scutes in snakes and Turtles

✓ Beaks in turtles

✓ Rattles on snakes

✓ Rattles on snakes

✓ Claws and spiny crests

SKIN OF REPTILE

- ✓ Epidermal glands – granular – present on localized regions of the body

These features represent ultimate adaptation of vertebrate skin to live in an arid environment with minimal water loss and protection from predators

Modifications of stratum corneum

SKIN OF REPTILE

- ❖ Dermis is notable for dermal bones inherited from ancestors
 - ❖ Crocodylians--- osteoderms in localized regions of the body
 - ❖ Along the dorsum they are overlaid by cornified crests
- Osteoderms are absent in snakes

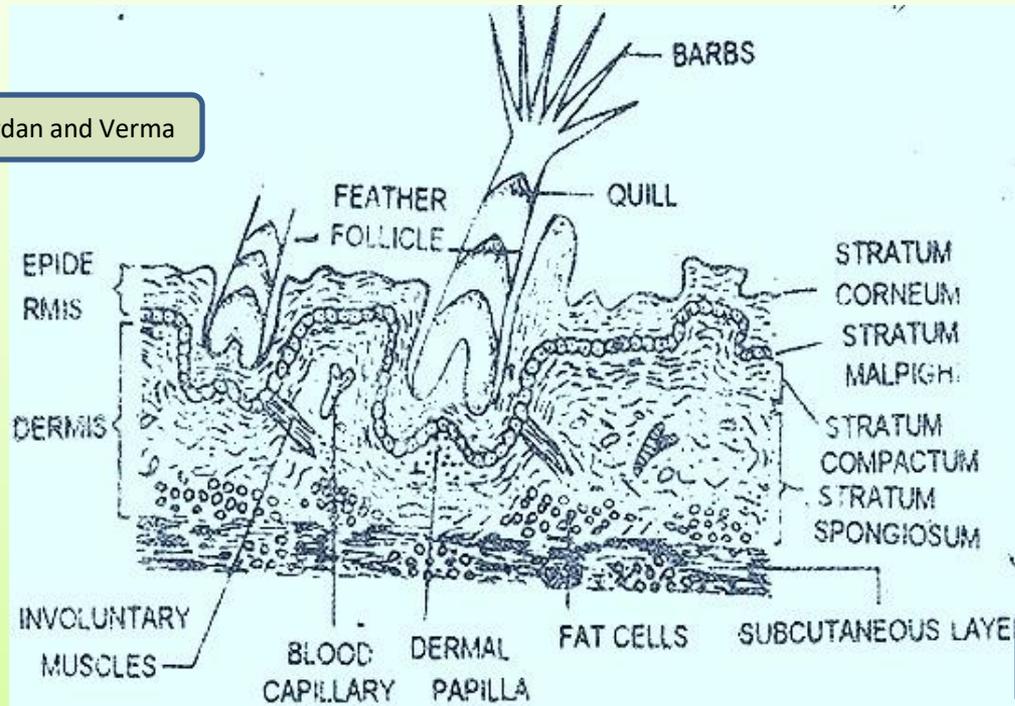


Bony Osteoderms of
Crocodile

<http://wdwcollegeprogram2011.blogspot.com/2011/02/smilin-at-crocodile.html>

SKIN OF AVES

PC: Chordate Zoology by Jordan and Verma



V.S of Skin of Aves

SKIN OF AVES

Thin Skinned---- Delicate epidermis and dermis

Feet and head---skin is relatively thick and intimately attached
Horny beak, Epidermal scales and Claws

Body is clothed with feathers

Epidermal scales are limited to base of the beak and feet

Beak is covered with horny sheath, horny tooth like
protruberances

SKIN OF AVES

Integumentary glands are lacking except for two varieties:

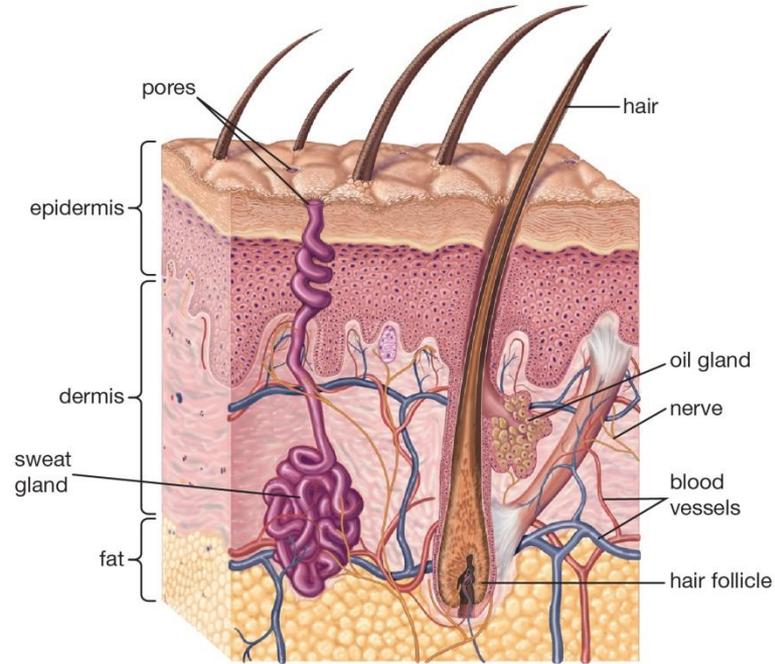
- ❖ Uropygial glands
- ❖ Small oil glands that line outer ear canal of some Galliformes birds and encircle the vent

Dermis supports feather follicles and arrectores pilorum

Do not possess osteoderms

Some birds develop spur of dermal bone on each ankle

SKIN OF MAMMALS



SKIN OF MAMMALS

Notable features of mammalian skin

Hair

Greater functional variety of **epidermal glands** than any other vertebrate class

Epidermis which is **highly stratified and cornified**

Dermis is **many times thicker** than epidermis

SKIN OF MAMMALS

Hair are cornified epidermal structures that arise from the hair follicles and extend deep into the dermis

Epidermal glands: Sebaceous glands, Sudoriferous glands, Mammary gland

Epidermis: Stratum malphigi, Stratum corneum-→ Thickest on the palms and soles

SKIN OF MAMMALS

Epidermis: Between stratum corneum and malphigi--→ Stratum granulosum (granules of keratohyaline) and Stratum lucidum (granules have dissolved and nuclei and cell organells have disappeared).

Strata have developed due to intensive activity of keratinization required to replace cornified cells being worn away by abrasions

Other epidermal derivatives: Horns, Antlers, Claws, Hoofs, Nails, Epidermal scales

SKIN OF MAMMALS

Thickest Dermis

Many hair follicles
Errector muscles

Sweat and Sebaceous
glands

Connecctive tissue

High vascularity

Nerve endings

EPIDERMAL GLANDS

Classification of Epidermal glands

```
graph TD; A[Classification of Epidermal glands] --> B[Structure]; A --> C[Function]; A --> D[Type of secretion];
```

Structure

Function

Type of secretion

EPIDERMAL GLANDS

Classification Based on structure of the gland

Unicellular glands

Goblet cells

Granular glands

Beaker cells

Multicellular glands

Tubular

Alveolar

EPIDERMAL GLANDS

Unicellular glands

Modified cells found among other epithelial cells

Amphioxus, Cyclostomes Fishes and Amphibians

Secrete Mucin

Mucin + Water = Mucous

EPIDERMAL GLANDS

Tubular glands

Multicellular glands of uniform diameter formed as ingrowths of Malpighian layers into the dermis

Simple Tubular gland



Glands of Moll on the margins of human eyelid

Coiled Tubular gland



Sweat glands of mammals

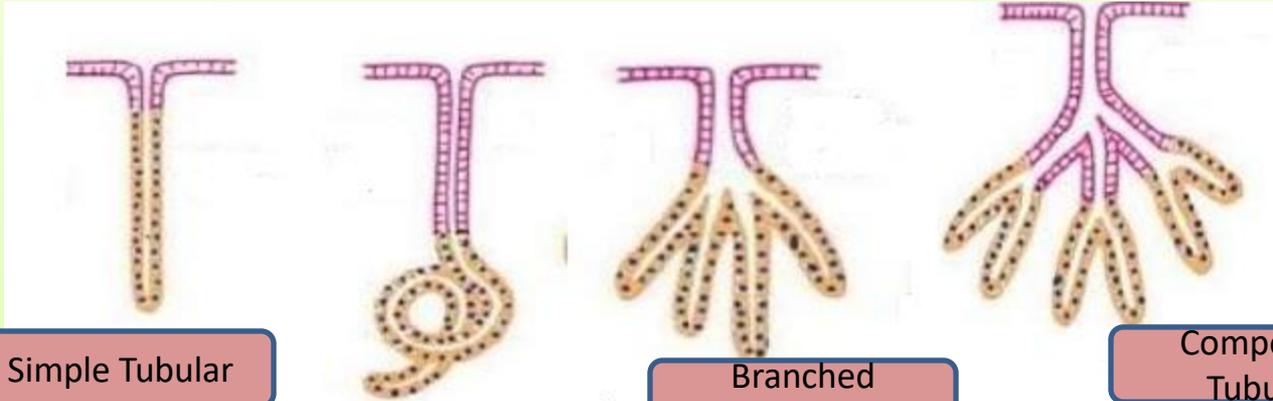
Compound Tubular gland



Mammary glands of monotremes

EPIDERMAL GLANDS

Tubular glands



Simple Tubular

Simple Coiled
Tubular

Branched
Tubular

Compound
Tubular

EPIDERMAL GLANDS

Alveolar glands

Saccular glands

Multicellular down-growths of malphigian layer into thd dermis having tubular duct whose terminal part forms rounded expansion

Simple Unbranched



Mucous or Poison glands of Amphibia

Simple Branched



Sebaceous gland
Tarsal gland

Compound



Mammary glands in
Eutherrial Salivary glands

EPIDERMAL GLANDS

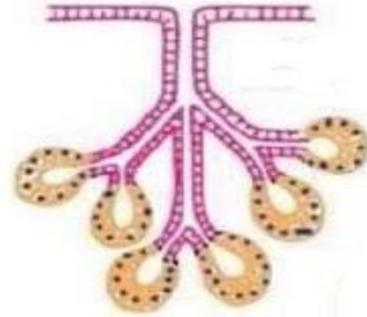
Alveolar glands



Simple Alveolar



Simple Branched Alveolar



Compound Alveolar

EPIDERMAL GLANDS

Classification of Epidermal glands based on the functions

Mucous
gland

Femoral
gland

Uropygial
gland

Sebaceous
gland

Luminescent organ
/photophore

Multicellular
Mucous gland

Sudorific
gland

Mammary
gland

EPIDERMAL GLANDS

Mucous gland

Unicellular

Goblet cells
Granular cells
Beaker cells

- ❖ Keeps the skin moist and slippery
- ❖ Protection against microbes

Multicellular

- ❖ Lubricates the skin
- ❖ Cutaneous Respiration
- ❖ Self defence

EPIDERMAL GLANDS

Poison glands

Parotid glands

Secretions have
burning taste

Defence



Giant poison gland

Caecilians

EPIDERMAL GLANDS

Tubular glands on the feet as suction discs of tree frog

Aids in climbing

Tubular glands on the swollen glandular thumb pads of male frogs and toads

Aid in clasping female during amplexus

EPIDERMAL GLANDS

Luminescent organs/ Photophores

Found in longitudinal row on the ventral side of the body of deep sea fishes

Photophore

Group of Epidermal cells in dermis

Glandular cells --- Phosphorescent light
Layer of reflecting pigments

Light helps to attract prey in deep sea

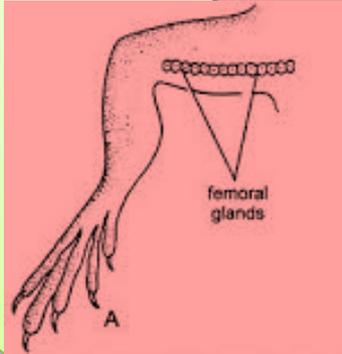
EPIDERMAL GLANDS

Femoral gland

Found in male lizards below thighs in rows from knee to cloaca

Secrete sticky substance--→ hardens into short spines

Spines used for holding females during copulation



EPIDERMAL GLANDS

Uropygial gland

Small Oil glands

Aves

Best developed in aquatic birds

Branched alveolar glands

Location: Uropygium, Ear

Odoriferous oil during sexual activity

Preening feathers

EPIDERMAL GLANDS



Anhinga (*Anhinga anhinga*) uropygial gland

© Photo by Christopher Reiss christopher.reiss737@gmail.com

Used by permission



EPIDERMAL GLANDS

Sudorific glands

Sweat glands

Mammals

Coiled Tubular
glands

Sweat

Water + Dissolved salts + Urea

Removes metabolic wastes

Regulate body temperature

EPIDERMAL GLANDS

Sweat glands are not uniformly distributed

- ❖ Man: More numerous on palm, sole, arm pits
 - ❖ Cats, Rats, Mice: Soles of feet
 - ❖ Rabbit: Around lips
 - ❖ Bat: sides of the head
- ❖ Ruminants: Muzzle, Skin between digits
 - ❖ Hippopotamus: Pinnae

EPIDERMAL GLANDS

Secretions of Sudorific glands may be red coloured
Hippopotamus, giant kangaroo

Modifications of Sudorific glands

Gland of Moll

Margins of human eye in
connection to the eye lashes

Ceruminous glands

External ear passage

EPIDERMAL GLANDS

Sebaceous glands

Alveolar glands found in hair follicles
Independently surround genital organs, tip of the nose and margins of the lips

Secretes Oil

Waxes, Fatty acids and Cholesterol

Lubricates hair
Forms thin coating of skin
Keeps the skin pliable

EPIDERMAL GLANDS

Modifications of Sebaceous glands

Meibomian glands

Eyelids

Form oily layer over lacrimal secretion
Holds tears evenly over eyeball
Keeps the eye moist

*Scent glands

Secretions are used to attract opposite sex

Dear family: Head
Carnivores: Around anus
Pigs and goats: Between toes

EPIDERMAL GLANDS

Mammary glands

Characteristics of Class Mammalia

Secrete milk to nourish young ones

Gynecomastia: Monotremes

Monotremes: Compound Alveolar , No nipples, Surface of the skin

EPIDERMAL GLANDS

Monotremes: Compound Alveolar , No nipples, Surface of the skin

Mammary glands open by their ducts into nipples or teat

Mammary gland + Fat = Integumentary swelling → Breast / Mammae

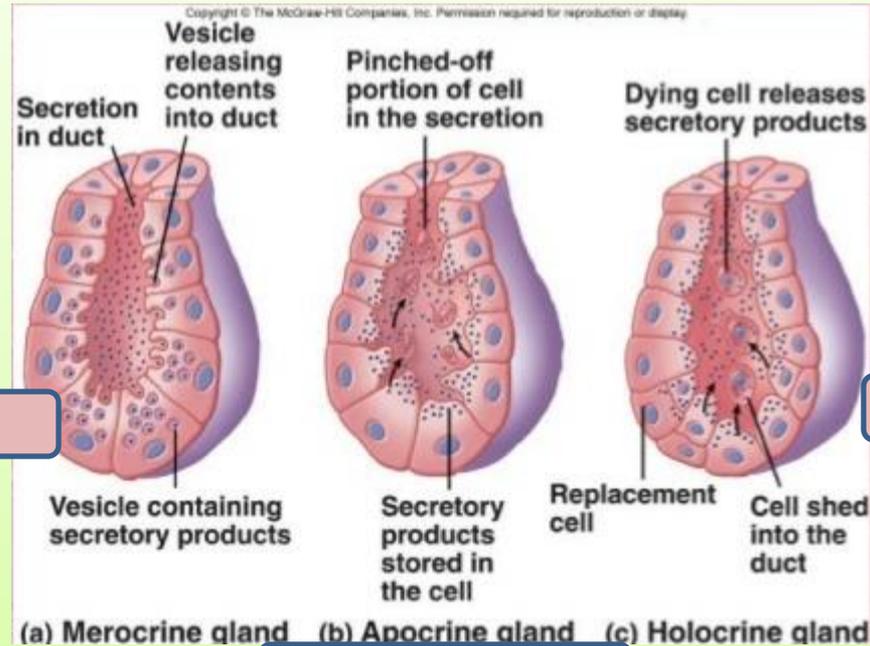
Number and locations of Mammae vary

2-25

Ventral Milk line → Armpits to groin

Axillary, Thoracic, Abdominal or inguinal in position

EPIDERMAL GLANDS



Sweat gland

Sebaceous gland

Mammary gland

EPIDERMAL DERIVATIVES

Skin of vertebrates is rarely naked

It is provided with

Protective scales

Bony plates

Feathers

Hair

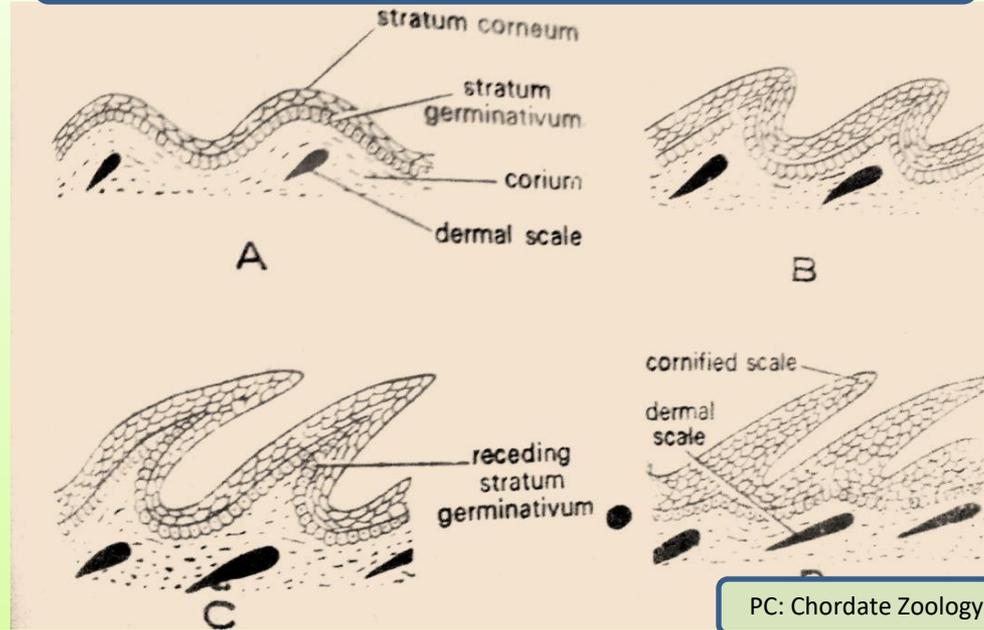
No Epidermal scales in fishes and amphibians

They appear for the first time in reptiles

Cornified derivatives of the Malphigian layer,
generally shed and replaced

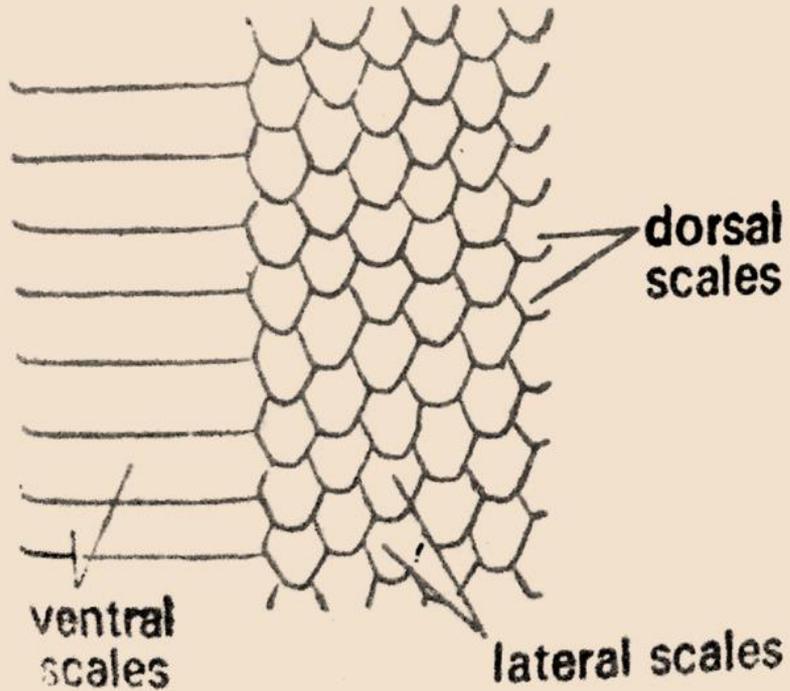
EPIDERMAL SCALES

DEVELOPMENT OF EPIDERMAL SCALES



PC: Chordate Zoology by Jordan and Verma

EPIDERMAL SCALES



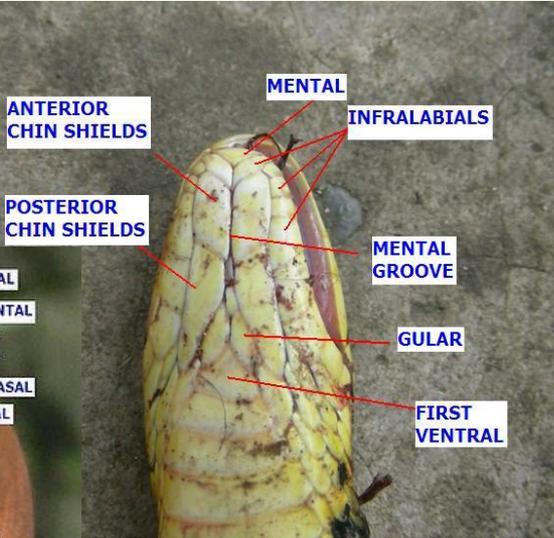
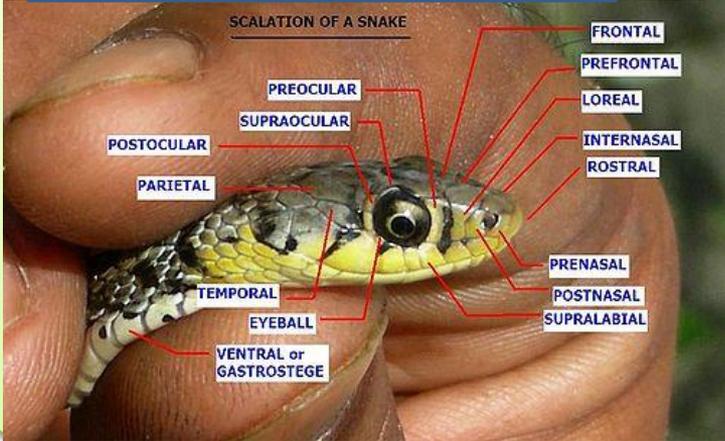
Snakes and Lizards

Overlapping and continuous scales

Periodic
shedding/Ecdysis

EPIDERMAL SCALES

https://en.wikipedia.org/wiki/Snake_scale



Moulted skin

EPIDERMAL SCALES

In crocodiles and turtles the scales are:

- ❖ Non-overlapping
- ❖ Do not undergo periodic ecdysis
- ❖ Scales are worn off and replaced

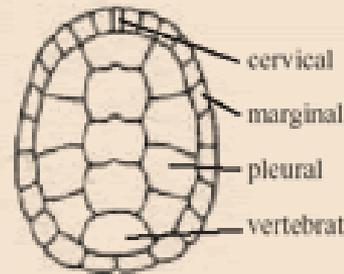
Carapace



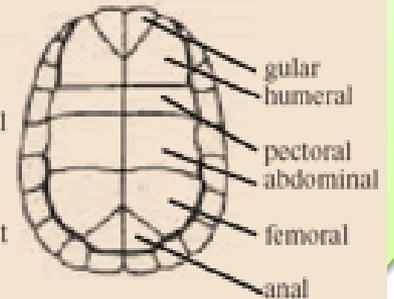
Plastron

Morphology: The Turtle Shell

Carapace - top



Plastron - belly



EPIDERMAL SCALES

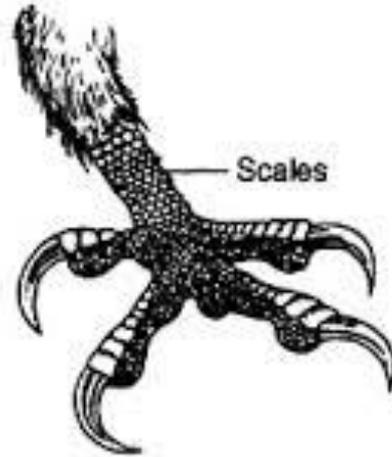


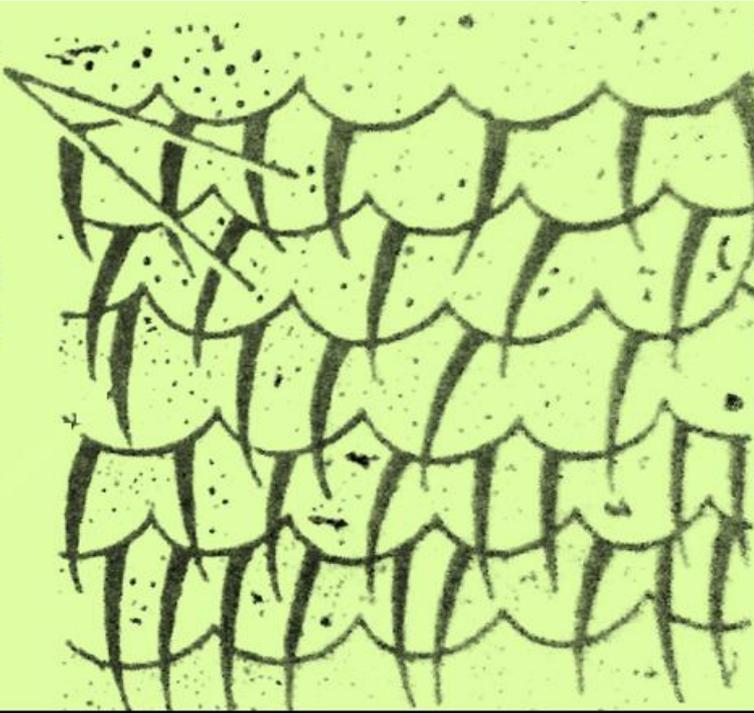
Fig. 2.19 : Epidermal scales are present on the feet and legs of birds

In birds scales are overlapping

EPIDERMAL SCALES

scales

dorsal
scales



- ❖ In mammals epidermal scales are found on tail and paws of rats, mice, beaver, musk rats and shrews
- ❖ Overlapping scales
- Do not undergo ecdysis

EPIDERMAL SCALES



Scaly anteater

Large epidermal scales are present on entire body, except on ventral side

- ❖ Overlapping
- ❖ Ecdysis singly

<https://m.facebook.com/PangolinSG/photos/a.407060359402513/2044660972309102/?type=3>

EPIDERMAL SCALES

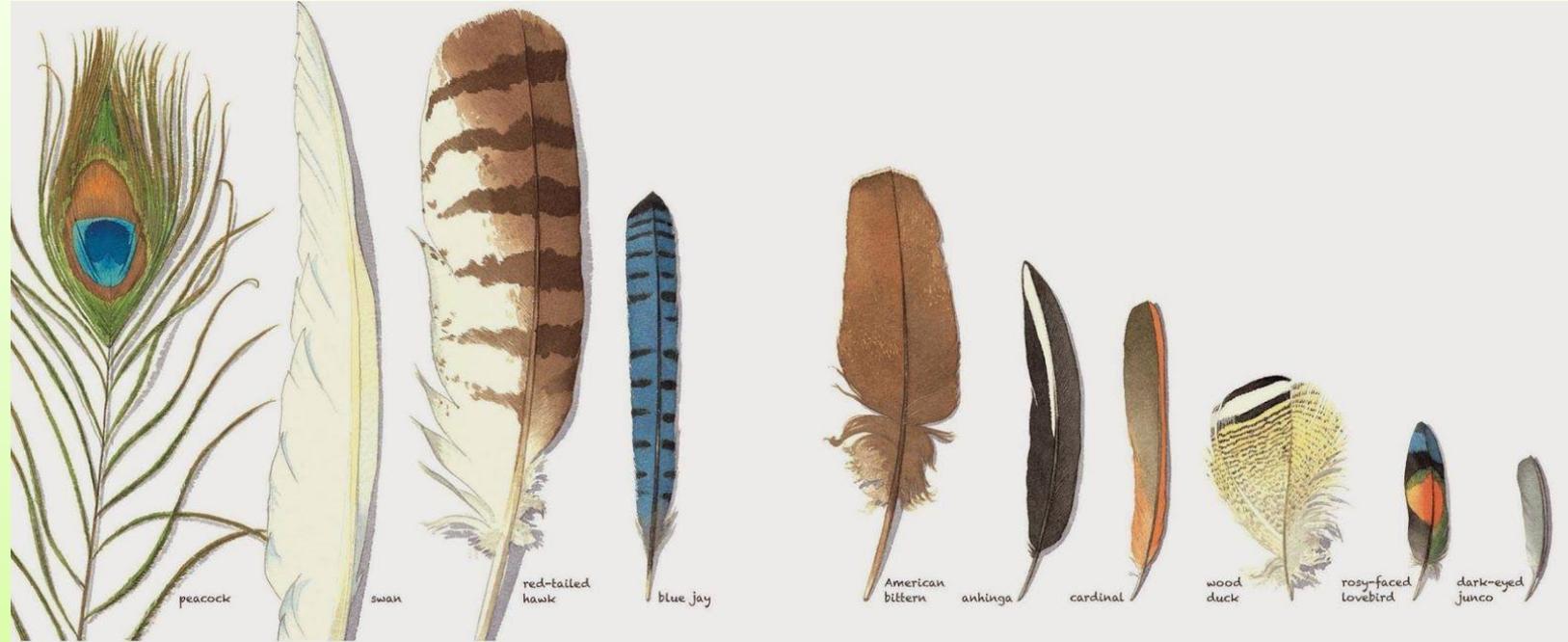
Armadillos



<https://en.wikipedia.org/wiki/Armadillo>

- ❖ Large scales that fuse to form plates on the head, shoulder and hips
- ❖ In the middle of the body except mid-ventrally --- Ring like bands
- ❖ Do not undergo ecdysis
- ❖ Gradually worn off and replaced

FEATHERS



FEATHERS

Characteristic feature of birds

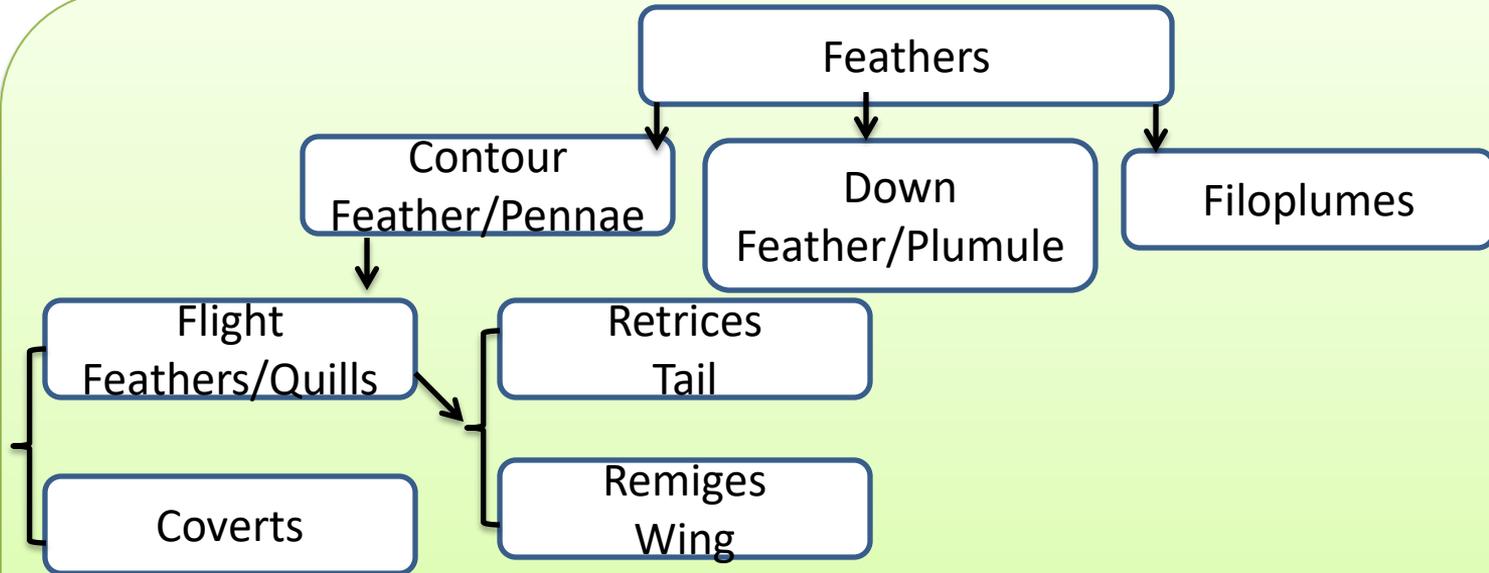
Modified reptilian scales

Developed from highly specialized stratum corneum

Light, strong, elastic and waterproof
Coloured due to pigments and structural arrangement

1)Protective covering, 2) Regulate body temperature,
3)Support the body in flight

EPIDERMAL DERIVATIVES



FEATHERS

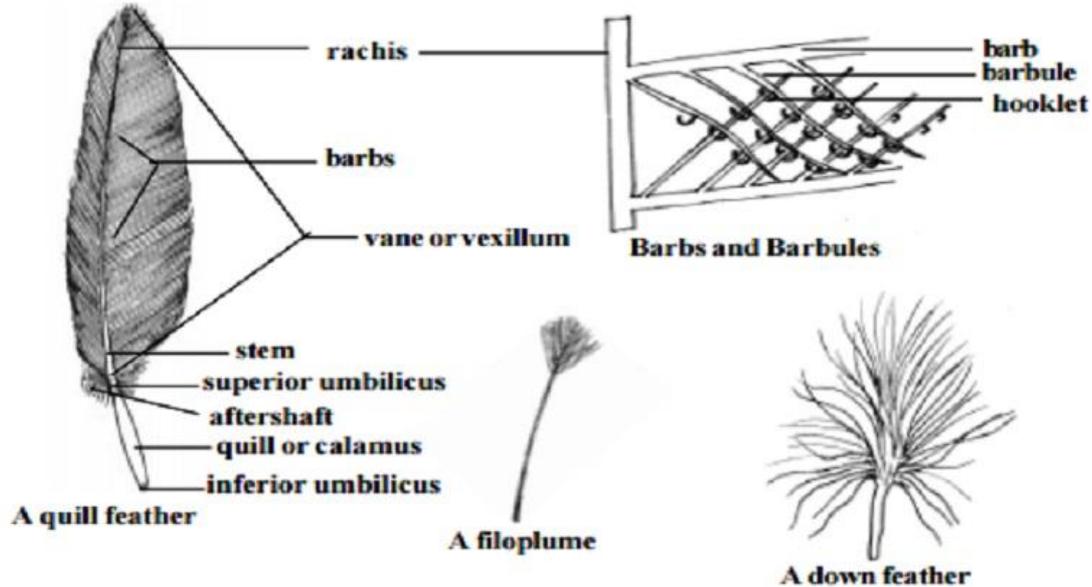


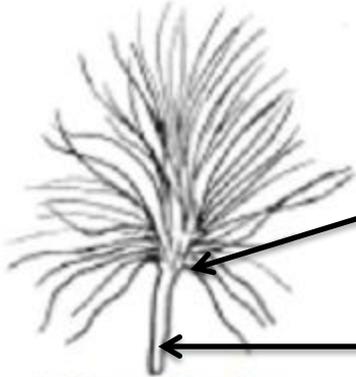
Fig. Pigeon - Feather types

FEATHERS

Down Feathers

Powder Down
Feathers

Nestling Down
Feathers



Barbs and Barbules
arising from the tip
No hamuli

Quill/Calamus
Very small

A down feather

FEATHERS



Barbs

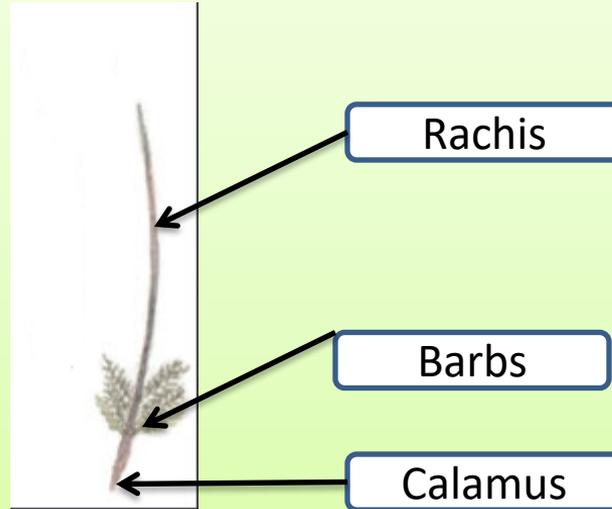
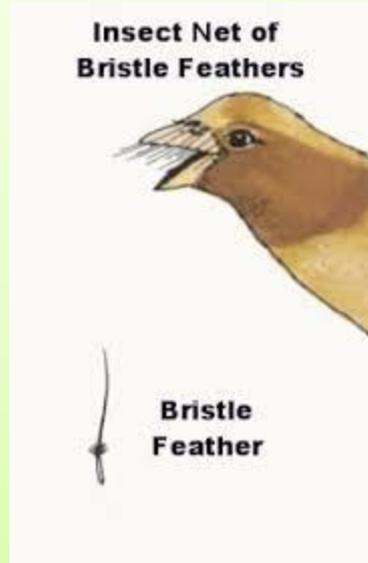
Rachis

Calamus

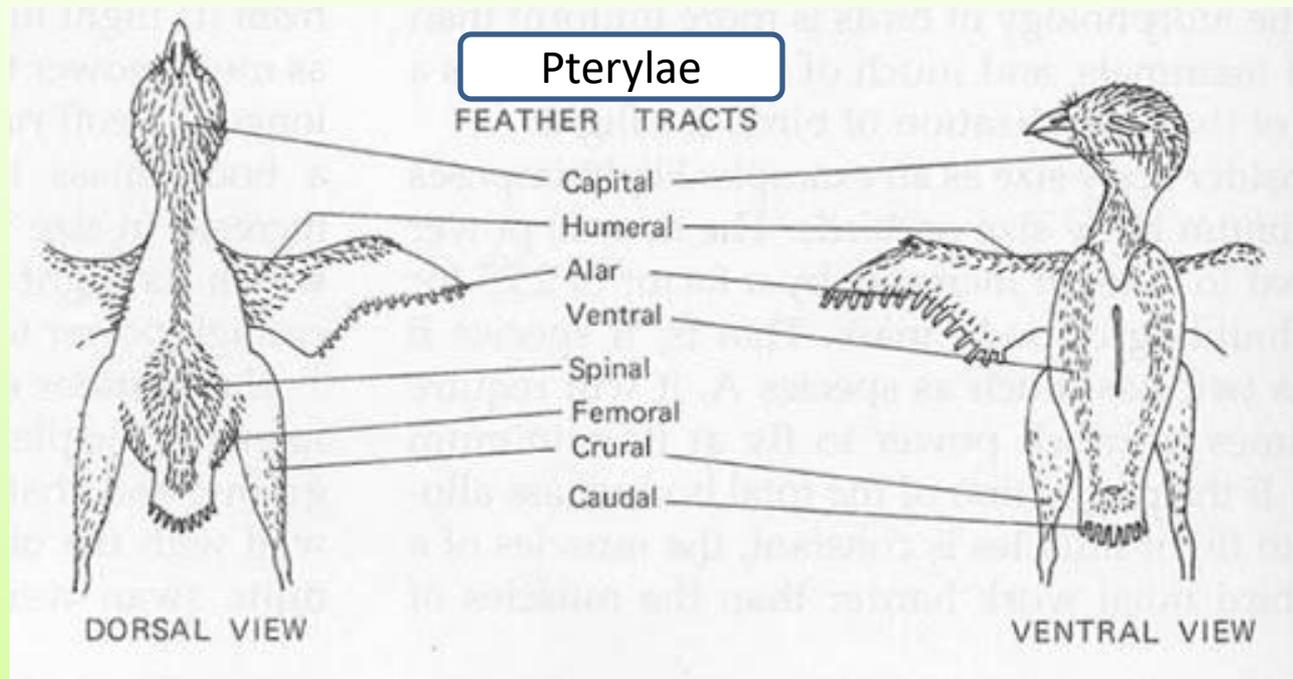
Filoplume feathers

- ❖ Delicate hair like feathers
- ❖ Long slender stalk
- ❖ Few terminal barbs
 - ❖ No hamuli
- ❖ Lie among contour feathers

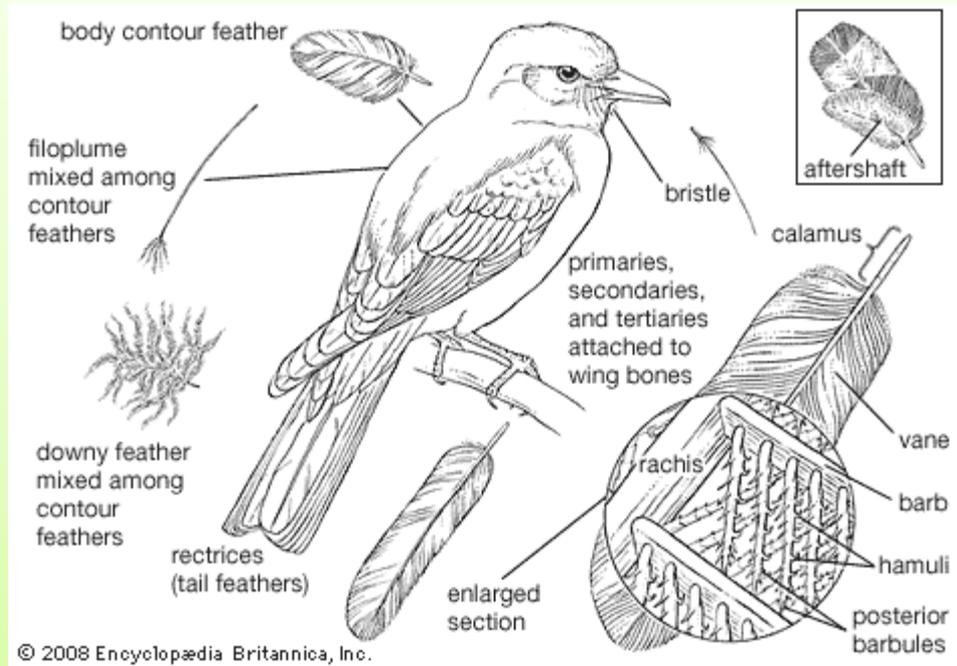
FEATHERS



FEATHERS



FEATHERS



HAIR

Found only in mammals

Either covers entire integument or present in few traces

Lanugo

- ❖ Projected at an acute angle from the skin
- ❖ It traps air and does not allow transmit body heat
 - ❖ Colour of hair are protective
- ❖ Hair in nostrils and ears prevent entry of dust
 - ❖ Eyebrows and eyelashes protect eye

HAIR

Hair structure

Shaft

Upper projecting part

Dead keratinised cells

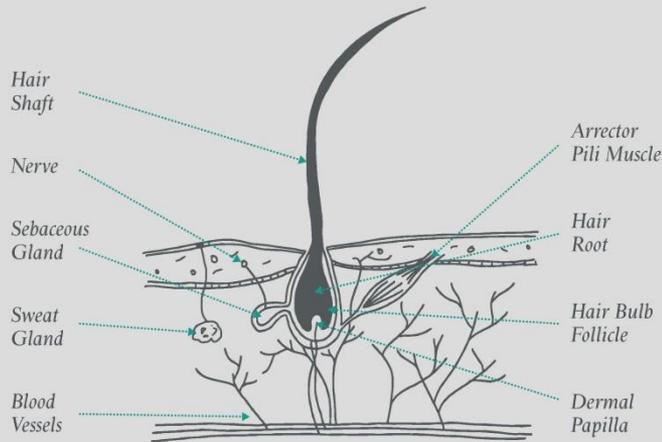
Root

Follicle
Sunken pit of dermis

Bulb- follicle base

Hair Growth

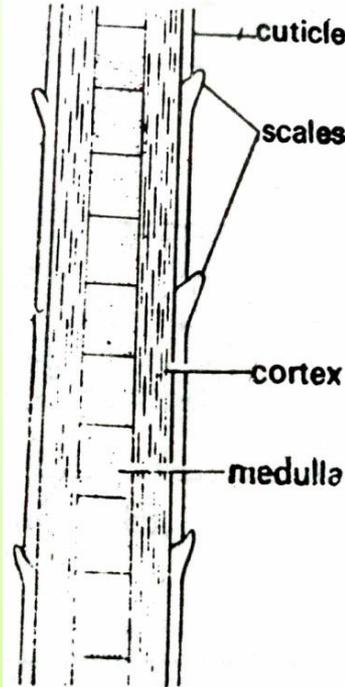
Dermal papilla



<https://www.philipkingsley.co.uk/hair-guide/hair-science/the-hair-structure>

HAIR

LS of Hair



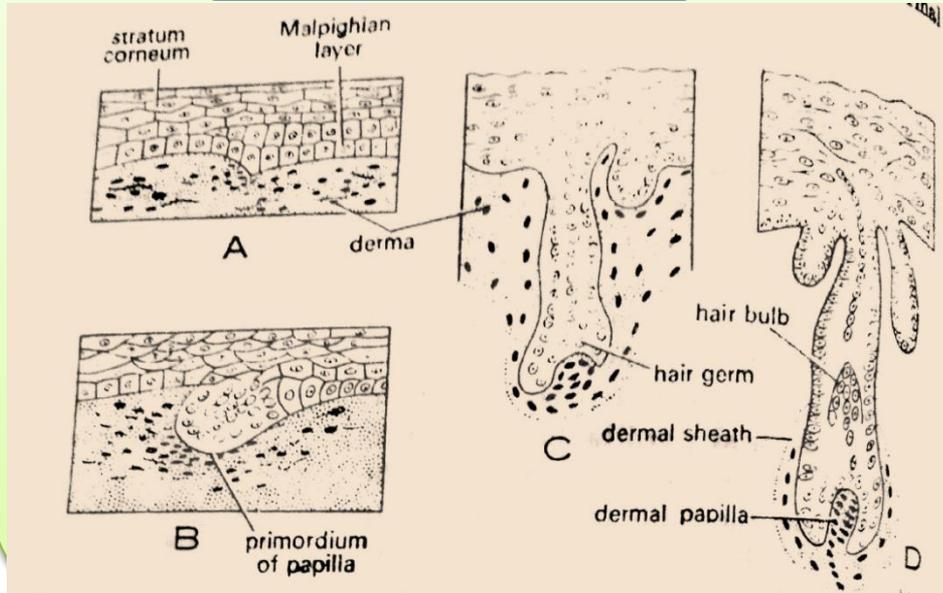
Transparent overlapping cells

Pigments

Shrunken cornified cells

HAIR

Development of hair



Thickening of epidermis



Pushed into dermis



Becomes cup shaped at its lower end



Dermis extends into the cup



Hair papilla



Epidermal down-growth

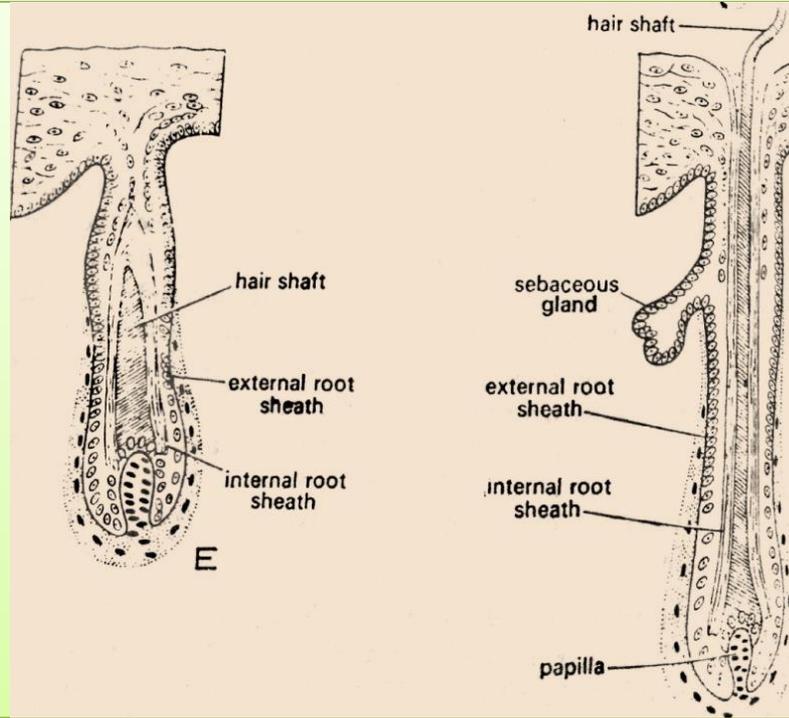


Central shaft of keratinised cells + Hair follicle



Lower part of hair follicle
Enlarges → Bulb

HAIR



Development of hair

HORNS & ANTLERS

Characteristic features of **Ungulates**



Large mammals with hooves

Organs of offense and defence

Horn: Surface is composed of keratin

HORNS & ANTLERS

TYPES

Bovine Horns

Hair Horns

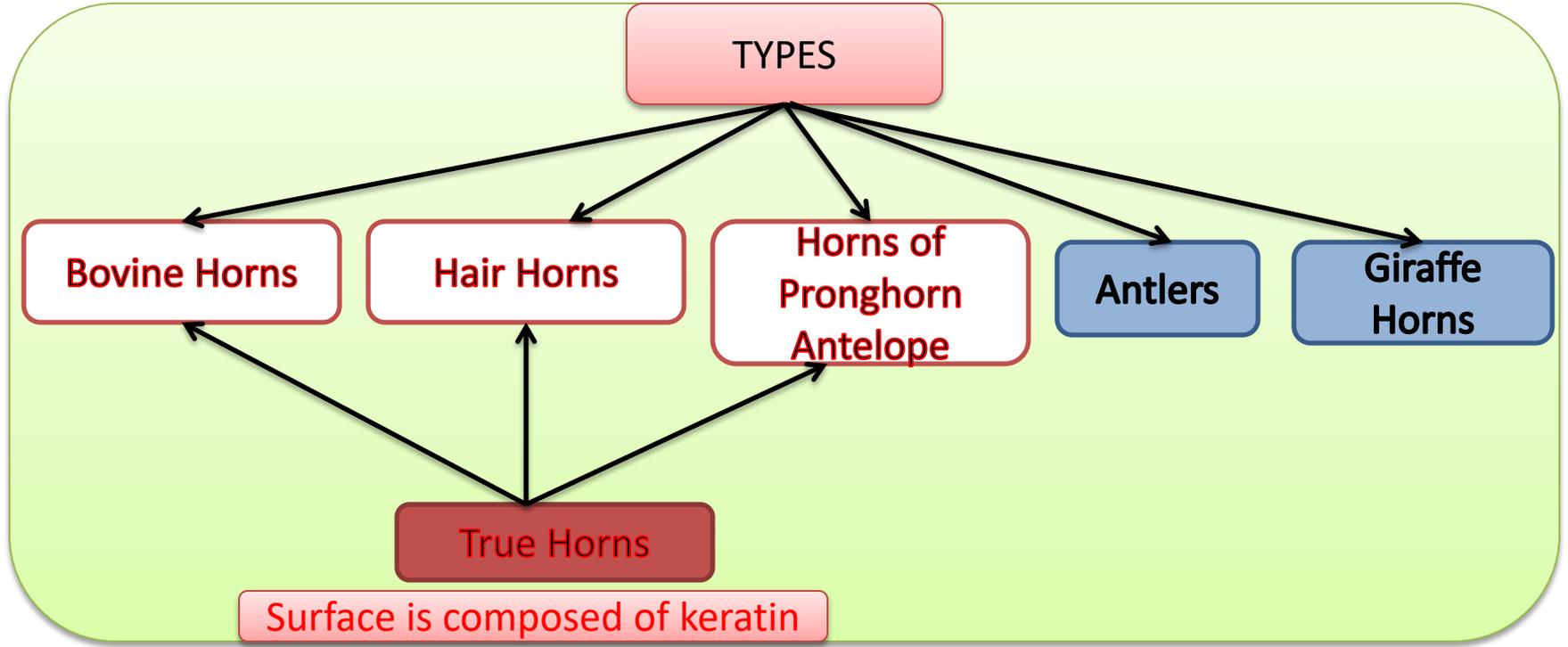
Horns of
Pronghorn
Antelope

Antlers

Giraffe
Horns

True Horns

Surface is composed of keratin



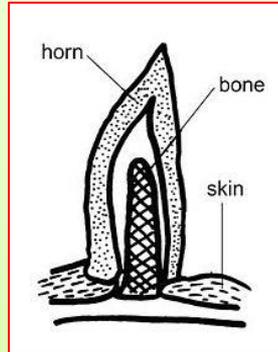
HORNS & ANTLERS

Bovine Horns

Artiodactyls of family Bovidae



Oxen, Sheep, Goats, Antelopes



Core of dermal bone covered by sheath of horn (hollow)

Usually curved and re-curved. Never shed

Present in both the sexes

Bovine Horns are un-branched , Pronghorns are branched

HORNS & ANTLERS

Hair Horns

Rhinoceros

Composed of agglutinated keratinized hair-like epidermal fibre that forms solid horn

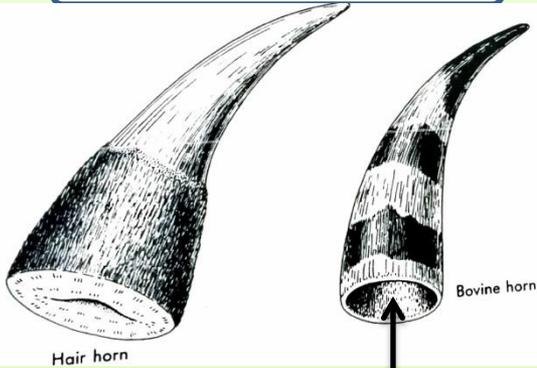
Perched on roughened area of nasal bone

Present in both the sexes

They are not she

HORNS & ANTLERS

Structure of True horn



Hollow

Hollow horns of Cattle

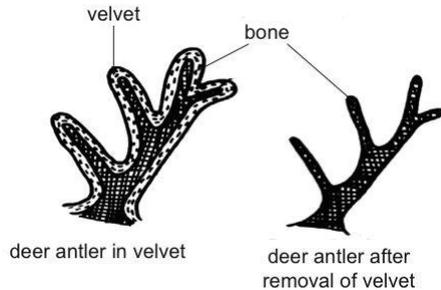
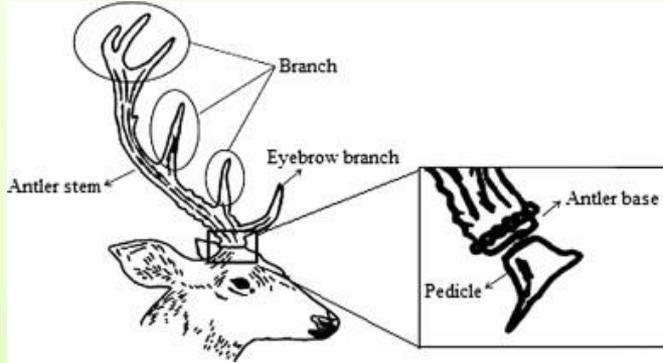


Fibre /Hair horns of Rhinoceros



Pronghorns Antelopes

HORNS & ANTLERS



Antlers

Males of deer family
Both the sexes in Caribou

Branching outgrowth of frontal
bone

Velvet is shed once it reaches
the full growth

HORNS & ANTLERS



Giraffe horns

Knob
horns/Ossicones

Males have knobbed
ends

Females have hair
tufts

DIGITAL TIPS

Vertebrates having fingers or Toes

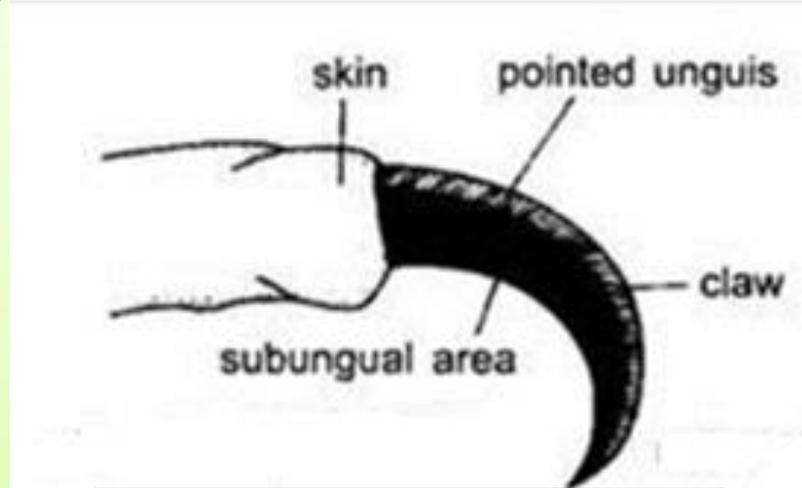
Supported by hard integumentary structures

Claws

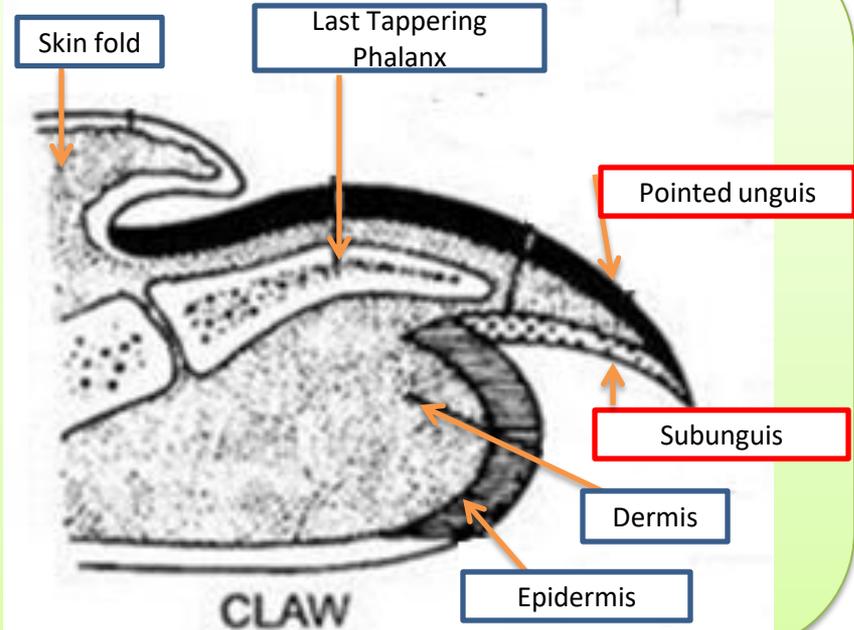
Hoofs

Nails

DIGITAL TIPS---- CLAWS



Typical Reptilian claw



DIGITAL TIPS-----CLAWS

Reptiles
Monitor Lizard



Aves
Eagle



Mammals
Cat



DIGITAL TIPS----CLAWS

Claws in Birds

Claws of a bird are reptilian

Wide variety of forms adapted to correspondingly different functions.

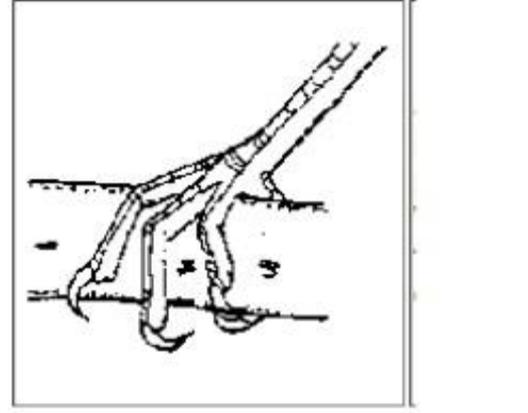
Perching

Holding the
prey

Scratching

Climbing

DIGITAL TIPS----CLAWS



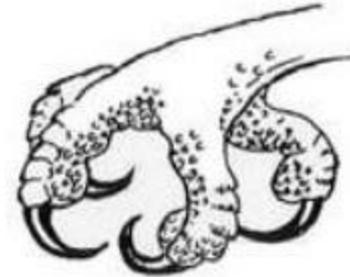
Perching birds have 4 bendable toes
3 pointing forward and 1 backward
Claws are **pointed, slender and curved**

DIGITAL TIPS---- CLAWS



Osprey (Sea Hawk) using Talons

Birds of prey like Osprey, Eagle, Vulture, Hawk, Owl possess **Talons**



Long curved sharp claws to catch and hold the prey

DIGITAL TIPS--- CLAWS



- ❖ Hens possess strong feet with 3 toes in front and 1 behind
- ❖ Each toe has **blunt stout claw** to **scratch the ground** in search of insects and seeds

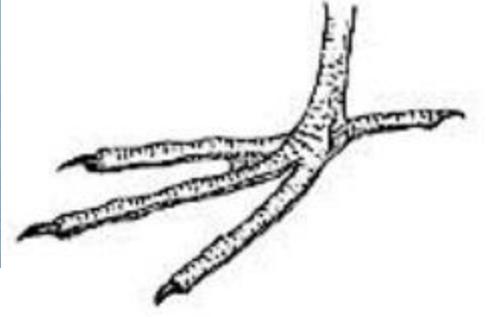


DIGITAL TIPS----CLAWS

- ❖ **Wading birds** have long legs and **wide spreading toes with slender claws**
- ❖ Helps them to **walk on shallow waters and mud.**
- ❖ Wide spreading toes **prevents** the birds from **sinking**



Black Pied Stilt



Comb Crested Jacana

DIGITAL TIPS----CLAWS



Emu



- ❖ Flightless running birds
- ❖ Strong feet with flat base and 3 toes
- ❖ Since these birds do not fly
- ❖ Need to run fast to catch food and escape from enemies
- ❖ Claws are short and blunt

DIGITAL TIPS---- CLAWS



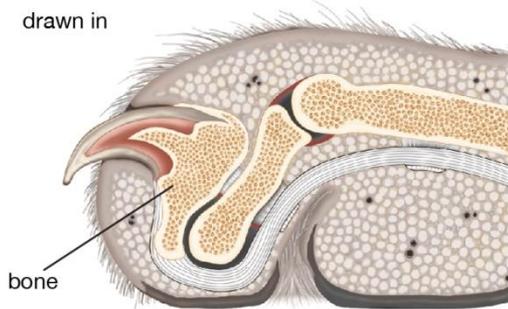
- ❖ Young hoactzin
- ❖ **Claws on its wings**
- ❖ Enables the animal to venture from the nest and scramble about in trees

DIGITAL TIPS----CLAW

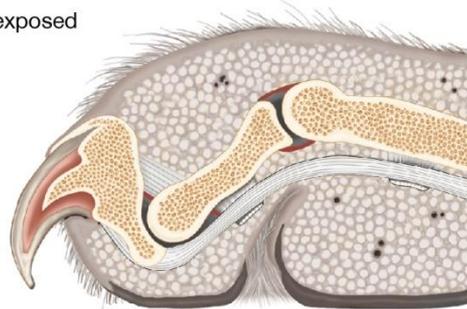
Retractable Claw

Cat Claw

drawn in



exposed



© Encyclopædia Britannica, Inc.

- ❖ Hunting, Gaining traction, against ground, climbing on trees
- ❖ Retractable claws protect the claws from wear and tear

DIGITAL TIPS---CLAWS

- ❖ Dew claw is vestigial
- ❖ On the foot of many mammals, birds, and reptiles
- ❖ Dogs almost always have dewclaws on the inside of the front legs and occasionally also on the hind legs.
- ❖ Used to lightly grip bones and other items that dogs hold with the paws.



DIGITAL TIPS----CLAWS

Ringed tailed Lemur



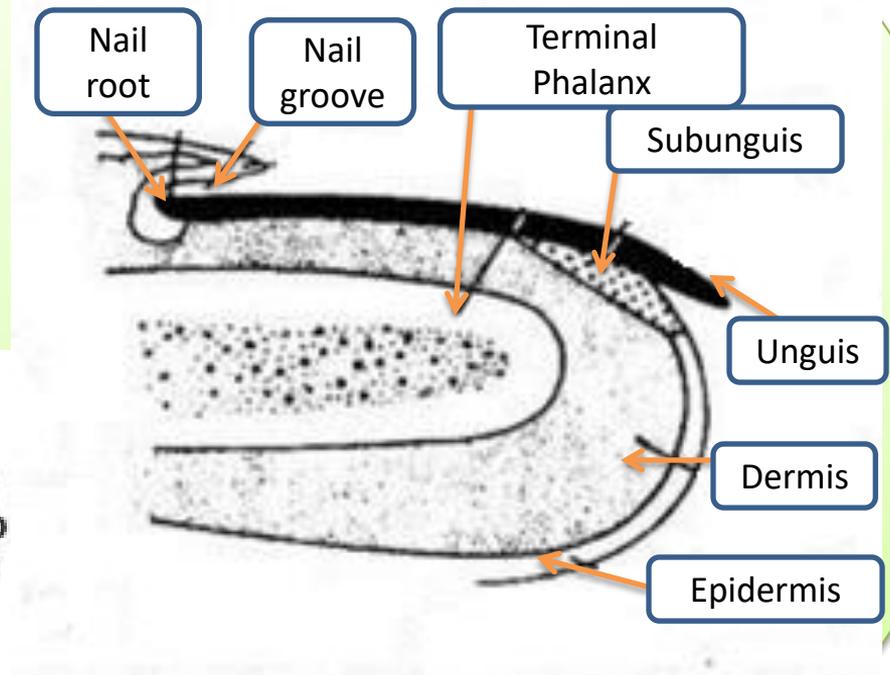
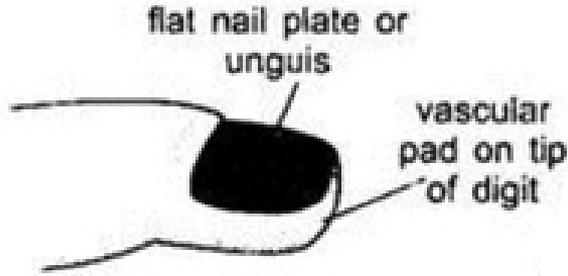
- ❖ **Grooming Claws**
- ❖ Some primates like Lemurs, Loris
- ❖ Personal grooming
- ❖ Not pointed



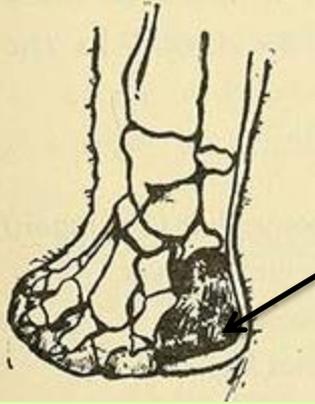
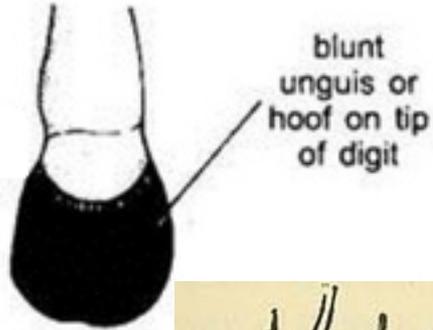
Loris

DIGITAL TIPS--- NAILS

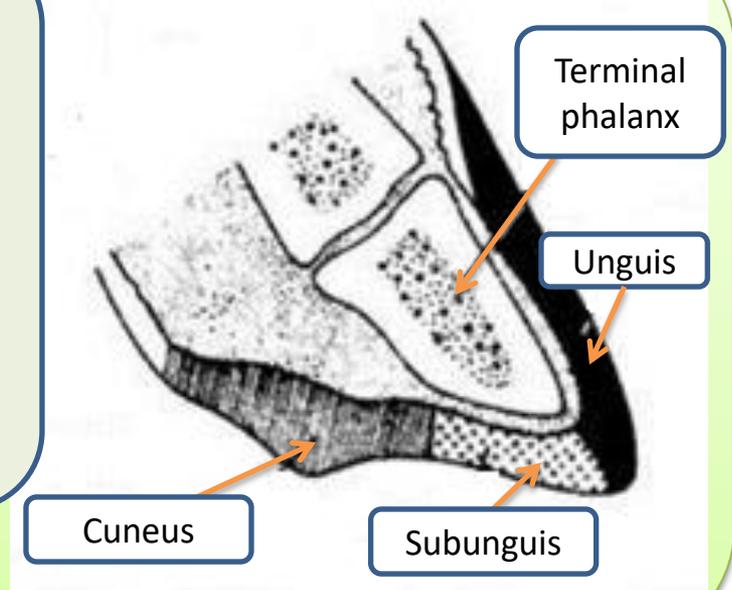
- ❖ Evolved from claws
- ❖ Covering on fingers and toes of **primates**
- ❖ Composed of keratin
- ❖ **Onychophagia**



DIGITAL TIPS---HOOVES



- ❖ Ungulate mammals
- ❖ Clove foot in Artiodactyla
- ❖ Rubber heels



DIGITAL TIPS



- ❖ Foot of lemur
- ❖ Showing 4 nails and 1 claw

<http://www.sci-books.org/biology/biology-of-the-vertebrates/derivatives-of-the-integument-digital-tips.shtml>

DERMAL SCALES

Mesodermal in origin

Fishes, Reptiles and few mammals

Osteoderms earliest known vertebrates

Armour of large bony plates

Cosmoid scales

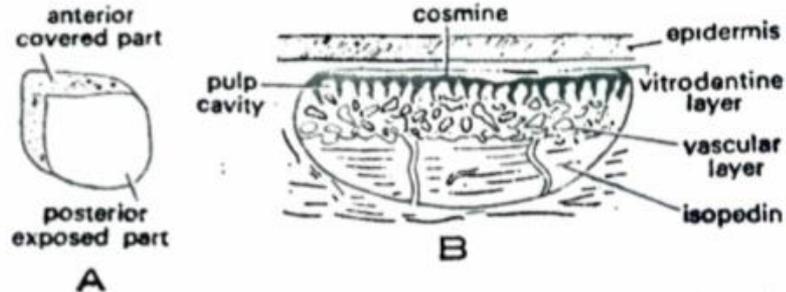
Placoderms

Bony plates became small



DERMAL SCALES

Cosmoid scales



Placoid scales

- ❖ Not found in any living forms
- ❖ 4 layers
- ❖ **Isopodine** – compact bone
- ❖ **Spongy bone** ---Vascular spaces – pulp cavities – odontoblasts
- ❖ **Cosmine**– hard compact
- ❖ **Viterodentine**- - enamel– thin but hard

DERMAL SCALES

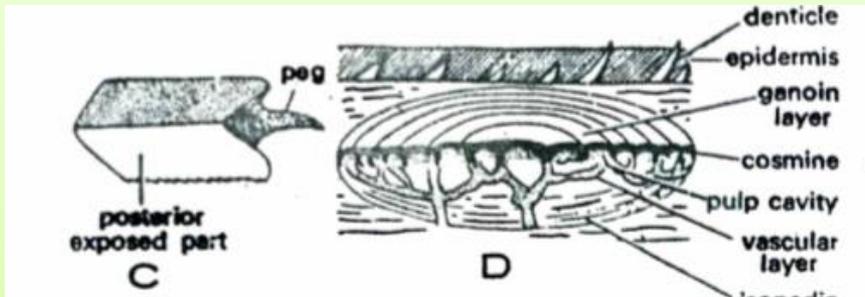
Cosmoid scales

Ganoid scales

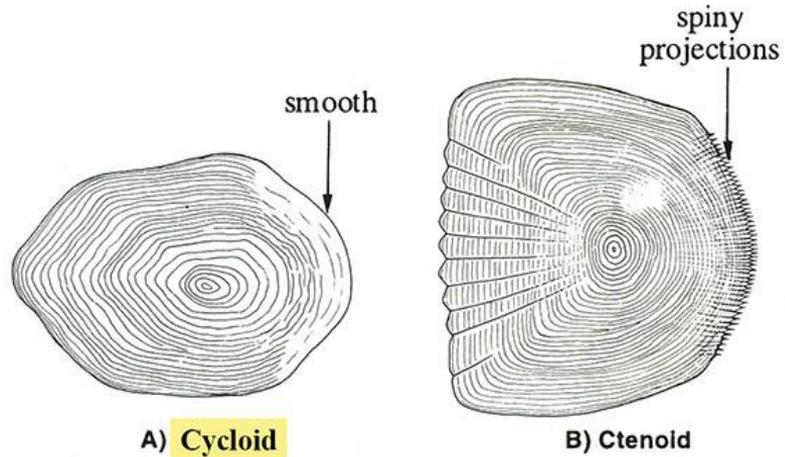
Leptoid scales

Cycloid scales

Ctenoid scales



DERMAL SCALES



Scales

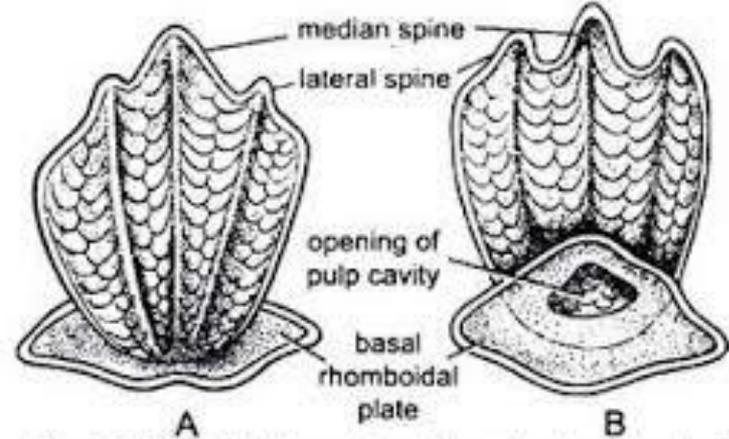


Fig. 14.4. *Scoliodon*. Placoid scales. A–Dorsal view; B–Ventral view.