

B. Sc. (Hons) Part-II Practical
Course: Zool. H. 211
Experiment 6
Integumentary derivatives of vertebrates

Definition of the integument

- ▶ Integument (L. to cover) refers to skin in vertebrates;
- ▶ It is composed of epidermis (epithelial tissue), dermis (connective tissue) and subcutaneous layer (fat);
- ▶ It is the largest organ with respect to the surface area of the vertebrate body; Integument has the same basic structure in all vertebrates.

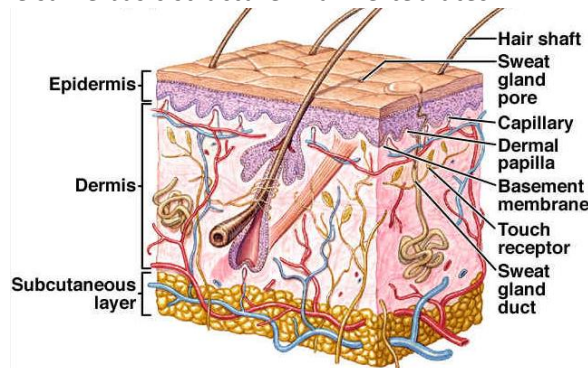


Fig. 1 Section through a mammalian integument

Functions of the integument

- Protection: From mechanical, chemical, thermal, microbial & UV damages; also from drying out;
- Prevention: Water loss;
- Sensation: Provides input to NS;
- Secretion: Mucous, sweat, oil, poison etc.
- Exchange: Liquid & fluid with surrounding environment;
- Storage: Fat, pigment cells;
- Excretion: Metabolic wastes;
- Regulation: Heat & osmosis (homoeostasis);
- Attraction: Sexual through odour & colour;
- Manufacturing: Vitamin D.

Characteristic features of major vertebrate classes

Characteristic features of Pisces

- ▶ Presence of scales and paired/unpaired fins;
- ▶ Gill respiration;
- ▶ Eggs fertilized after being laid;
- ▶ Poikilothermic.

Characteristic features of Amphibia

- ▶ Presence of smooth or slimy skin;
- ▶ Gill or lung respiration;
- ▶ Eggs fertilized after being laid;
- ▶ Poikilothermic.

Characteristic features of Reptilia

- ▶ Presence of epidermal scales and dry skin;
- ▶ Lung respiration;
- ▶ Lay fertilized eggs;
- ▶ Poikilothermic.

Characteristic features of Aves

- ▶ Presence of feathers and forelimbs transformed into wings;
- ▶ Thin & light-weight bones;
- ▶ Lay fertilized eggs;
- ▶ Homoeothermic.

Characteristic features of Mammalia

- ▶ Presence of hair or fur, mammary glands and lung respiration;
- ▶ Give live births (primitives lay fertilized eggs);
- ▶ Homoeothermic.

Integumentary derivatives in Pisces

Jawless fishes (Agnatha)

- ▶ Relatively thick skin, serves as protective cuticle;
- ▶ Multicellular slime glands secrete large amount of mucous to protect body surface.

Cartilaginous fishes (Chondrichthyes)

- ▶ Body covered with microscopic dermal denticles called placoid scales, similar in structure to teeth.

Bony fishes (Osteichthyes)

- ▶ Body covered with dermal scales (cycloid or ctenoid) or naked;
- ▶ Since not shed, scales grow at the margins, seen as lines of growth.

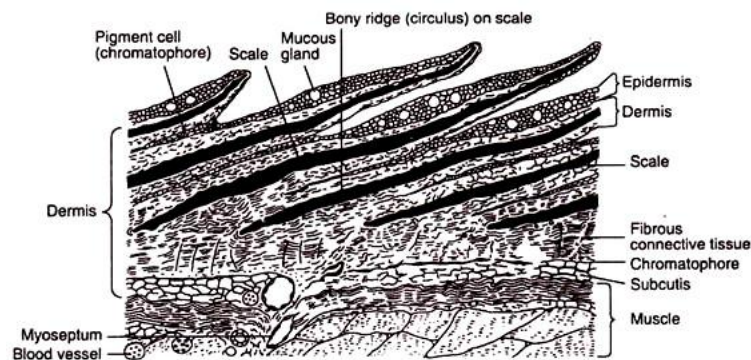
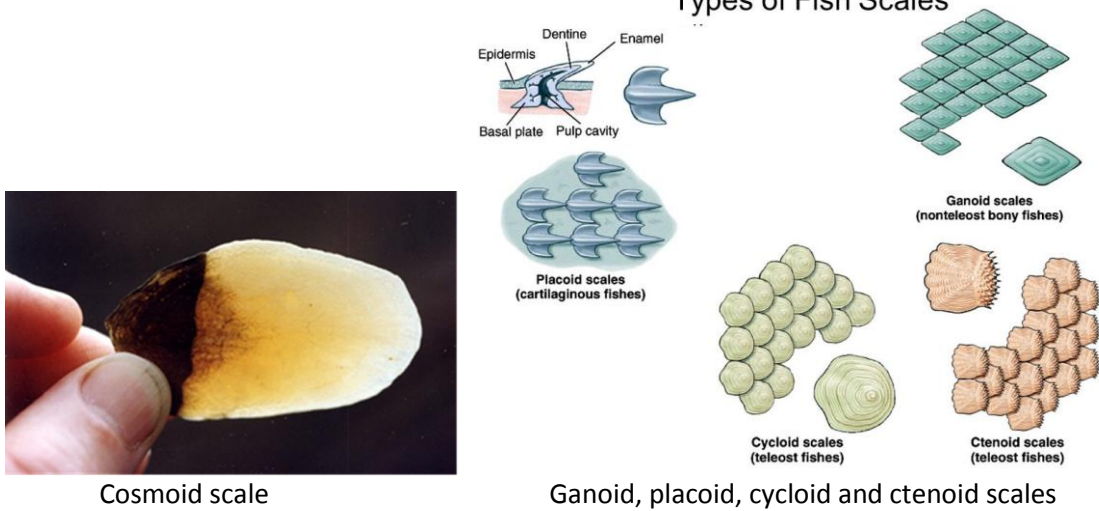


Fig. 3.1 : Section of fish skin (Source : General Biological Supply House)

Five major types of fish scales

- ▶ 1. Cosmoid: Primitive, presence of cosmine; found in Australian lungfish and *Latimaria*.
- ▶ 2. Ganoid: Diamond-shaped, shiny and hard, presence of ganoin; found in non-teleost fishes, e.g. *Polypterus*, *Amia* and garpike.
- ▶ 3. Placoid: Microscopic, dermal denticles (teeth-like), presence of a median spine and two lateral spines, e.g. Dog fishes and sharks
- ▶ 4. Cycloid: Smooth outer edge, most common in fishes with soft fin rays, e.g. carps and salmon.
- ▶ 5. Ctenoid: Comb-like outer edge, usually found in fishes with spiny fin rays, e.g. perches and tilapias.

Types of Fish Scales



Cosmoid scale

Ganoid, placoid, cycloid and ctenoid scales



Fish fins and fin rays



Teeth in a shark



Teeth in tiger fish

Integumentary derivatives in Amphibia

4. Amphibian

• amphibians are transitional between aquatic and terrestrial vertebrates

Epidermis with thin stratum corneum and very little keratin; Leydig cells
Dermis with chromatophores, poison glands and mucous glands
Scales are rare

Characteristic features of amphibian integument

- ▶ Glandular skin secretes mucous (mucin);
- ▶ Skin without scales;
- ▶ Presence of bony dermal scales in caecilians (*O. Apoda*);
- ▶ Presence of claws in African clawed frog, *Xenopus laevis*.



African clawed frog, *Xenopus laevis*

Integumentary derivatives in Reptilia

Characteristic features of reptilian integument

- ▶ Epidermis is thick and lacks glands;
- ▶ Body usually covered with epidermal, keratinized scales that molt at regular intervals;
- ▶ In some reptiles, presence of scutes, rattles, shells and spiny crests.
- ▶



Scales of snakes



Scutes of crocodiles

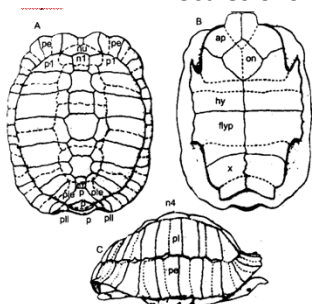


Fig. 1.13. Shell of a tortoise A, carapace; B, plastron; C, lateral view of shell. epistriastron: ep, epistriastron; hy, hyostriastron; hyp, hypostriastron; mu, muclastron; n7, neurals; p, pygal plates (postneurals); ps, peripheral plates; pl, eleventh peripheral; pl, pleural plates; x, xiphiplastron.

Chelonian shells



Spiny crest in *Sphenodon*



Spiny crest in iguana lizard

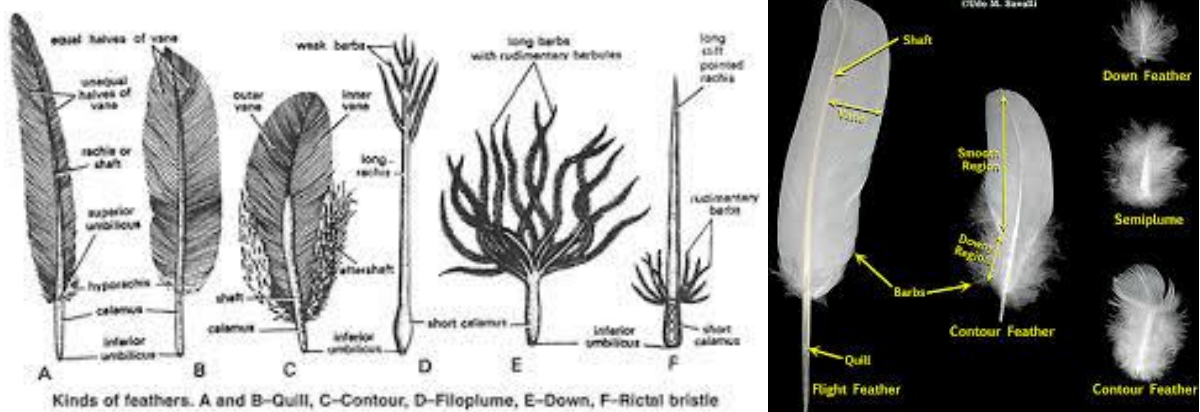
Integumentary derivatives in Aves

Characteristic features of avian integument

- ▶ Epidermis is thin, dermis is well-vascularized;
- ▶ Unique epidermal feathers (plumage) made of keratin;
- ▶ Absence of integumentary glands, except uropygial gland for preening;
- ▶ Dermal scales are limited to feet and base of the beaks;
- ▶ Presence of spurs in both sexes.

Type of feathers (plumages)

1. Quill feathers (flight)
2. Contour feathers (shape + flight)
3. Down feathers (insulation)
4. Plumules (sensory)
5. Filoplumes (display)
6. Bristles (sensory)



Different types of feathers in birds

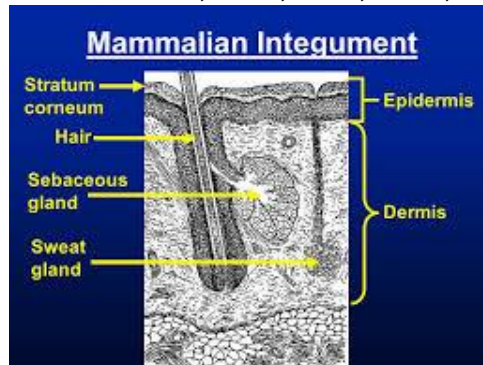


Beaks, claws and spurs in birds

Integumentary derivatives in Mammalia

Characteristic features of mammalian integument

- ▶ Presence of epidermal hairs that arise from dermal hair follicles;
- ▶ Epidermal glands are sebaceous (oil), sudoriferous (sweat), scent and mammary (milk) glands;
- ▶ Other epidermal derivatives include horns, hoofs, claws, scales, nails and spurs.



Various integumentary derivatives in mammals

1. Glands: Sebaceous, sweat, scent and mammary glands
2. Various structures:
 - ▶ Hairs
 - ▶ Nails
 - ▶ Claws
 - ▶ Scales
 - ▶ Horns
 - ▶ Hoofs
 - ▶ Tusks
 - ▶ Baleen
 - ▶ Spurs
 - ▶ Teeth etc.

Hairs, nails, claws and scales in mammals



Different types of horns in mammals

1. True horns

- ▶ F. Bovidae: Cattle, buffaloes, sheep, goats and antelopes;
- ▶ Paired, hard, hollow & pointed, permanent; composed of bony core covered by keratin, never branch, shed or stop growing;
- ▶ Present on males of all species, sometimes on females as well.

2. Antlers

- ▶ F. Cervidae: Deer family, not true horns;
- ▶ Made only of bone, not keratin, and covered with velvet;
- ▶ Present only in males in most species;
- ▶ Branched and shed annually.

3. Pronghorns

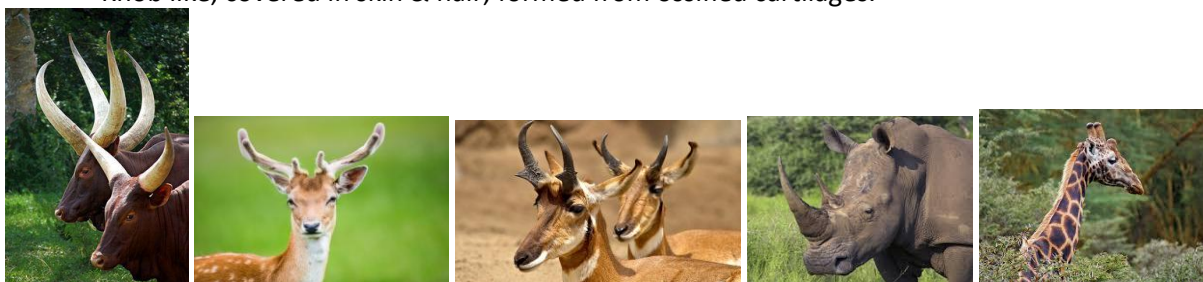
- ▶ F. Antilocapridae, only in pronghorn antelopes;
- ▶ Mix of true horns & antlers (*i.e.* bony core + keratin sheath);
- ▶ Branched & shed annually like antlers.

4. Rhino horns

- ▶ F. Rhinocerotidae, all rhinoceroses;
- ▶ Lack bony core of the true horns, made of keratin only;
- ▶ Grow continuously, single or double on the snout.

5. Giraffe horns (=ossicones)

- ▶ F. Giraffidae, all giraffes;
- ▶ Knob like, covered in skin & hair; formed from ossified cartilages.



True horns

Antlers

Pronghorns

Rhino horns

Giraffe horns

Hoofs and tusks in mammals



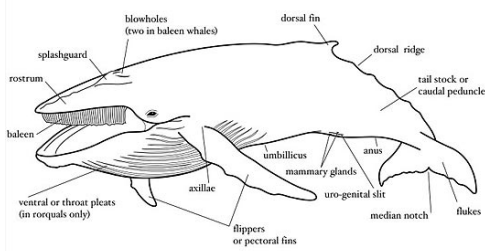
Odd- and even-toed hoofs



Tusks of elephant and walrus

Baleen, spurs and teeth in mammals

BALEEN WHALE MORPHOLOGY



Humpback Whale *Megaptera novaeangliae*

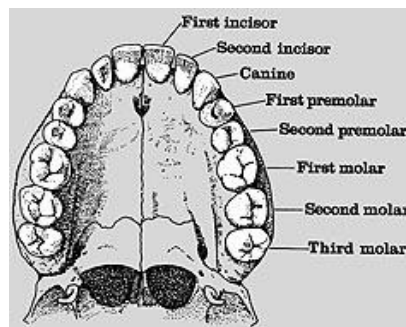
Baleen in humpback whale



Spurs in duck-billed platypus



Homodont in a river dolphin

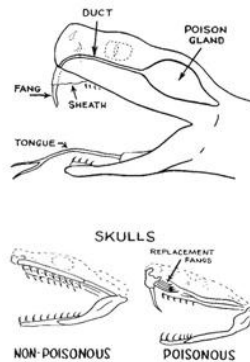


Heterodont in man

Teeth in Amphibia, Reptilia and Aves



Maxillary teeth in a frog



Teeth in snakes



Teeth in a domestic goose



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