Integumentary System

- Functions:
  - Defense
  - Regulation
  - Sensory Perception
- Highly Variable Characteristics

- Components
  - Epidermis
    - Derived from ectoderm
    - Layers
      - always has ***Stratum Germinativum***
      - outer layers highly variable
      - if additional layers are present, the outermost is the ***Stratum Corneum***

- Components
  - Dermis
    - Derived from mesoderm
    - Connects epidermis to underlying musculature
    - Generally thicker than epidermis
    - Contains connective tissue and smooth muscle fibers
    - Contains all nervous and circulatory elements of the integument
    - Houses many of the structures made in the epidermis

- Integumentary color
  1. Chromatophores
     - cells that actually produce color
     - epidermal
       - only one type = **melanophores**
     - dermal
       - melanophores & **lipophores**
         - » lipophore = **xanthophores** and **erythrophores**
  2. Iridocytes (guanophores)
     - contain crystal of guanine
  3. Photophores
     - light producing

- Integumentary color
  - Color change
    - Morphological color change
    - Physiological color change

- Integumentary Glands
  - all develop from the stratum germinativum in the epidermis
  - all integumentary glands are exocrine (vs. endocrine)
- Glandular cell types
  - Merocrine
    - Cellular secretions
  - Apocrine
    - Partial cell disintegration
  - Holocrine
    - Entire cell destroyed

- Glandular structures
  Unicellular
  - Multicellular
    - Simple
    - Compound
    - Tubular
    - Saccular
    - Combinations of the above:
      - Simple tubular, compound saccular, etc.

- Specialized Glands:
  - Class Reptilia
    - femoral gland
    - cloacal gland
  - Class Aves
    - uropygial gland
  - Class Mammalia
    - sebaceous gland
    - sweat gland
    - scent gland
    - mammary gland
      - (mammae with projecting nipples or teats)

Hard Tissues of the Body

- Enamel:
  - hardest body tissue
  - 3% organic - 97% inorganic
  - occurs in teeth, scales, armor plates
  - derived from the ectoderm (therefore the epidermis)
  - grows by accretion on external surface
  - ganoine type of enamel

Hard Tissues of the Body

- Dentine:
  - 2nd hardest tissue
  - 30% organic
  - also in teeth, scales, and armor plates
  - derived from mesoderm (=dermis)
  - grows by accretion on internal surface
  - cosmine type of dentine

Hard Tissues of the Body

- Bone:
  - 35% organic
  - contains living cells - more later
- Keratin:
  - 100% organic
  - entirely made of protein
  - contributes to scales, horny teeth, and other epidermal structures

Scales

- Dermal scales:
  - Originate in the dermis
  - Mesodermal in origin
  - Composed of bone with an enamel or dentine covering
  - May be multilayered
- Epidermal scales:
  - Originate in epidermis
  - Ectodermal in origin
  - Hardness due to keratin
  - Ecdysis – shedding of the epidermal scale

Feathers

- Specialized epidermal scales with mesodermal components
- Development similar to reptilian scales
- Three major types:
  - Contour
  - Down
  - Bristle feather

Hair

- Unique structure with no homolog in earlier vertebrates
- Entirely ectodermal in origin
- Grows by deposition of keratin within the follicle
- Housed within the dermis, but is lined entirely with epidermal cells

Other Integumentary Structures

- Claws
  - keratin extension of the distal phalanx
  - composed of
    - unguis (dorsal plate)
    - subunguis (ventral plate)
  - hooves are modified claws

Other Integumentary Structures

- Horns – general term used for several types of mammalian head ornamentation
  - True horn
    - bony extension of the frontal bone covered with keratin sheath (bovids)
    - never shed or branched.
  - Pronghorn
    - bony extension of the frontal bone covered with a keratin sheath that is often branched
    - sheath shed annually (pronghorn antelope).

Other Integumentary Structures

- Horns – general term used for several types of mammalian head ornamentation
  - Keratin Fiber Horn
    - modified hairs "glued" together
    - not shed, but may be repaired or replace (rhinoceroses)
  - Antler
    - extension of frontal bone
    - branched and shed annually
    - covered in skin and hair as it grows
    - solid bone at maturity

General Integument Overview

- Myxini & Cephalaspidomorphi
  - All cells of epidermis are mitotically active.
    - Lots of unicellular mucous glands.
  - Dermis thinner than epidermis.
- Chondrichthyes
  - Two layers to dermis: compact and spongy.
  - Placoid scales formed from basal boney plates.

General Integument Overview

- "Bony Fish"
  - Epidermis with unicellular and multicellular mucous glands.
  - Scales imbedded in dermis – type depended on species.
- Amphibia
  - Multilayered epidermis with distinct stratum corneum
  - Lots of epidermal glands.
  - Dermis comprised of stratum spongiosum and stratum compactum.

General Integument Overview

- Reptilia
  - Multilayered epidermis with distinct stratum corneum
    - Water impervious layer.
    - Very few epidermal glands.
  - Scales both dermal and epidermal
    - Dermal scales limited to a few taxa
    - Epidermal scales shed with growth
      - ecdysis

General Integument Overview

- Aves
  - Epidermis thin except in exposed areas.
    - Epidermal scales present on legs & bill.
    - Feather are modified epidermal scales.
  - Dermis thin but with abundant smooth muscle fibers.
- Mammalia
  - Epidermis highly developed with numerous glands & hair follicles.
    - Epidermal scales present in some taxa
  - Dermis thick & highly innervated