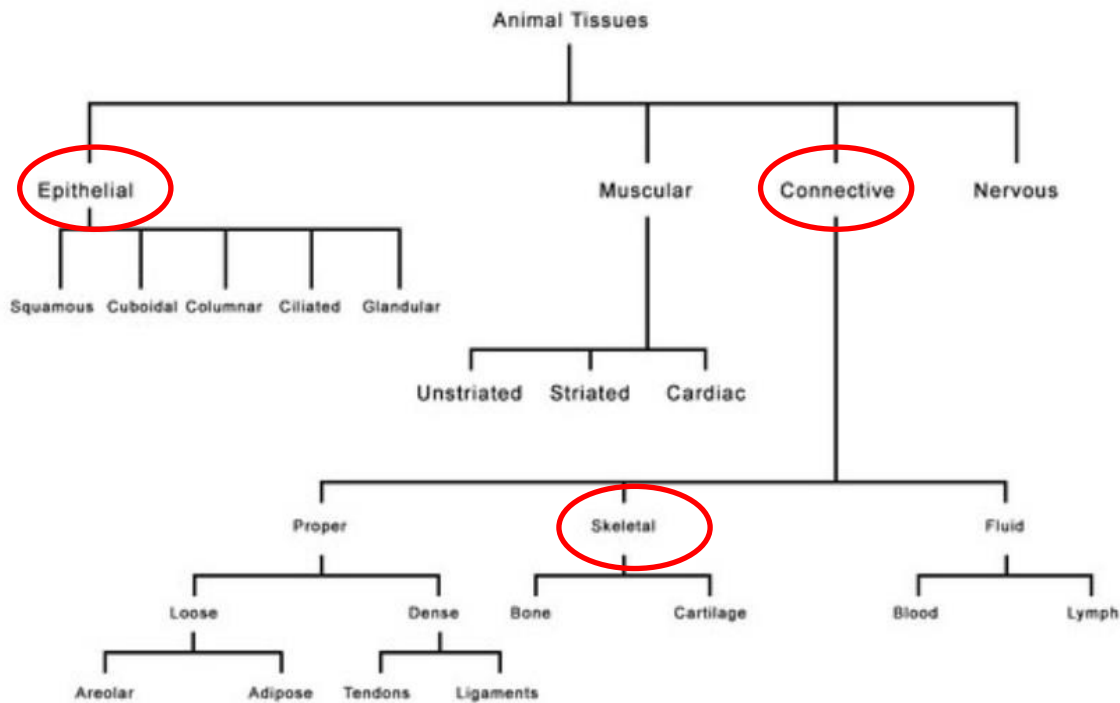


# ANIMAL TISSUES



**Epithelial tissue** is made up of layers of tightly packed cells that line the surfaces of the body for protection, secretion, and absorption. Examples of epithelial tissue include the skin, the lining of the mouth and nose, and the lining of the digestive system.

**Muscle tissue** is made up of cells contain contractile filaments that move past each other and change the size of the cell. There are three types of muscle tissue: smooth muscle which is found in the inner linings of organs; skeletal muscle, which is attached to bone and moves the body; and cardiac muscle which is found only in the heart.

**Nervous tissue** is made up of the nerve cells (neurons) that together form the nervous system, including the brain and spinal cord.

**Connective tissue** is made up of many different types of cells that are all involved in structure and support of the body. Bone, blood, fat, and cartilage are all connective tissues. Connective tissue can be densely packed together, as bone cells are, or loosely packed, as adipose tissue (fat cells) are.

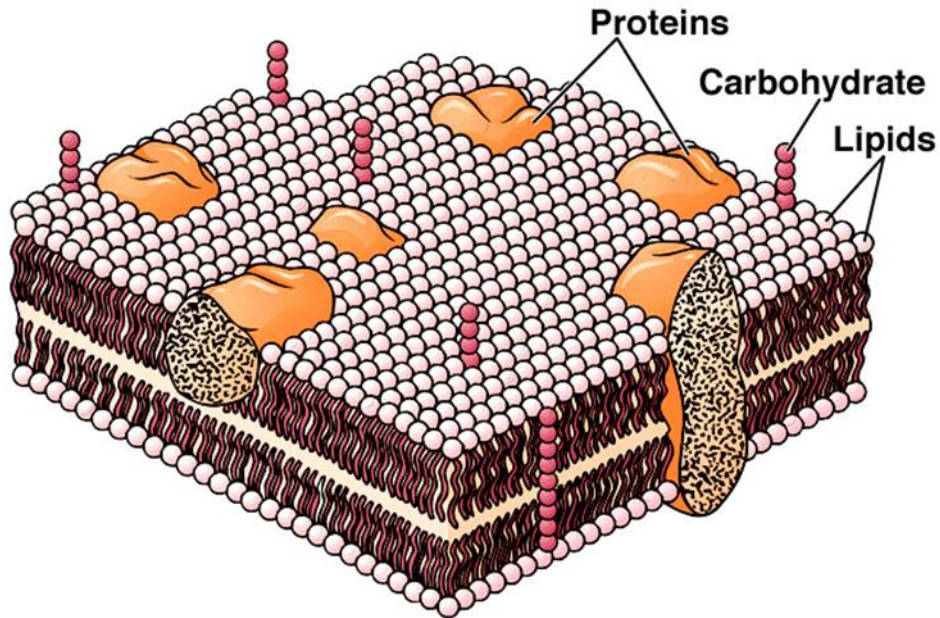
# INTEGUMENTARY SYSTEM

The integumentary system is the largest organ of the body that forms a physical barrier between the external environment and the internal environment:

- Serves to protect and maintain body
- Secretion (glands)
- Sensory
- Gas exchange
- Excretion
- Body temperature regulation

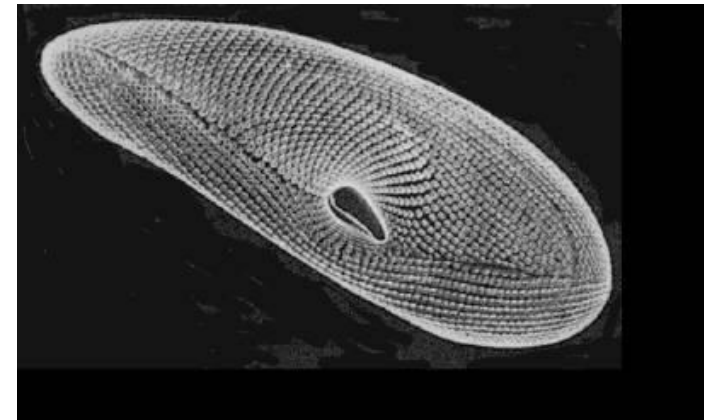
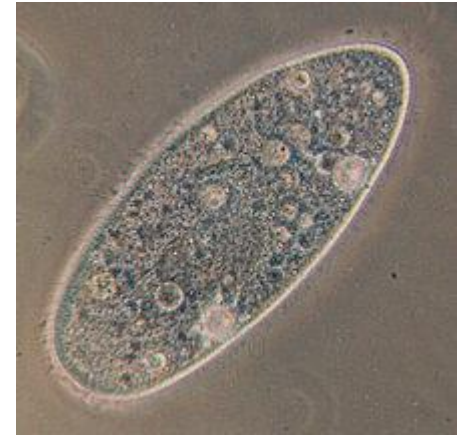
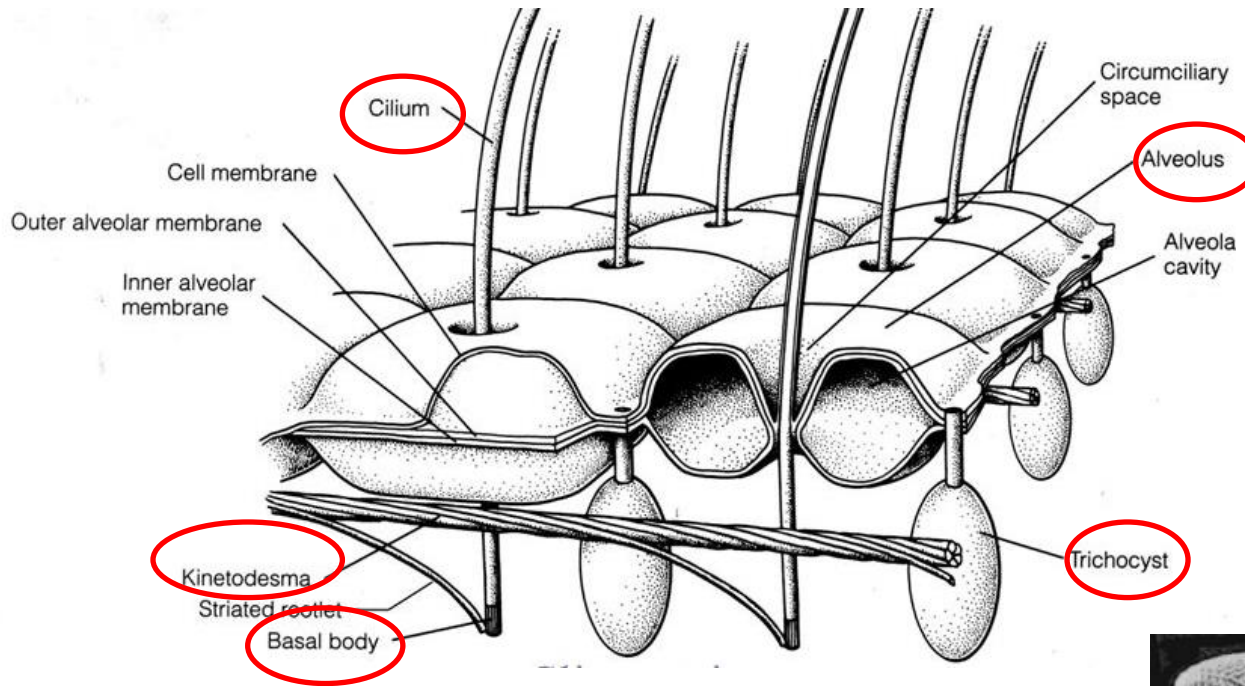
# Protists (kingdom Protista)

- Amoeba - Double membrane



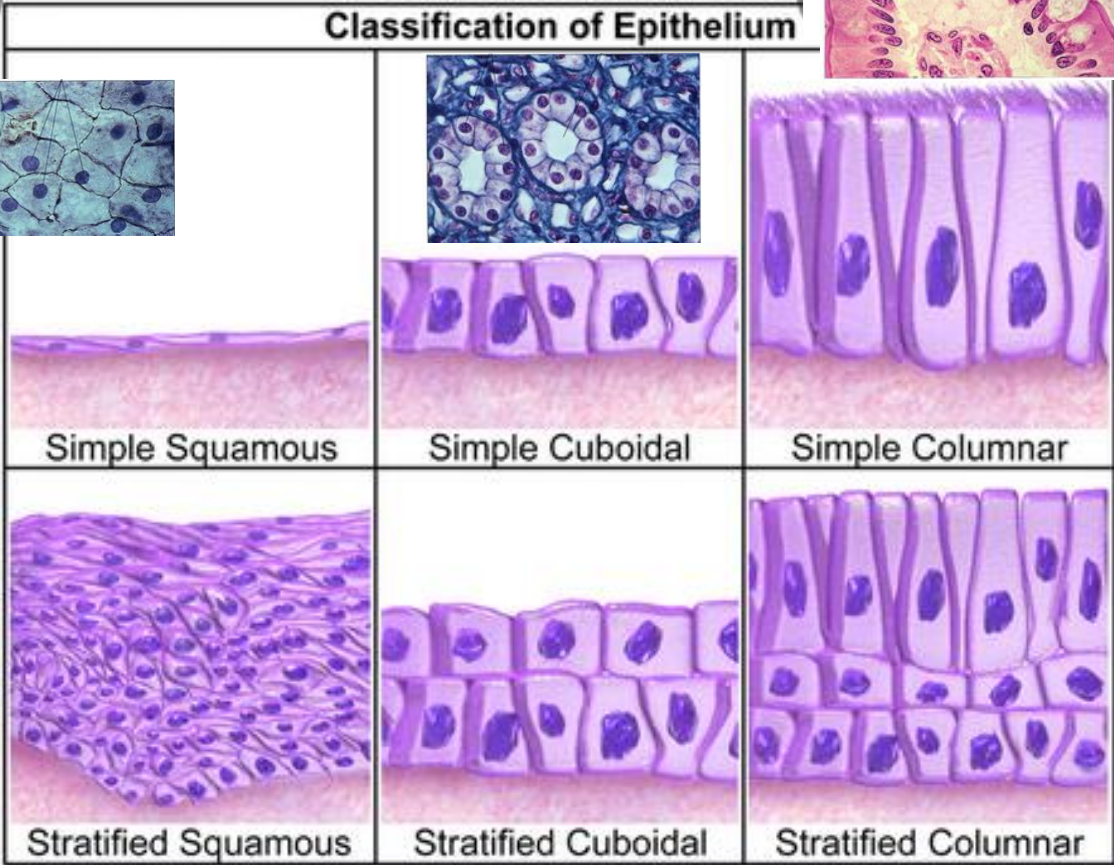
# Protists (kingdom Protista)

Paramecium - body of the cell is enclosed by a stiff but elastic structure called the **pellicle** (shape, moving)



- Multicellular animals - skin is built by **epithelium tissue** (cover, glands, sensory)

**Cover**

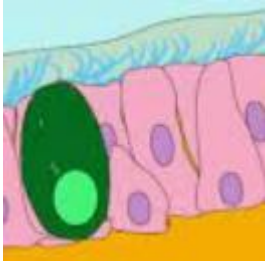


**Invertebrata  
(one layer)**

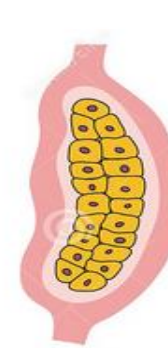
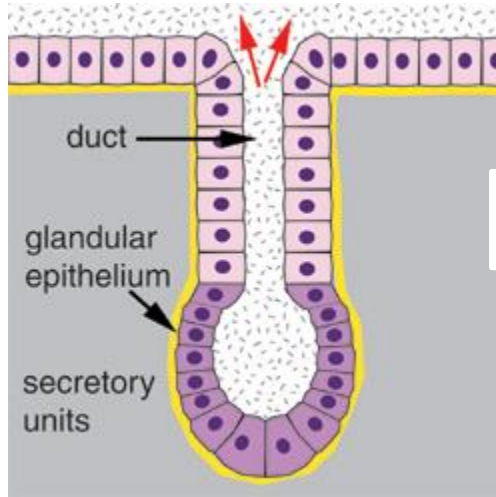
**Vertebrata  
(many layers)**

# Glands produce secret

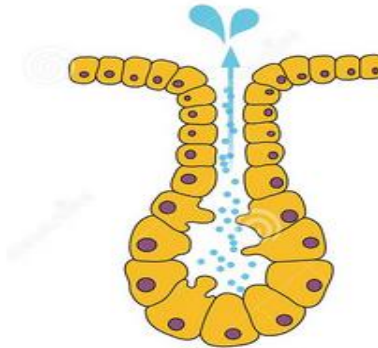
- unicellular



- multicellular



Endocrine gland



Exocrine gland

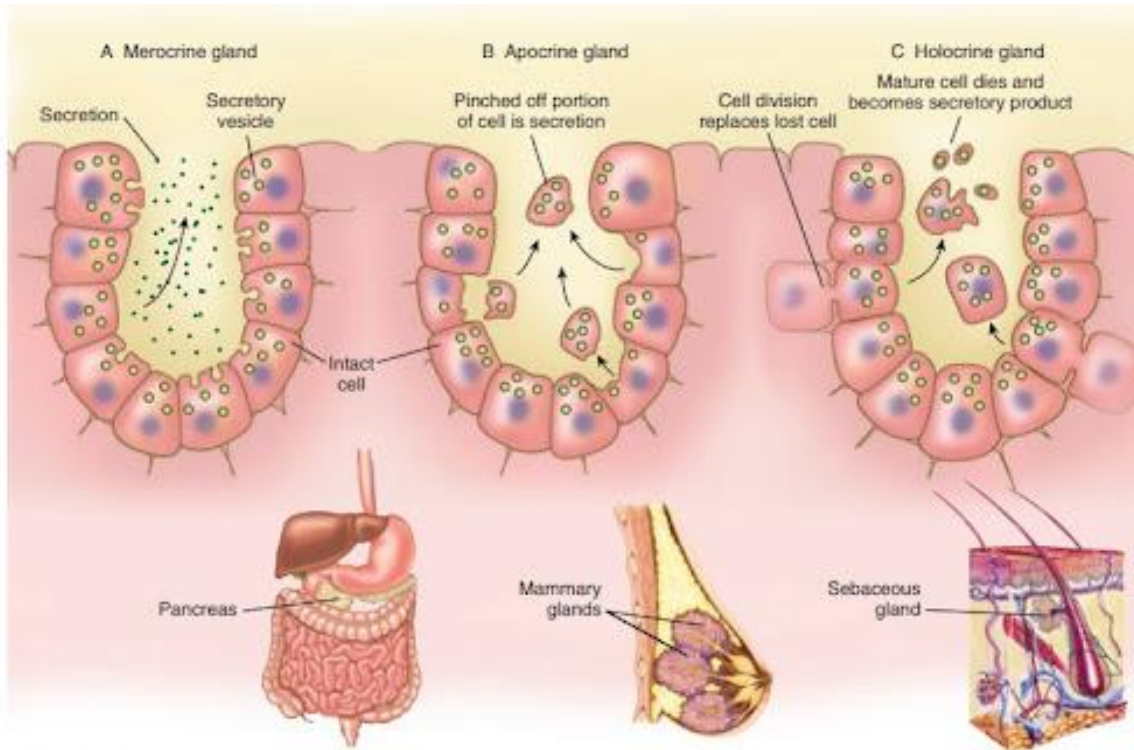


FIGURE 5-5 Merocrine, apocrine, and holocrine glands.

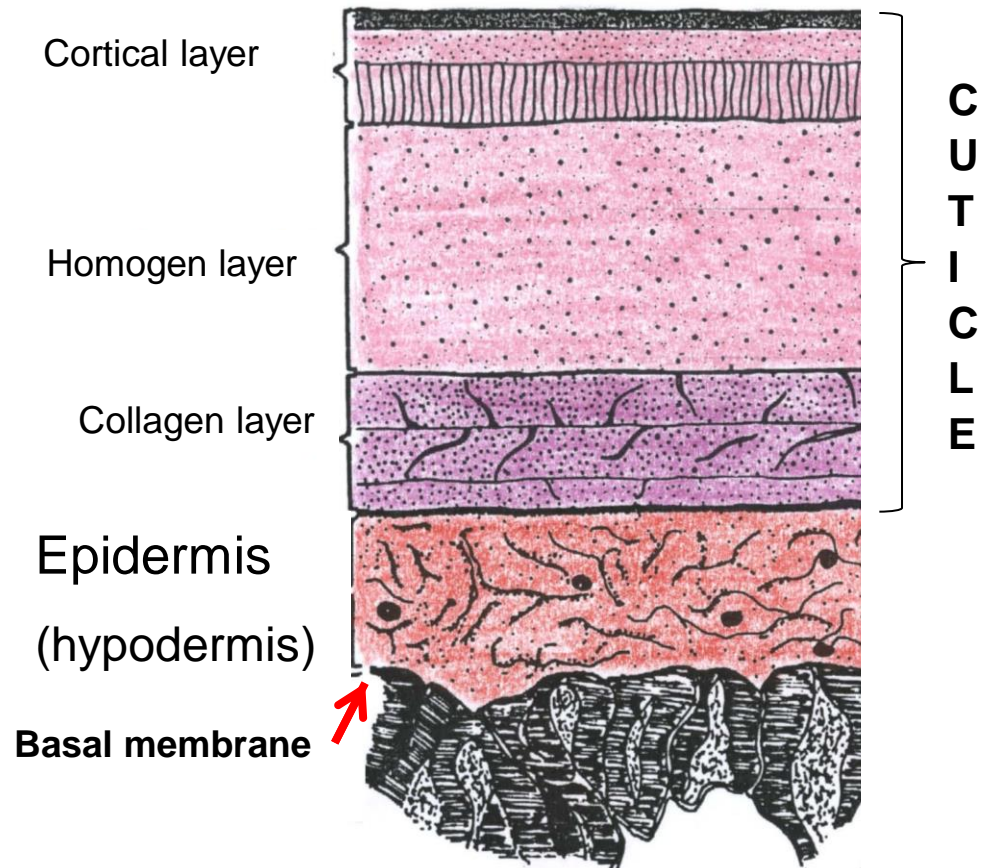
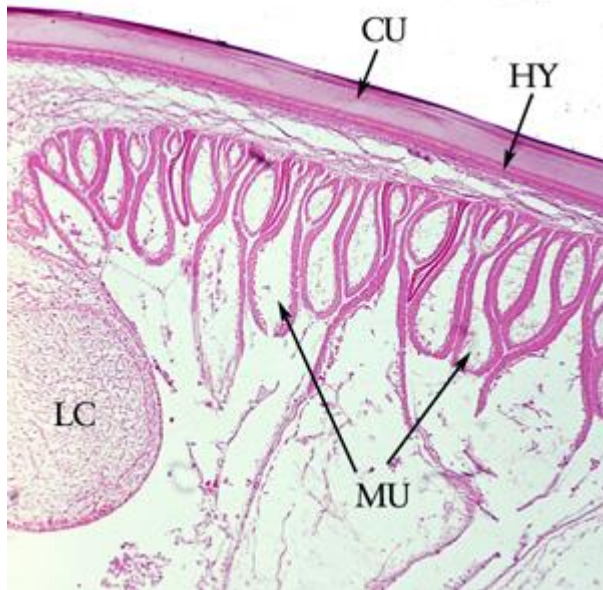


## Nematods (phylum Nematoda)

### Ascaris worm (*Ascaris lumbricoides*)

- Parasite (intestinal roundworm)

- epidermis is syncytial

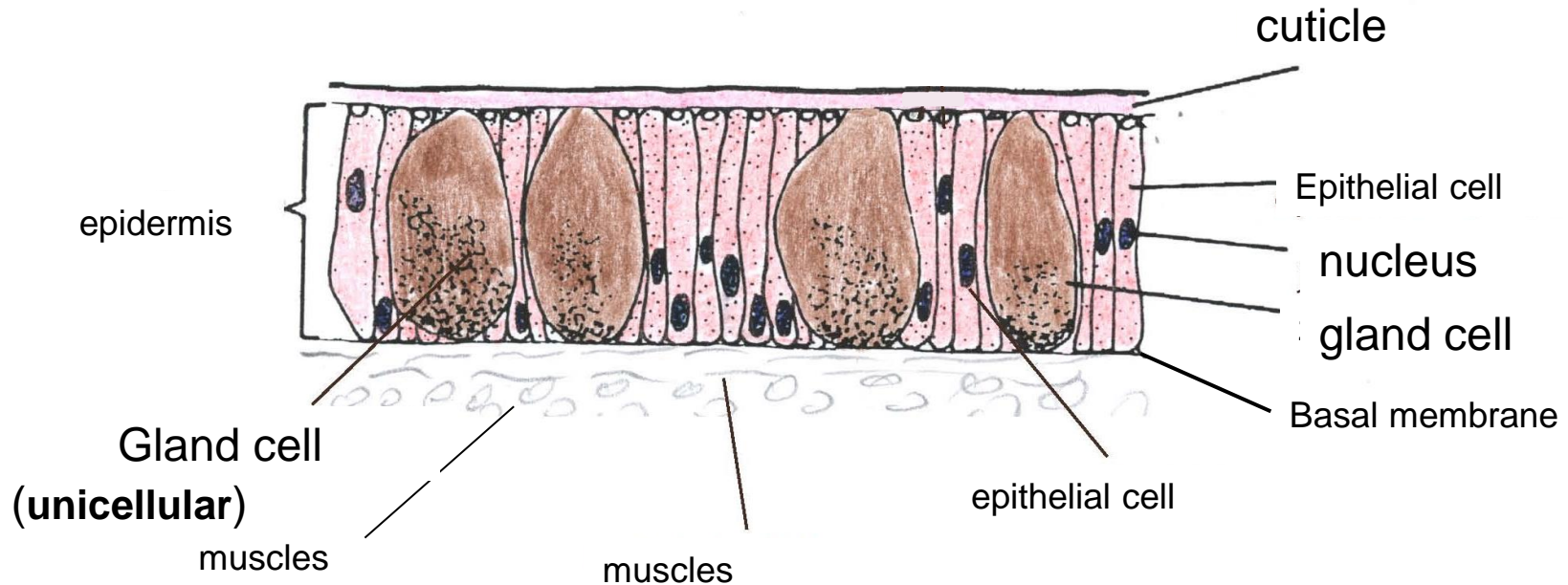




# Annelids (phylum Anellida)

## Earthworm (*Lumbricus terrestris*)

- **One layer of epidermal cells with thin cuticle**
- Glands (keep the surface wet – breathing and moving)

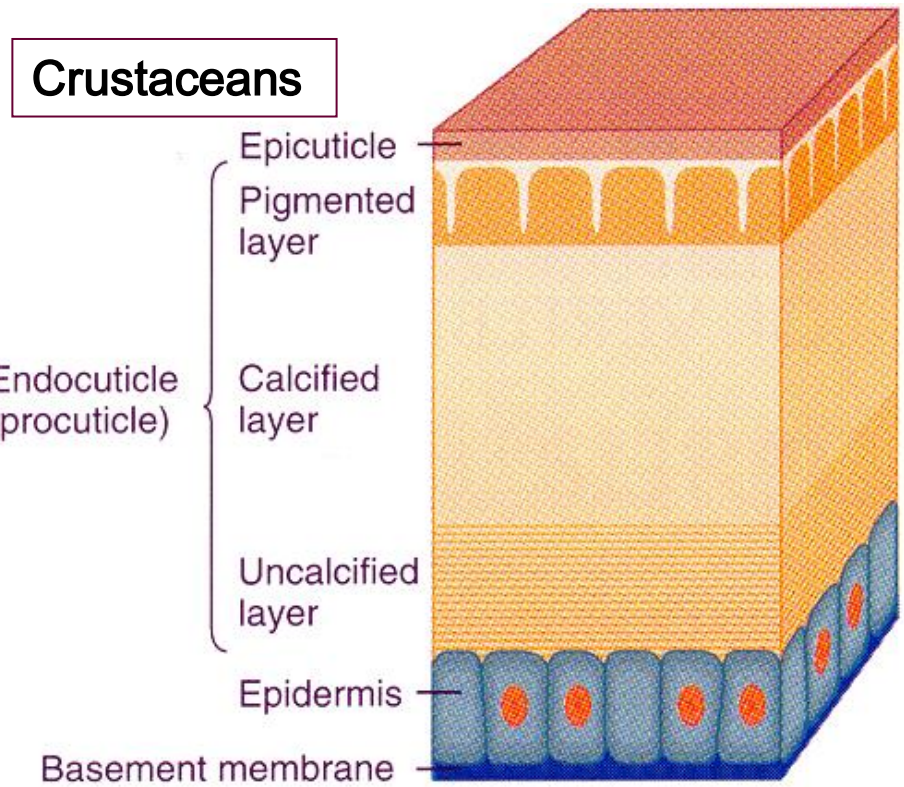


# Arthropods (phylum Arthropoda)

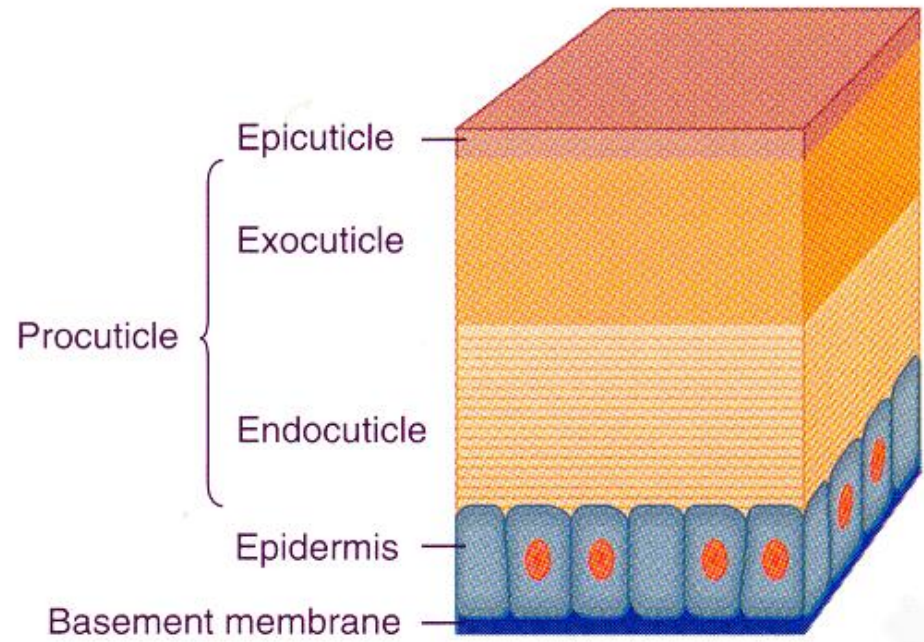


- **Simple (one layer) epidermis (hypodermis)**  
- on the surface chitin cuticle (in crustaceans with  $\text{CaCO}_3$ )

**Crustaceans**



**Insects**

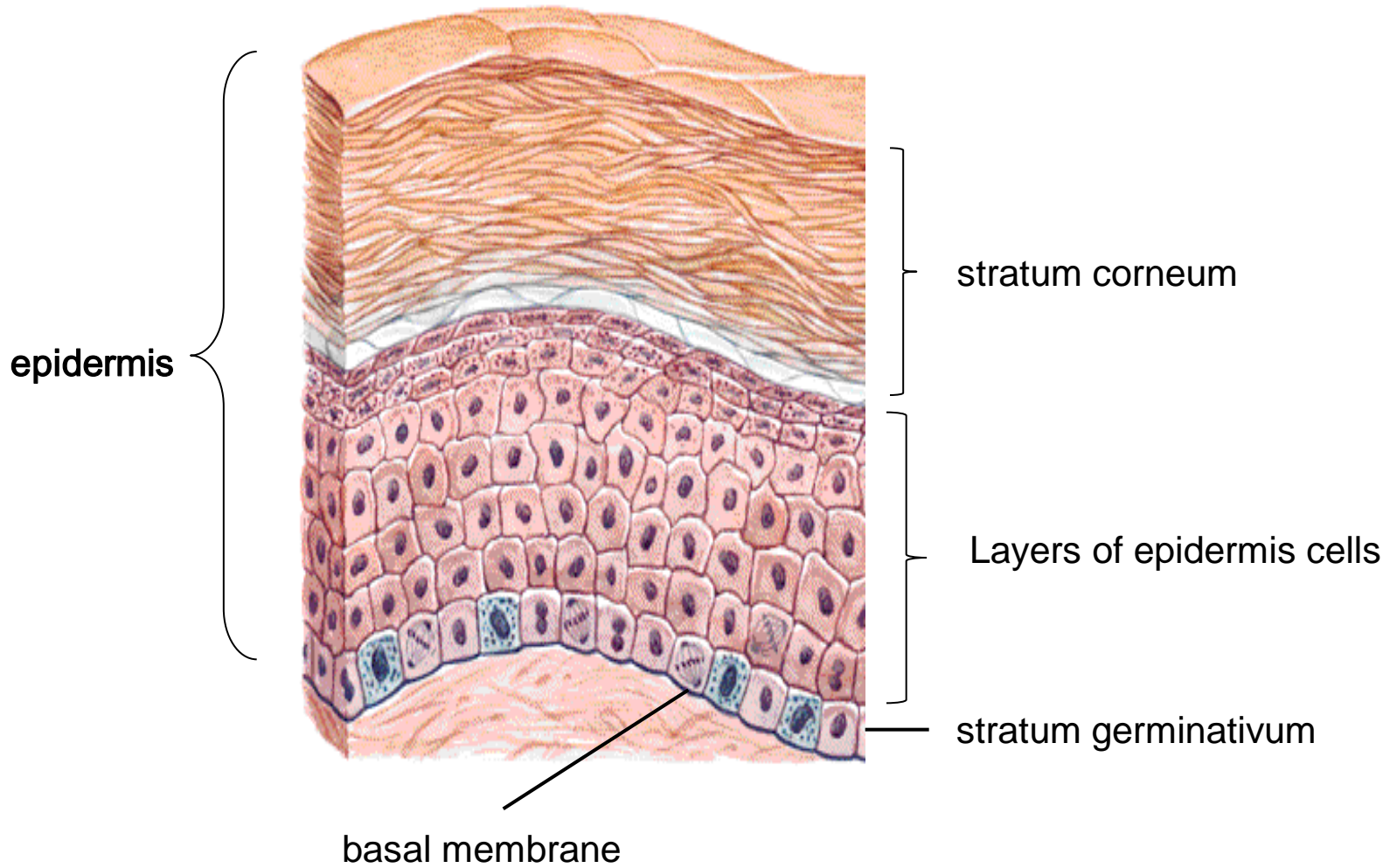


## Vertebrates ((sub)phylum Vertebrata)

1. **epidermis** – ectodermal multilayer part on the top: basal layer (*stratum germinativum*) mitosis – pushing cells up, at the top *stratum corneum*
2. **dermis, cutis** – mesodermal; connective tissue with glands, blood vessels, nerves...



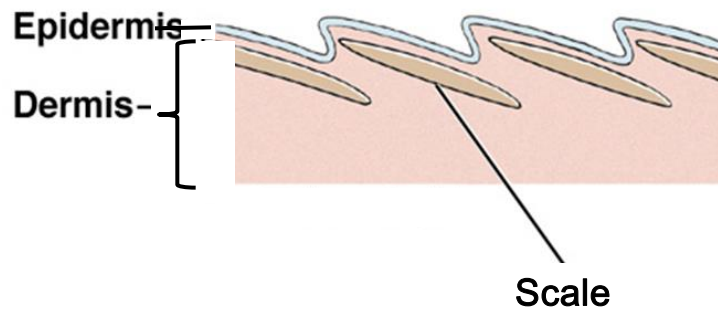
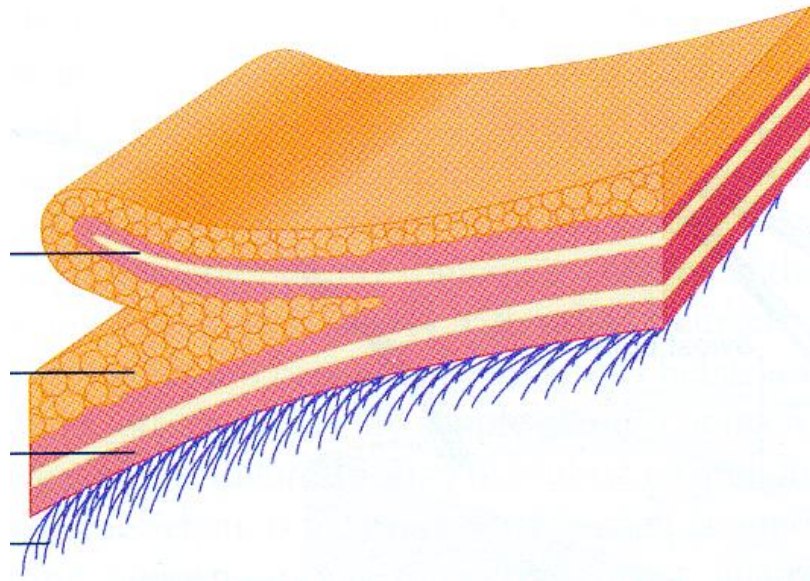
# Epidermis :



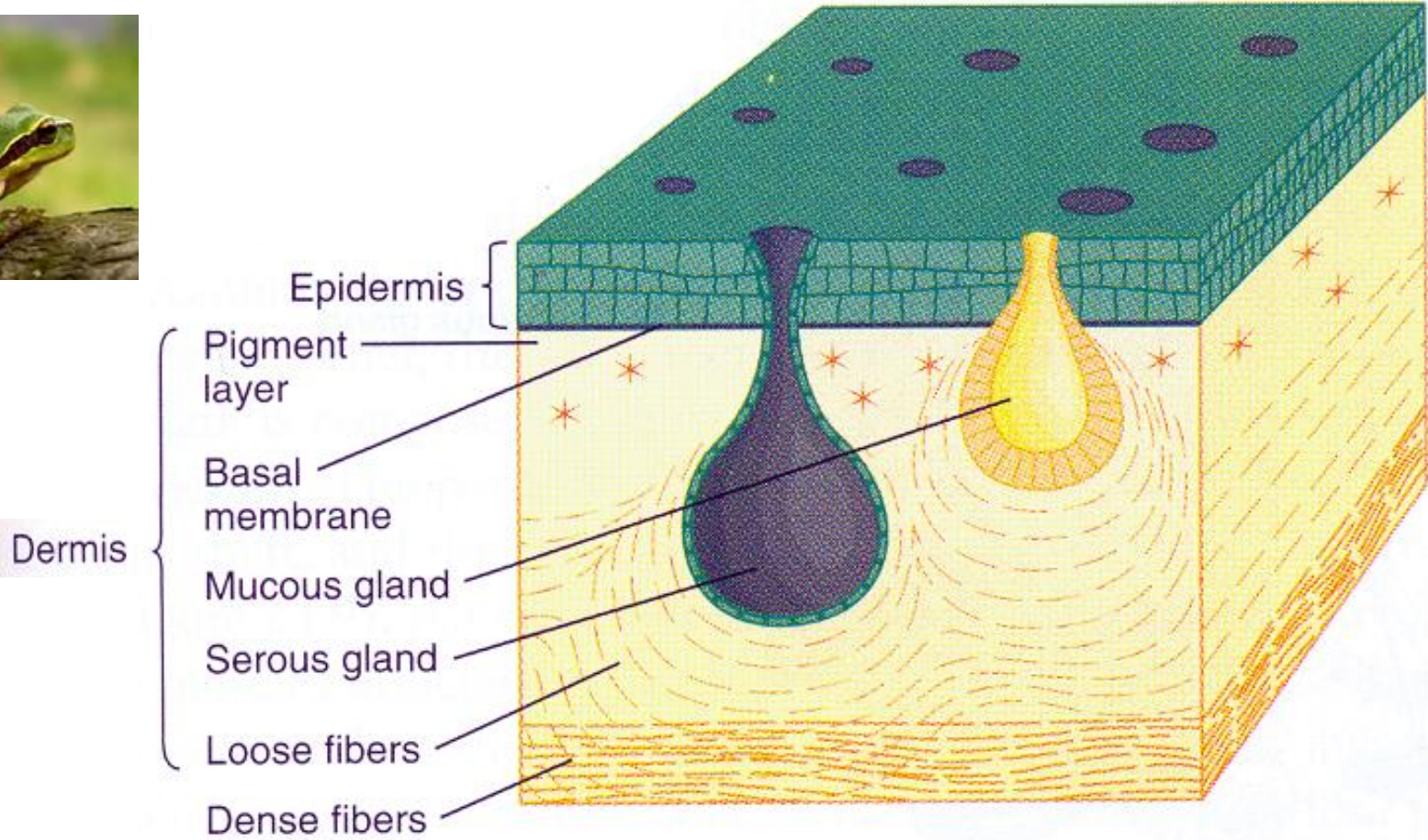
# Fish:

Scale – part of dermis

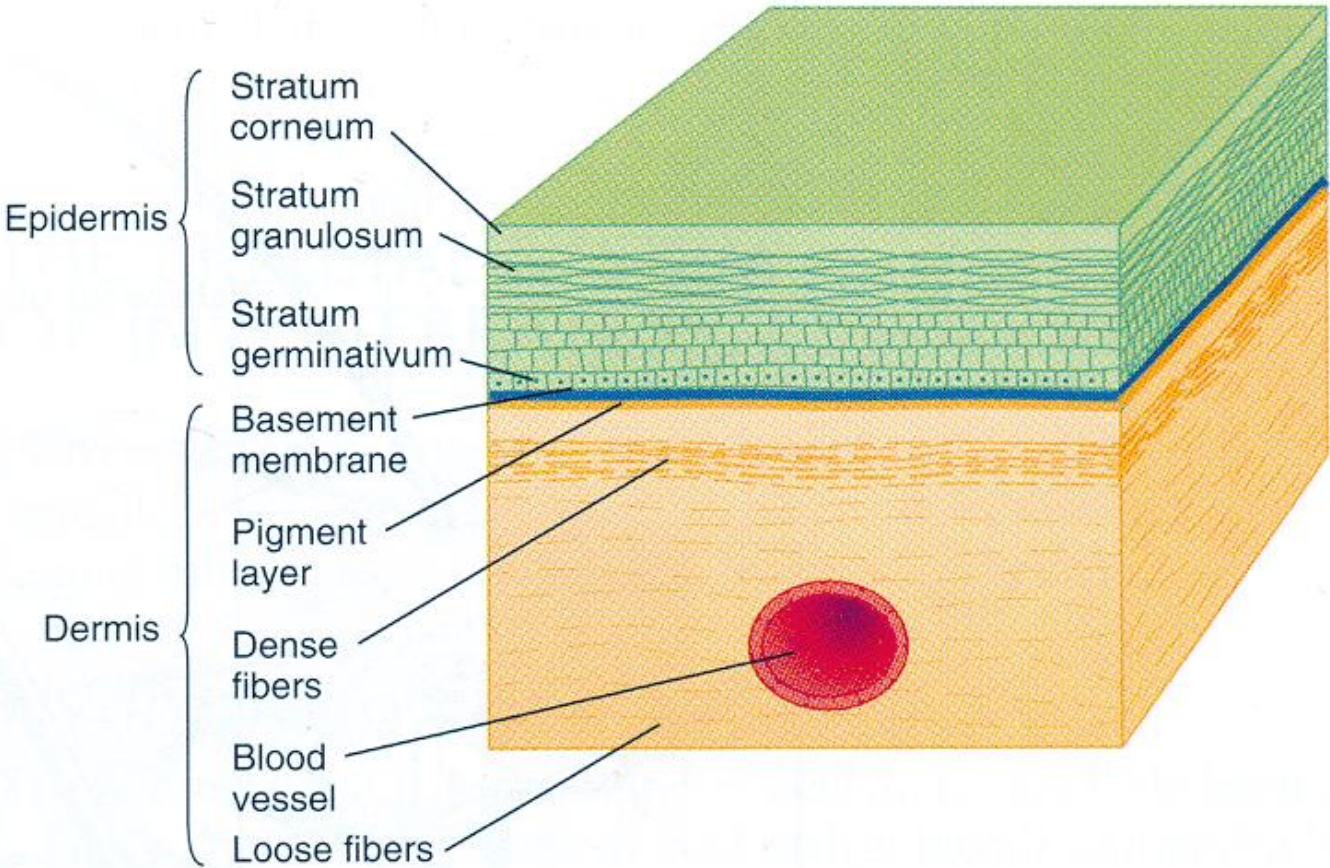
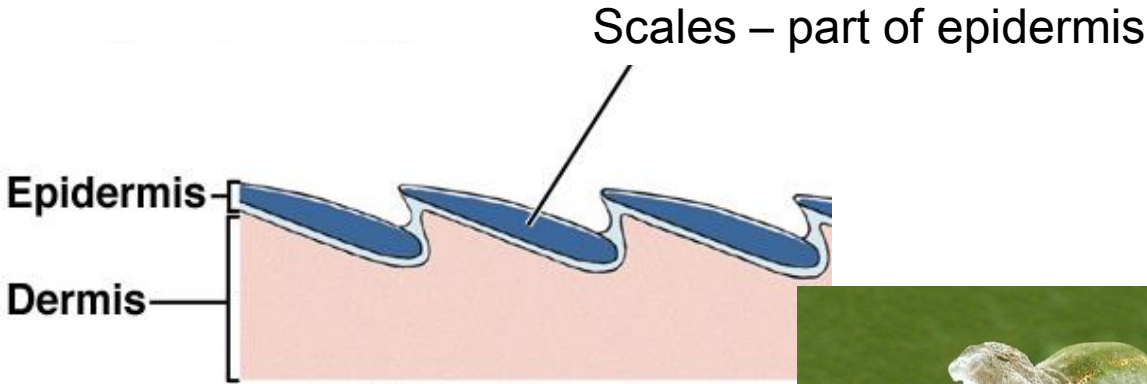
**epidermis**  
(gland openings)  
**dermis**



# Amphibians:



# Reptiles:



## Homeothermic (endotherm) species

– worm-blooded – birds and mammals

+ feathers and hairs - air layer – thermal isolation



**Ectotherm species** – cold-blooded – can't keep body temperature constant (depends on environment)(internal physiological sources of heat are of relatively small or of quite negligible importance in controlling body temperature)





# Birds :

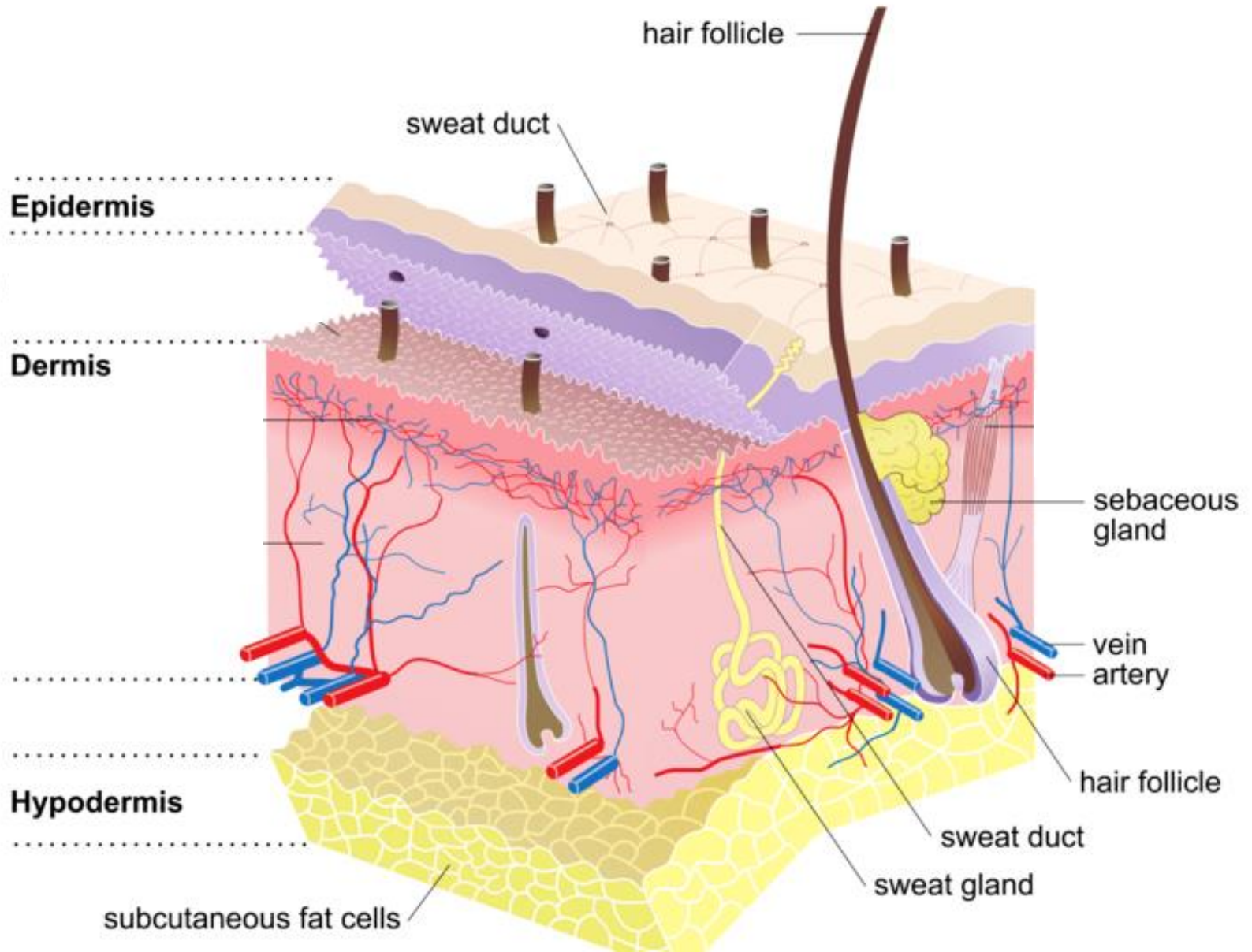


feather – from epidermis (can moult)

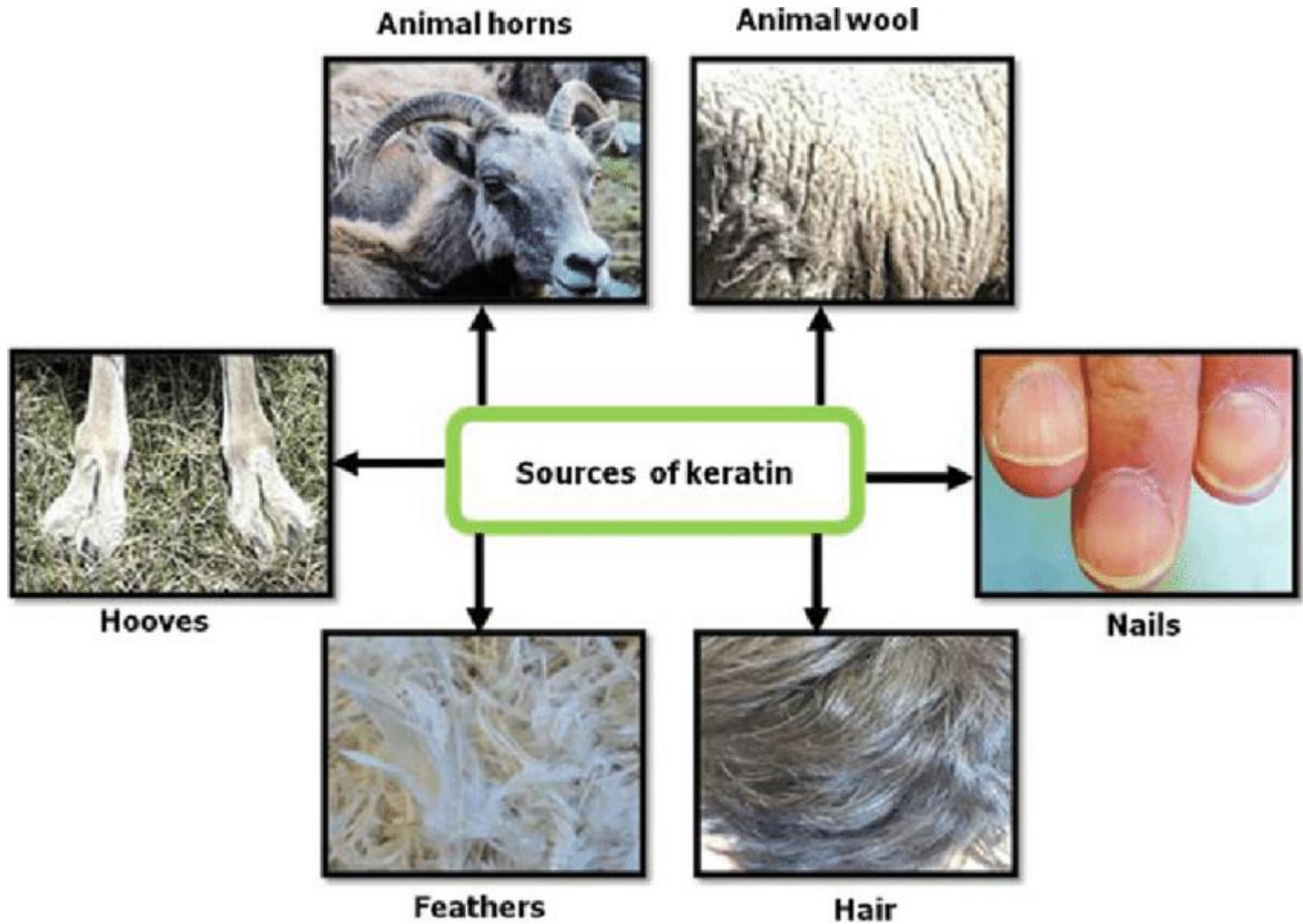


# Mammals

## Hairs from epidermis - moult

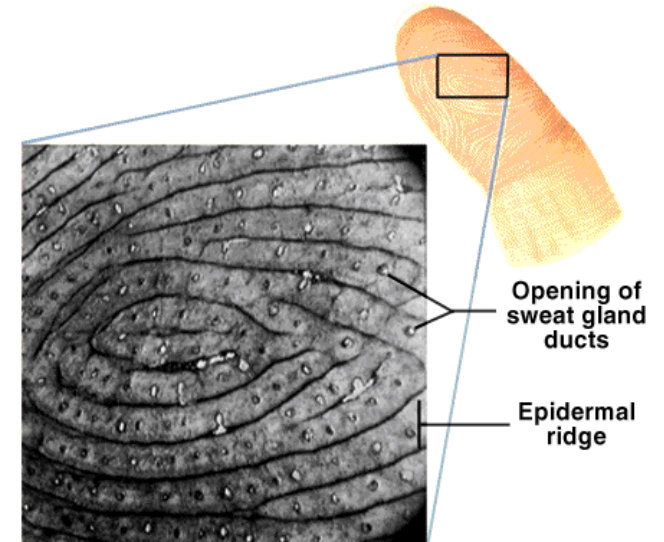
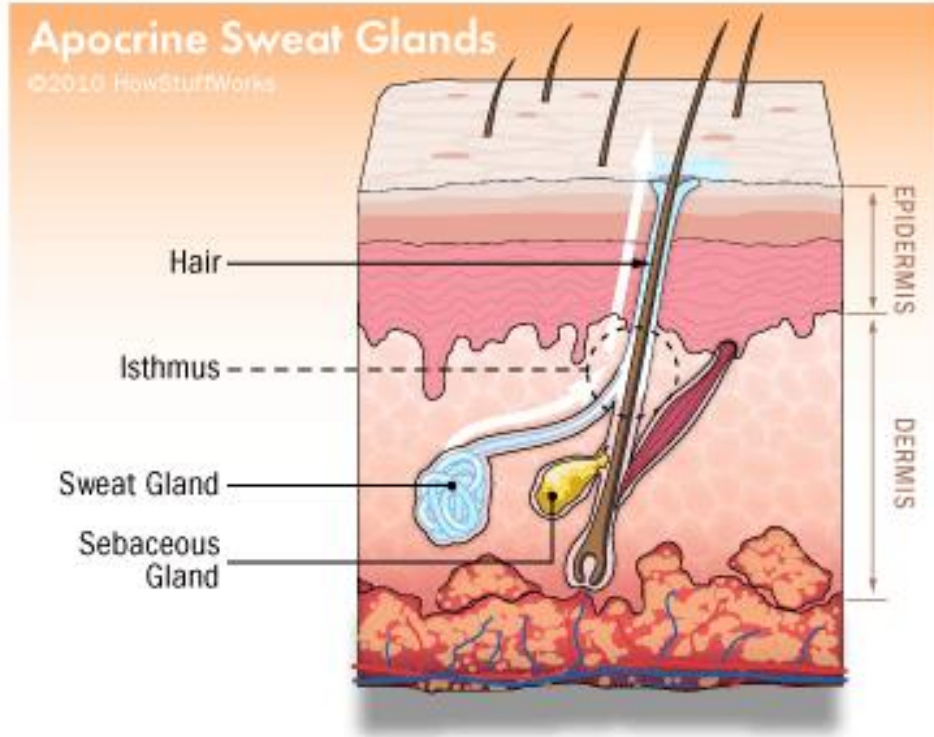
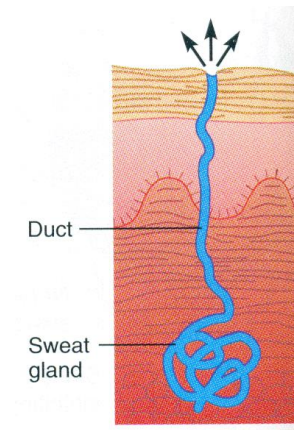


# KERATIN STRUCTURES



## glands: sweat , sebaceous

- **sweat** – thermal regulation
- mammary glands are modified sweat glands
- sebaceous - lubricate hairs, skin (elasticity)
- **connected to smell**



# SKELETAL SYSTEM

The major functions of the skeletal system are:

- **body support,**
- **facilitation of movement,**
- **protection of internal organs,**
- **storage of minerals and fat,**
- **blood cell formation**

types:

hydroskelet



turbellarian

hard skeletons

**exoskeleton:** a hard outer structure that provides both structure and protection to creatures such as insects, Crustacea..



**endoskeleton:** the internal skeleton of an animal, which in vertebrates is comprised of bone and cartilage



# hydroskelet

In organisms with hydrostatic skeletons, the muscles contract to change the shape of the body cavities (pseudocoelom, coelom), which then produces movement due to the pressure of the fluid inside the fluid-filled cavity.

-platyhelminthes, cnidaria, nematoda, annelidae, etc.



flatworm



hydra



roundworms



# hydroskeleton

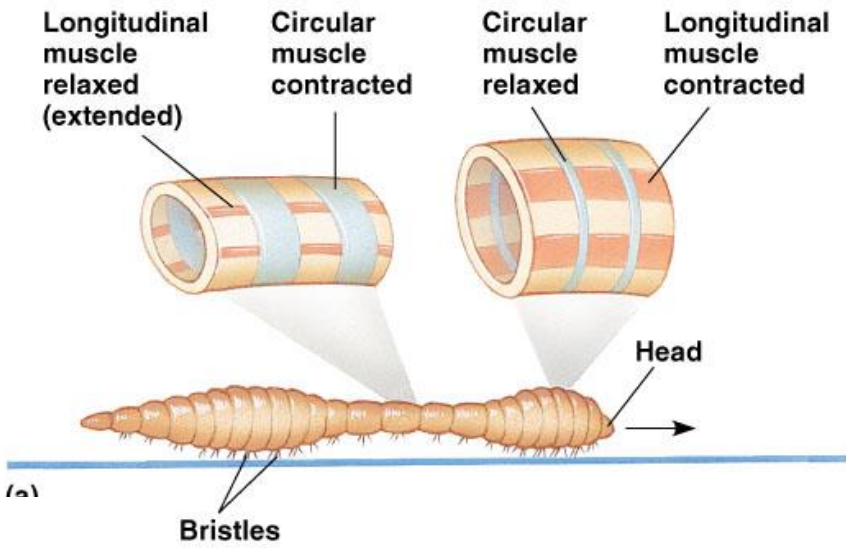
Turbelaria

-The whole body – one system



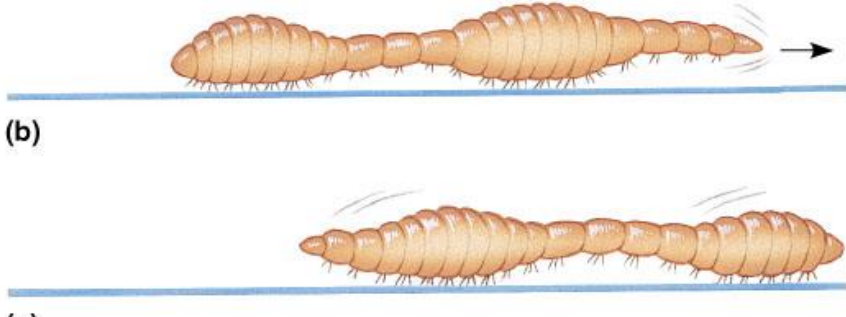
-Annelida

- Each body segment - a small system



## drawbacks:

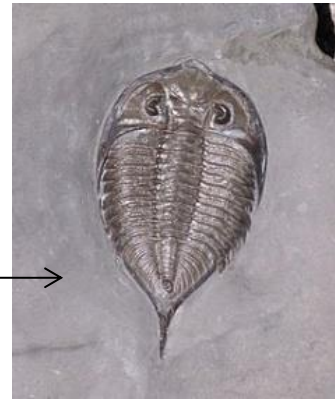
- the whole body is involved
- slow reaction
- lots of energy



# HARD SKELETONS

➤ important for big(er) animals (specially for those out of water)

-1st hard skeletons in Precambrian period (600 MYA) trilobites



## EXOSKELETONS (ectodermal origine)

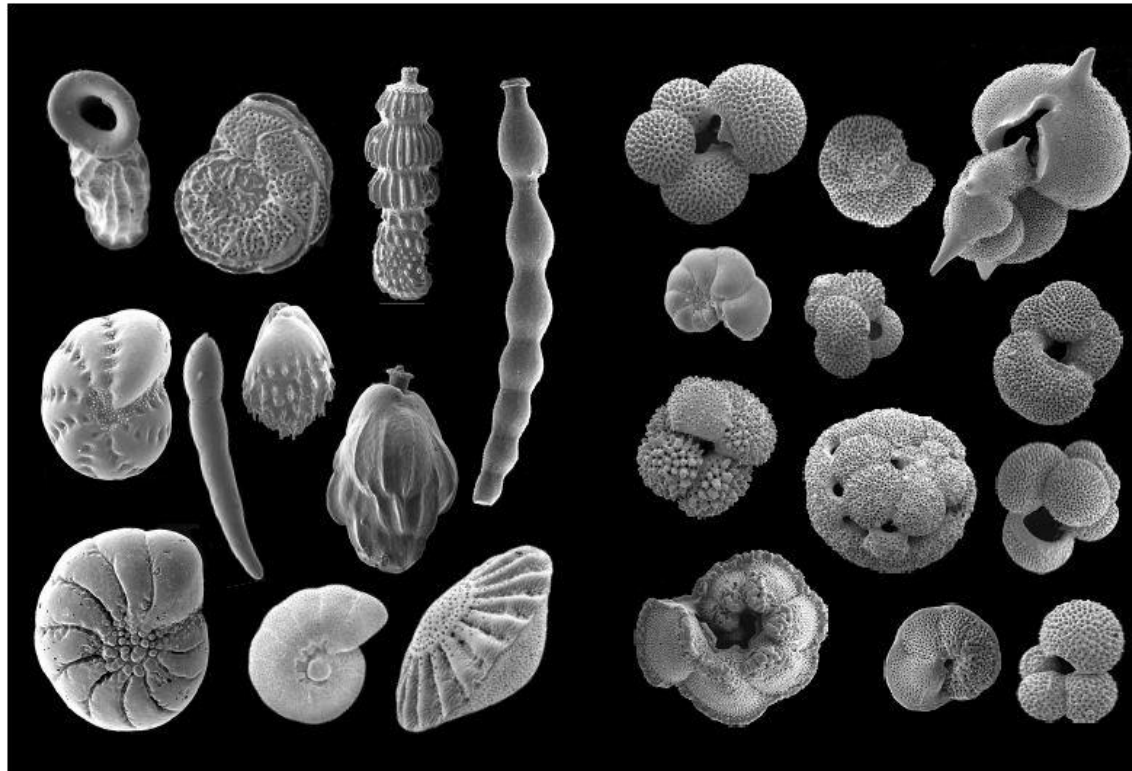
- Exoskeletons are external skeletal systems that are made up of chitin and calcium carbonate.



# PROTISTS

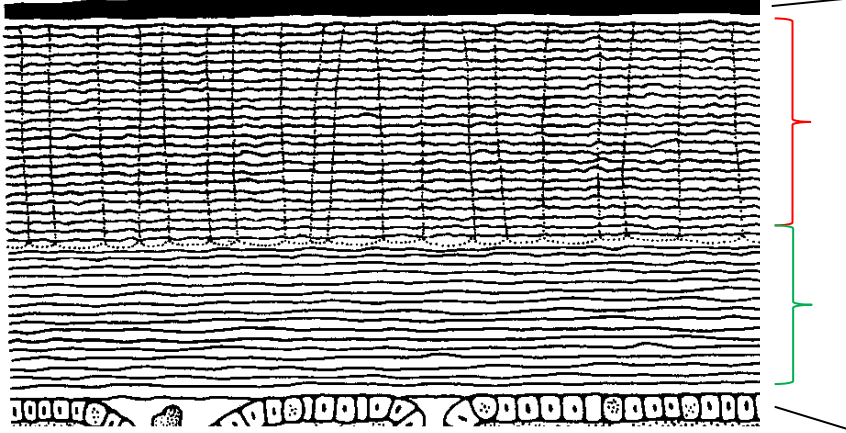
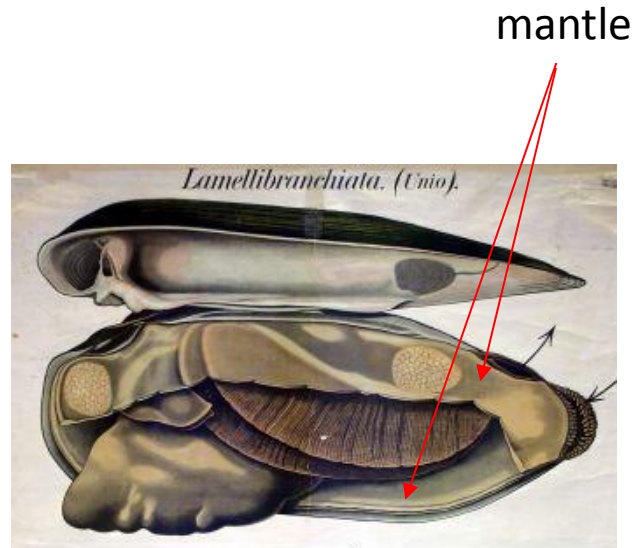
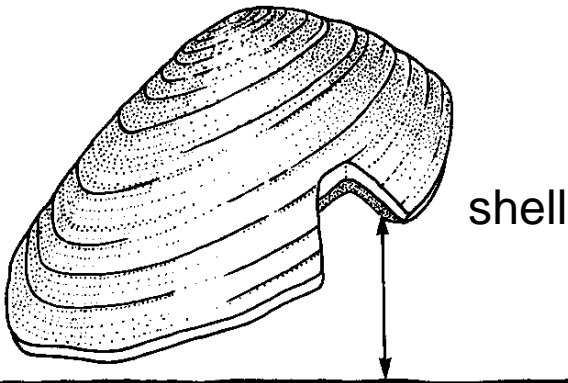
## Foraminifera

- One part or multipart shells
- Mainly  $\text{CaCO}_3$
- In plankton or on the benthos



# MOLLUSCS

- Mantle produces shells



**periostracum** (outside, protein + pigment)

**oostracum** (middle,  $\text{CaCO}_3$ )

**hypostracum** (inside,  $\text{CaCO}_3$ )

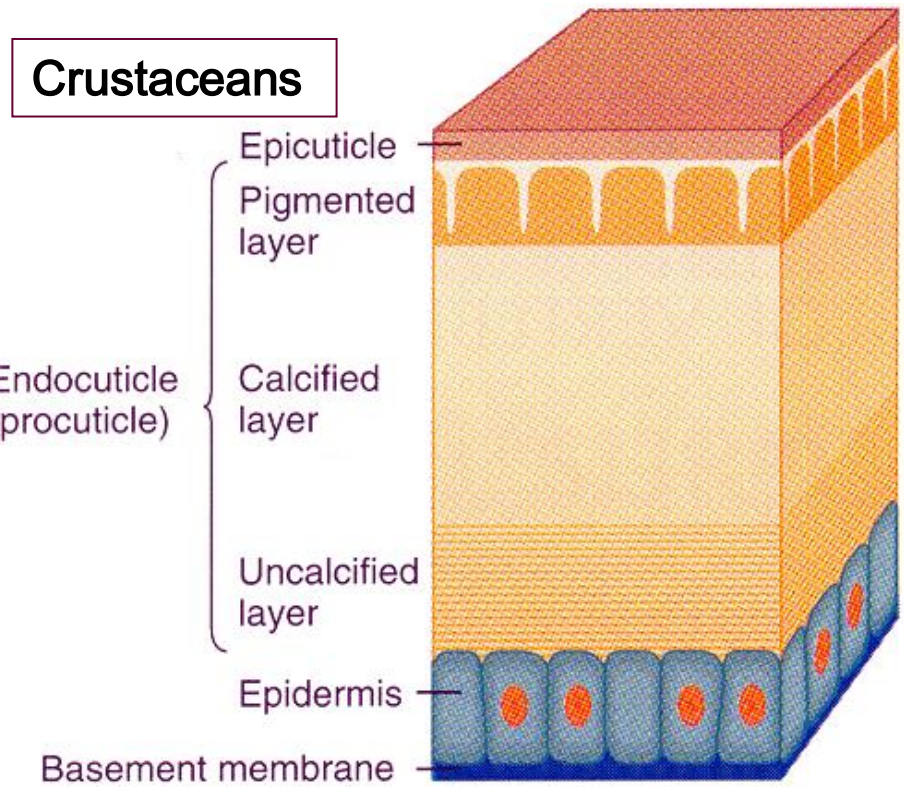
mantle

# Arthropods

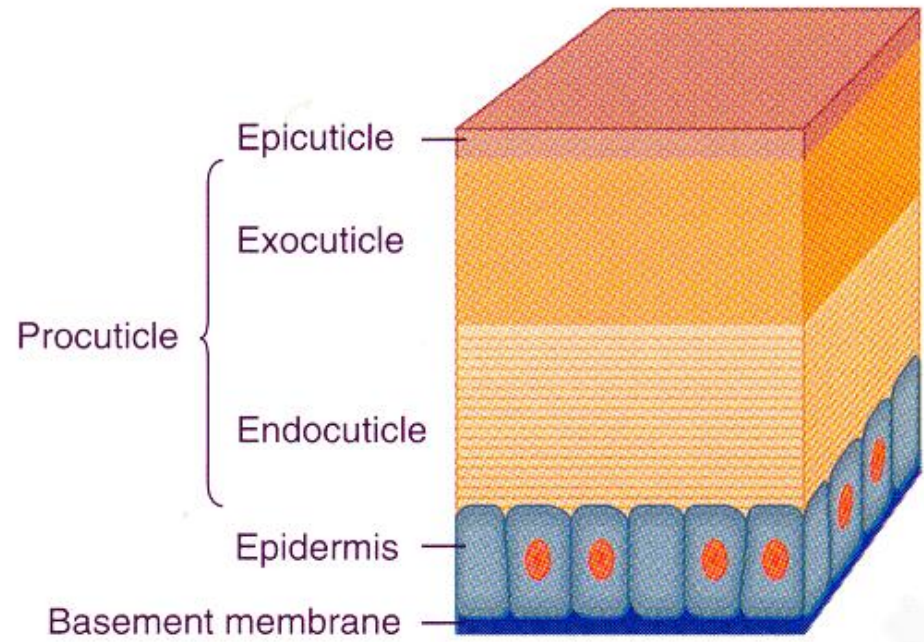
- Above epidermis is cuticle - exoskeleton
- on the surface chitin cuticle (in crustaceans with  $\text{CaCO}_3$ )



## Crustaceans



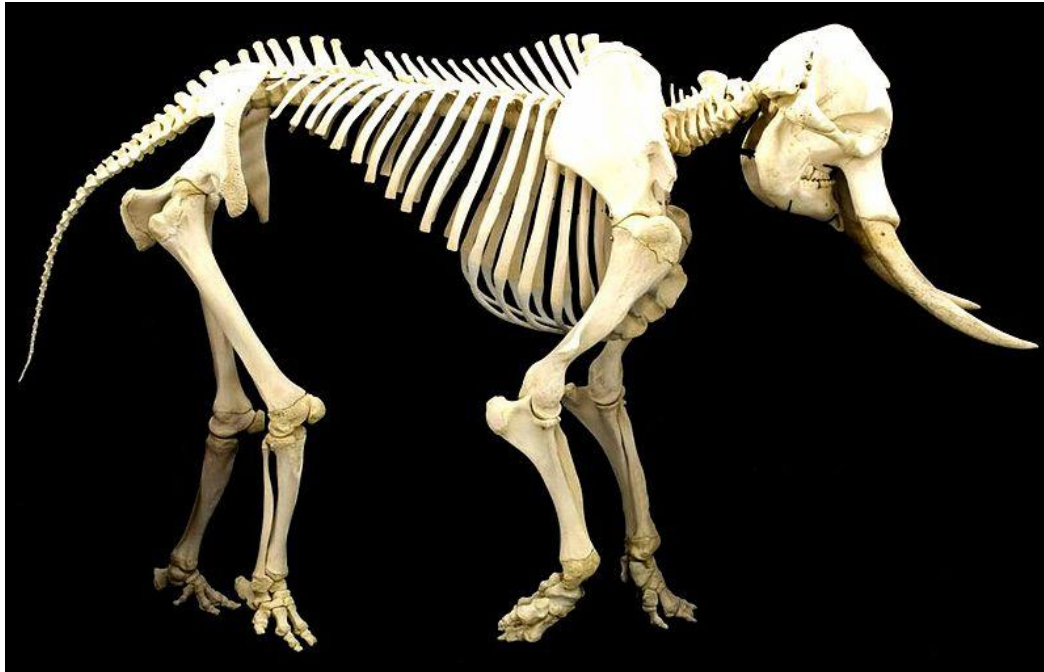
## Insects



# ENDOSKELETON (mesodermal origin)

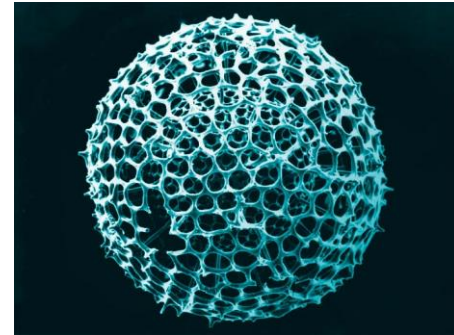
Organisms with an endoskeleton are supported by a hard, mineralized skeletal system that resides inside the body.

In vertebrates, the endoskeleton system is further divided into the axial skeleton and appendicular skeleton.



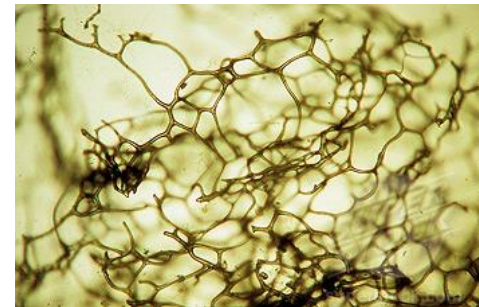
## PROTISTS

- Radiolaria –  $\text{SiO}_2$  (or  $\text{CaCO}_3$ )

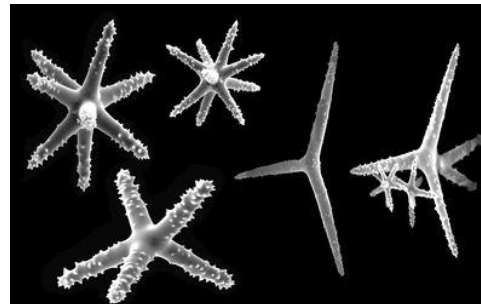


## SPONGES - PORIFERA

- soft fiberlike skeleton from protein spongin  
(*Euspongia officinalis*)

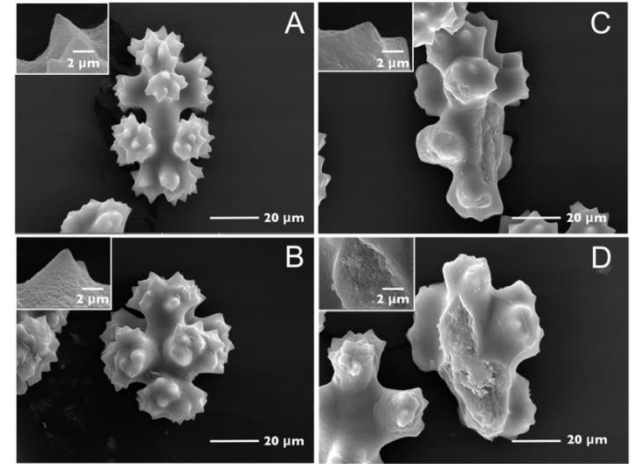


- $\text{SiO}_2$  (*Geodia cydonium*): geodes, spicule, asters



# CNIDARIANS

- Octocorallia (corals) possess  $\text{CaCO}_3$  **sclerites** in skin
- if joined together – strong – coral atolls



sclerites

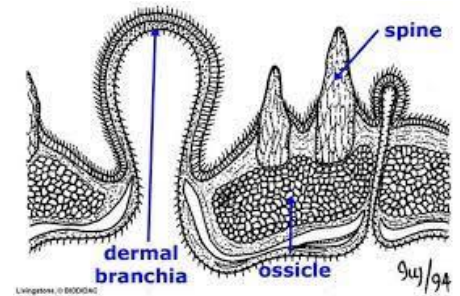
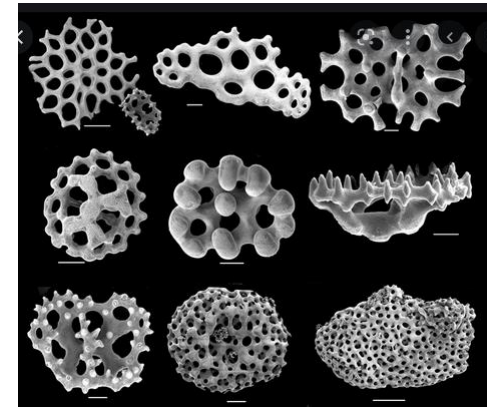


*Alcyonium palmatum*

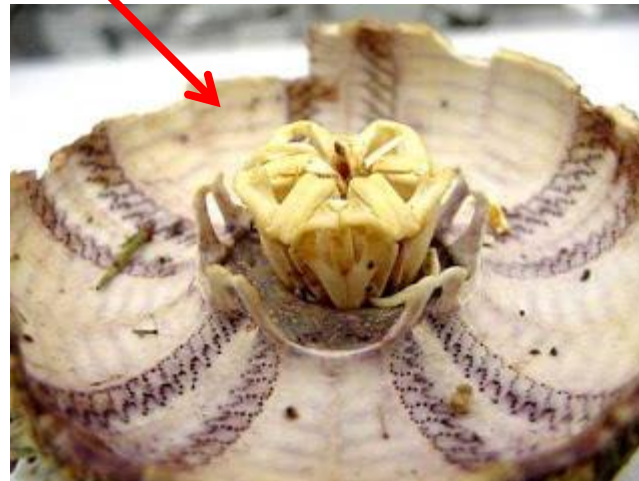
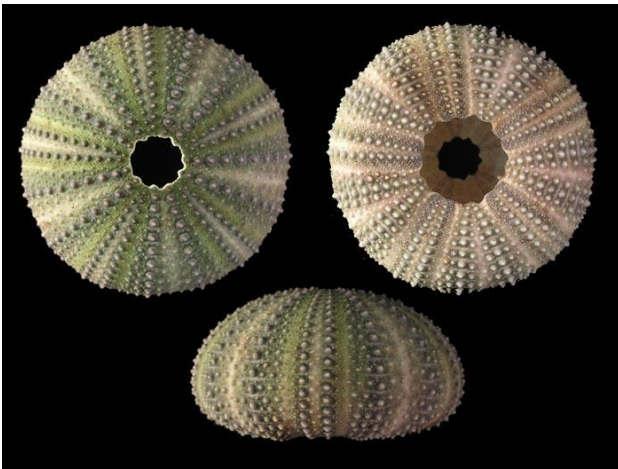


# ECHINODERMATA

- **Ossicles** are small calcareous elements embedded in the dermis of the body wall of echinoderms.
- provide rigidity and protection
- different forms and arrangements in sea urchins, starfish, brittle stars, sea cucumbers, and crinoids.

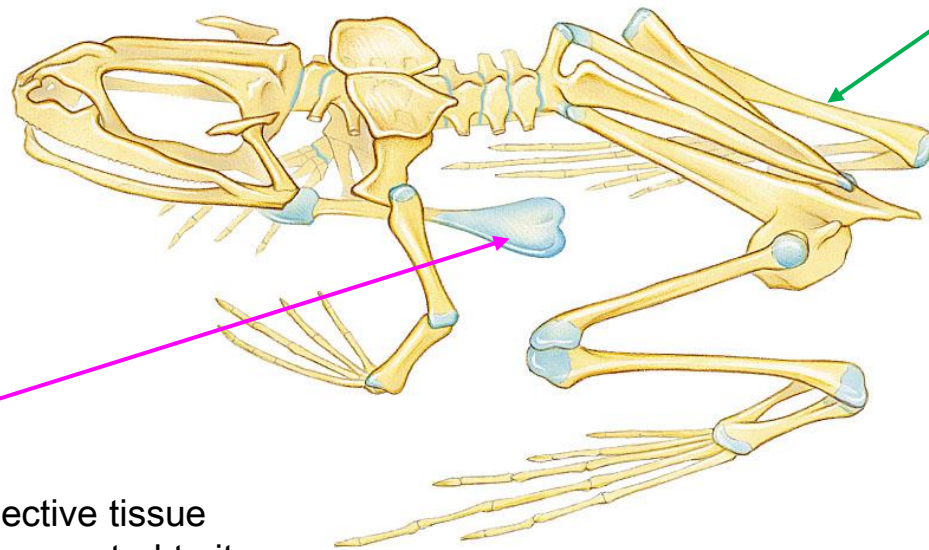


- sea urchins: Aristotle's lantern – 35 ossicles shaping „teeth”



# VERTEBRATES

- Skeleton consists of many movable (and less movable) parts that are interconnected (joints)



## Bone

Specialised connective tissue

- Support muscles
- Transfer movement
- Support inner organs

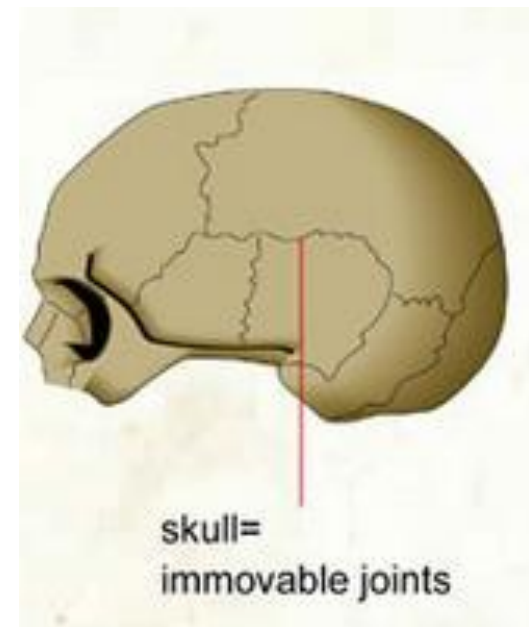
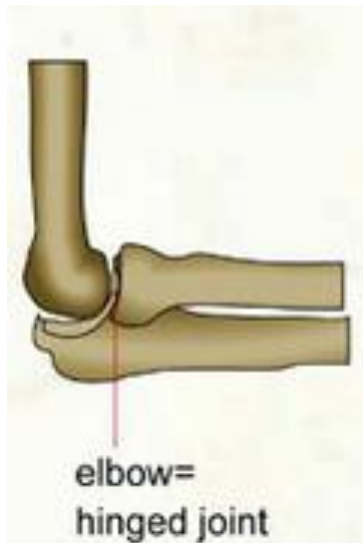
## Cartilage

Specialised connective tissue

- Muscles are connected to it
- Help joints movement

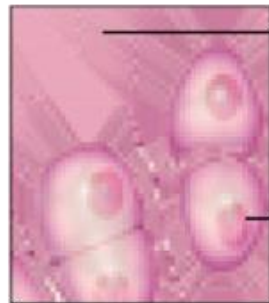
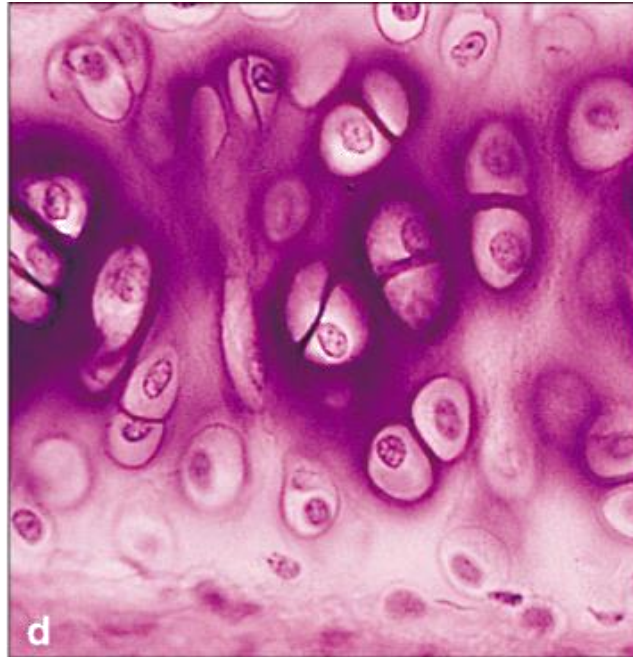
# joint

- connection of two (or more) bones
  - Some joints, such as the knee, elbow, and shoulder, are self-lubricating, almost frictionless, and are able to withstand compression and maintain heavy loads while still executing smooth and precise movements.
  - Other joints such as sutures between the bones of the skull permit very little movement (only during birth) in order to protect the brain and the sense organs.



# Cartilage

➤ **cartilage cells** (5 %) + **intercellular matter** (95 %, ground substance with collagen)

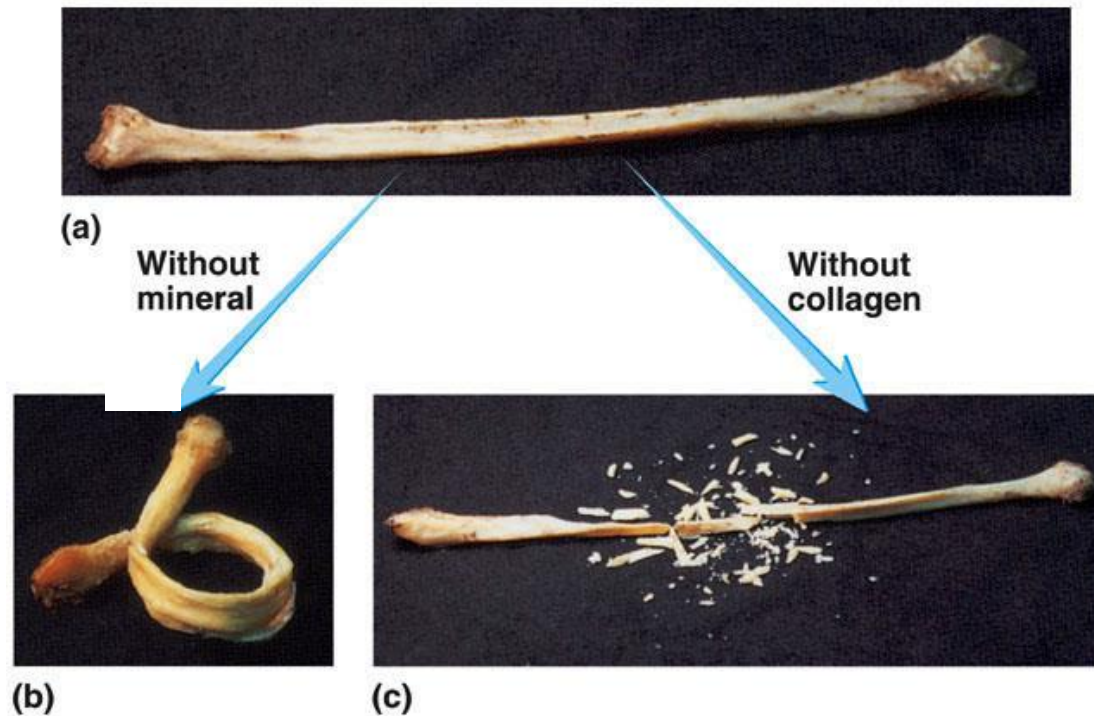


ground substance  
with very fine  
collagen fibers

cartilage cell  
(chondrocyte)

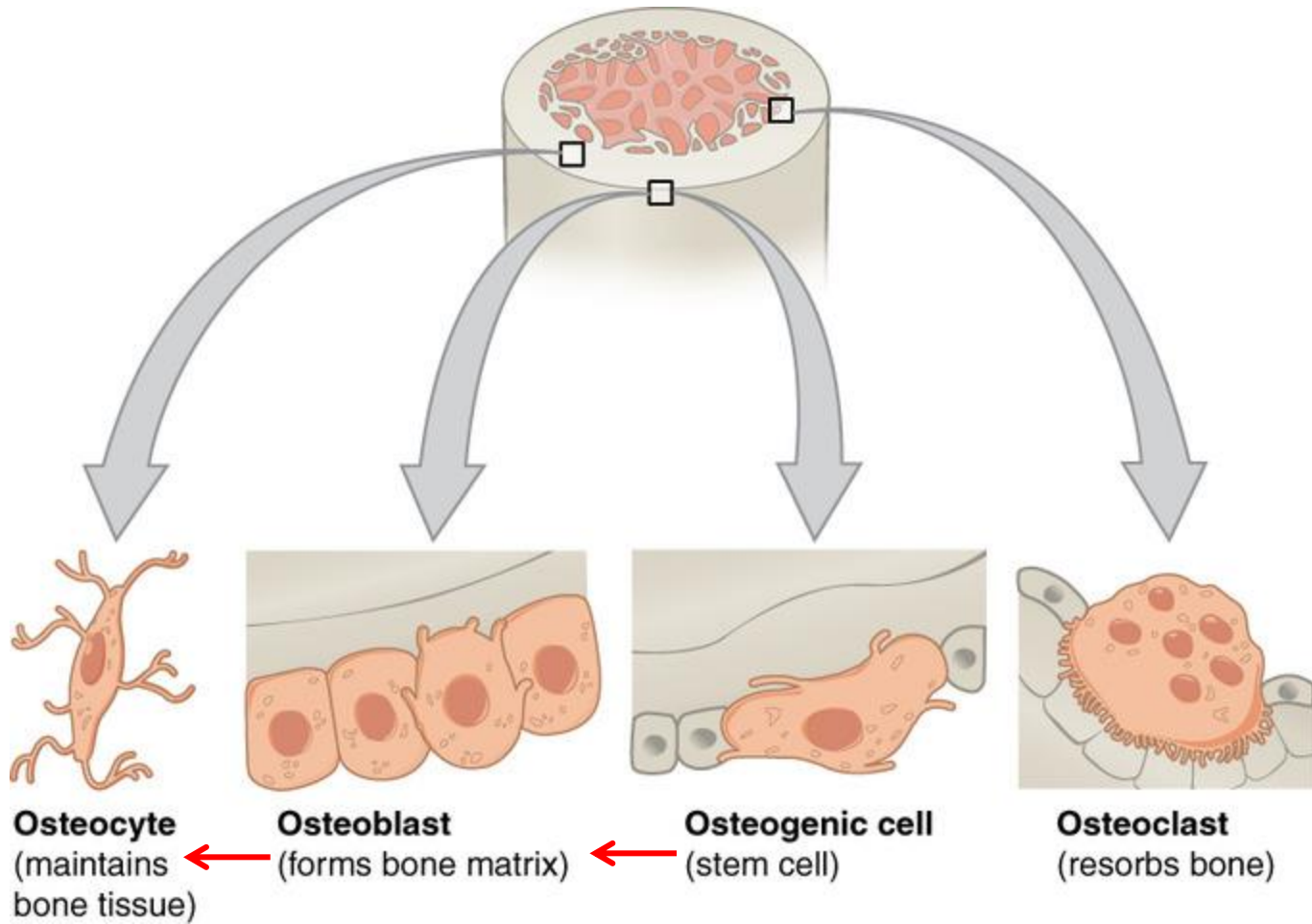
# Bones

➤ comprised of calcified (mineralised) connective tissue. Ground substance and collagen fibers create a matrix that contains osteocytes.

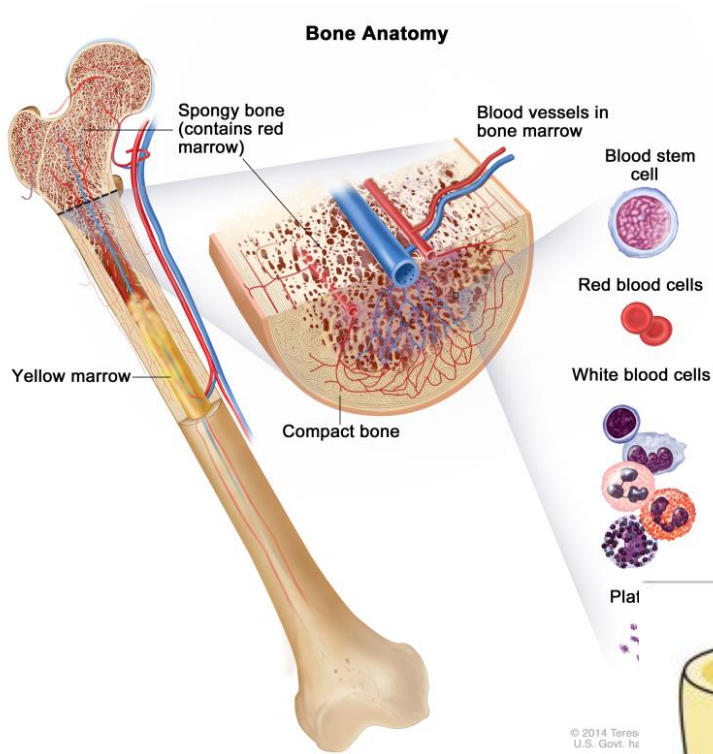


Mineralized tissue gives it rigidity and a honeycomb-like three-dimensional internal structure

Collagen gives it flexibility



- variety of shapes with a complex internal and external structure
- lightweight, yet strong and hard.
- mineralized tissue gives it rigidity and a honeycomb-like three-dimensional internal structure.
- Other types of tissue found in bones include marrow, nerves and blood vessels.



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