HISTOLOGY DRAWINGS

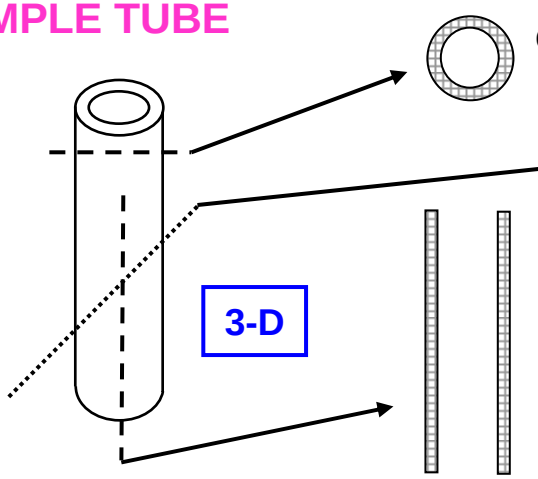
created by Dr Carol Lazer
during the period 2000-2005

INTRODUCTION

- The first pages illustrate introductory concepts for those new to microscopy as well as definitions of commonly used histology terms.
- The drawings of histology images were originally designed to complement the histology component of the first year Medical course run prior to 2004.
- They are sketches from selected slides used in class from the teaching slide set.
- These labelled diagrams should closely follow the current Science courses in histology, anatomy and embryology and complement the virtual microscopy used in the current Medical course.

STEREOLOGY: SLICING A 3-D OBJECT

SIMPLE TUBE



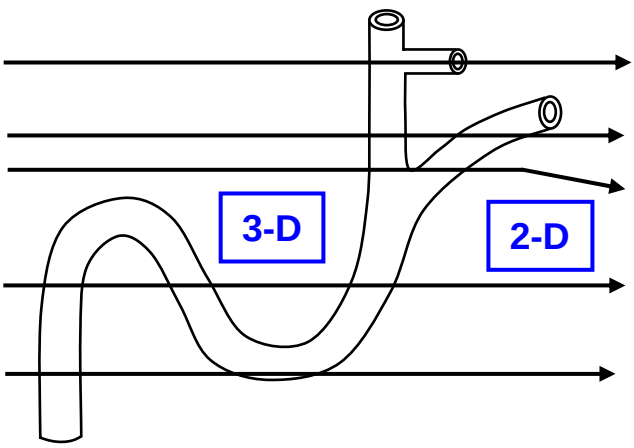
CROSS SECTION = TRANSVERSE SECTION (XS) (TS)

OBLIQUE SECTION

LONGITUDINAL SECTION (LS)

2-D

BENDING AND BRANCHING TUBE



branch off a tube

2 sections from 2 tubes cut at different angles

section at the beginning of a branch

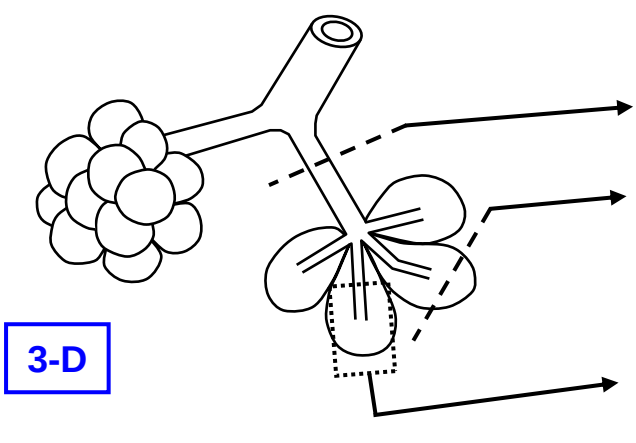
3 sections from one tube

1 section and the grazed wall of a tube

en face view = as seen from above

COMPLEX STRUCTURE (gland)

COMPOUND (= branched ducts)
ACINAR (= bunches of secretory cells)
GLAND



duct (XS =TS)

acinus (cluster of cells) (TS)

duct and acinus (LS)

2-D

Do microscope images of 2-D slices represent a single plane of section of a 3-D structure?

No, 2-D slices have a thickness which can vary from a sliver of one cell to several cells deep. With the limited depth of field of high power lenses it is possible to focus through the various levels within a slice.

Do all microscope slides show 2-D slices of 3-D structures?

No, slides can also be smears, where entire cells lie on the surface of the slide, or whole tissue mounts of very thin structures, such as mesentery.

LININGS, COVERINGS & TERMINOLOGY

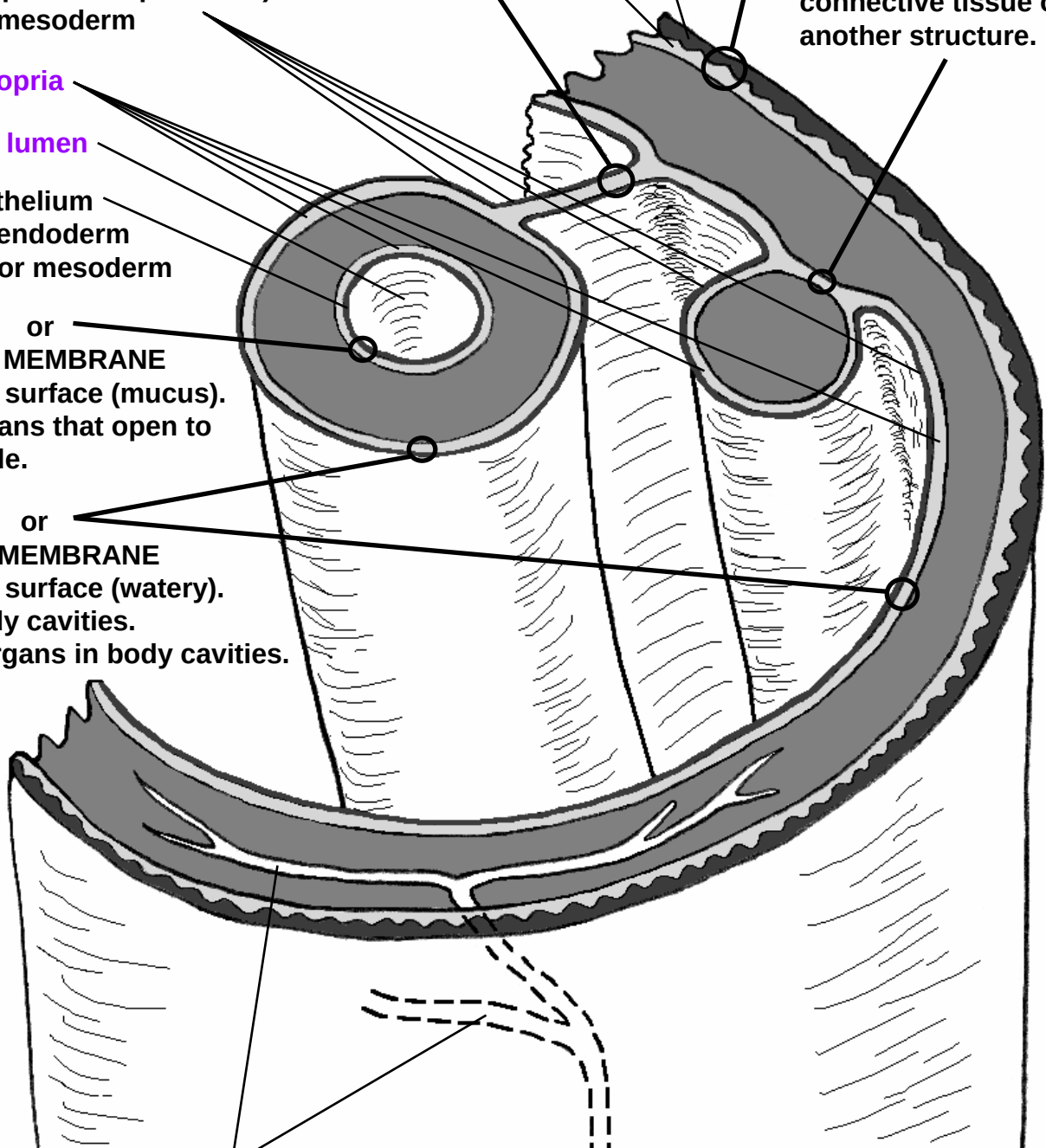
KEY

epithelium

connective tissue beneath epithelium

connective tissue, muscle, glands, etc

GENERALISED SECTION OF THE BODY



epidermis
(keratinised stratified squamous epithelium)
ORIGIN: ectoderm

SKIN
Covers the external surface.

dermis

ADVENTITIA
Connective tissue of one structure meets connective tissue of another structure.

mesothelium
(simple squamous epithelium)
ORIGIN: mesoderm

mesentery

lamina propria

lumen

lining epithelium
ORIGIN: endoderm or mesoderm

MUCOSA or
MUCOUS MEMBRANE
has a wet surface (mucus).
Lines organs that open to the outside.

SEROSA or
SEROUS MEMBRANE
has a wet surface (watery).
Lines body cavities.
Covers organs in body cavities.

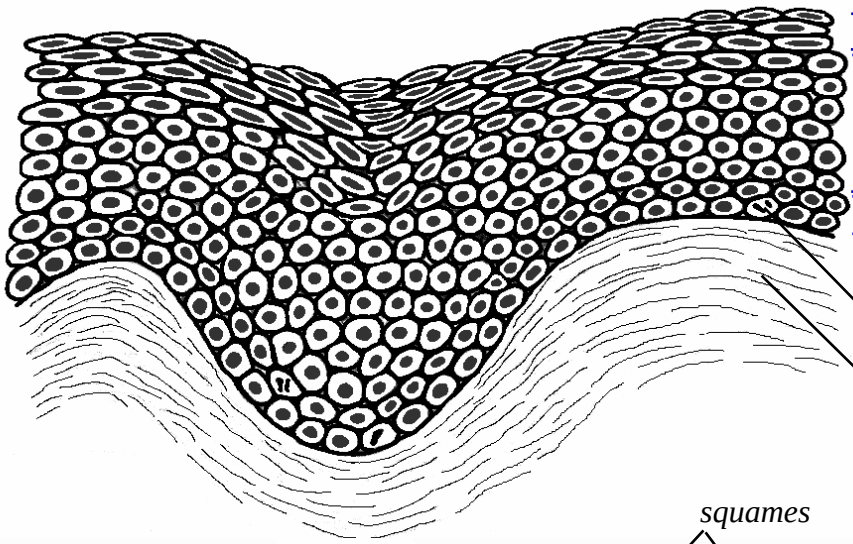
blood vessel lined by endothelium
(simple squamous epithelium)
ORIGIN: mesoderm

COVERING AND LINING EPITHELIA

STRATIFIED EPITHELIA

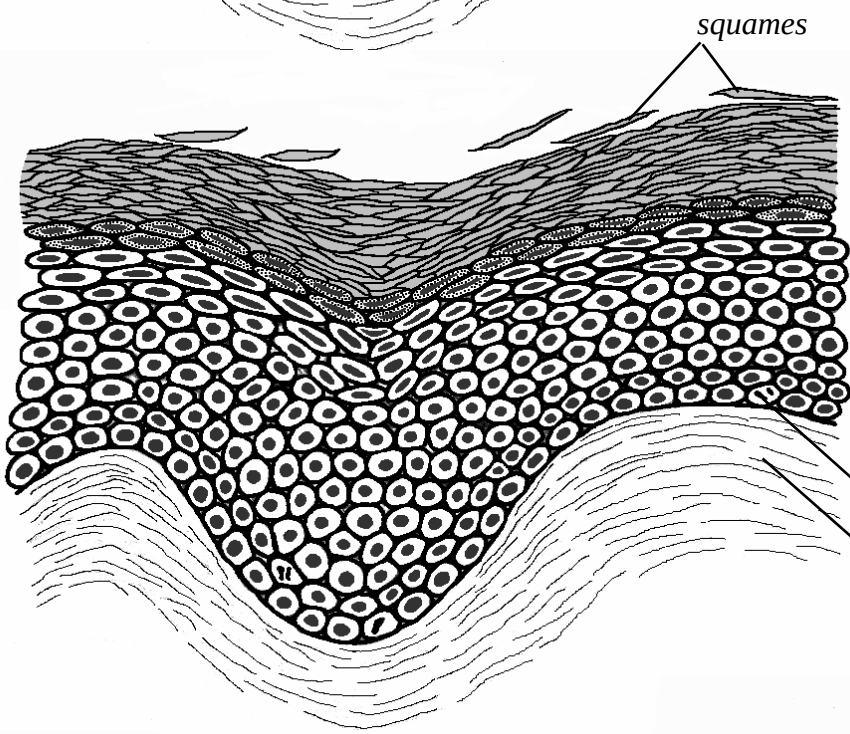
EPITHELIUM:
non-keratinised stratified squamous

TISSUE / ORGAN:
oesophagus

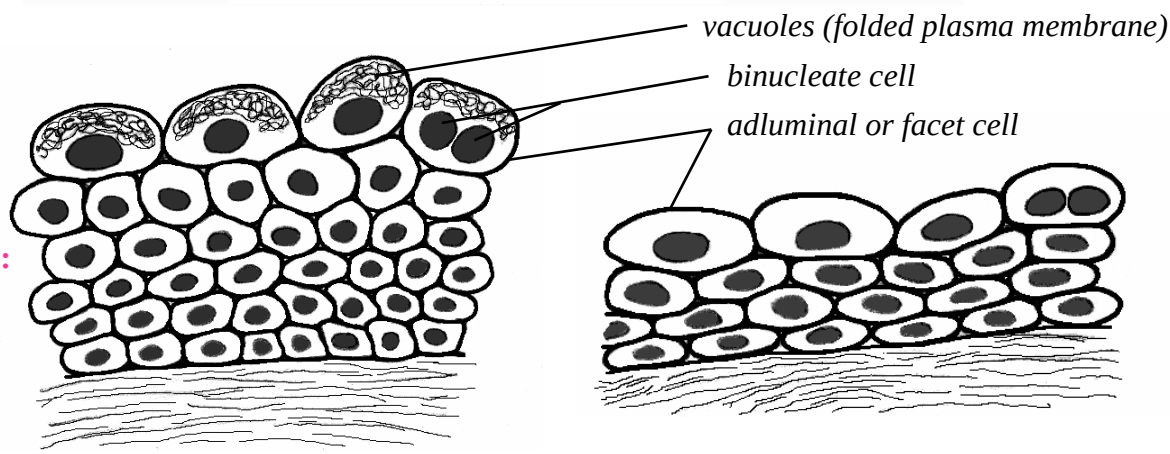


EPITHELIUM:
keratinised stratified squamous

TISSUE / ORGAN:
skin (epidermis)



EPITHELIUM:
transitional



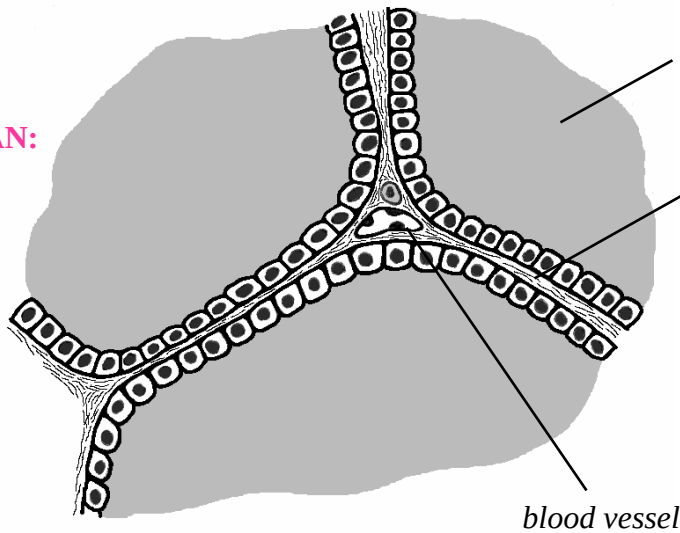
TISSUE / ORGAN:
bladder (relaxed)

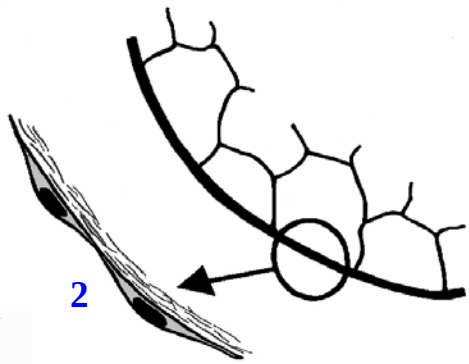
TISSUE / ORGAN:
bladder (stretched)

SIMPLE EPITHELIA

EPITHELIUM:
simple cuboidal

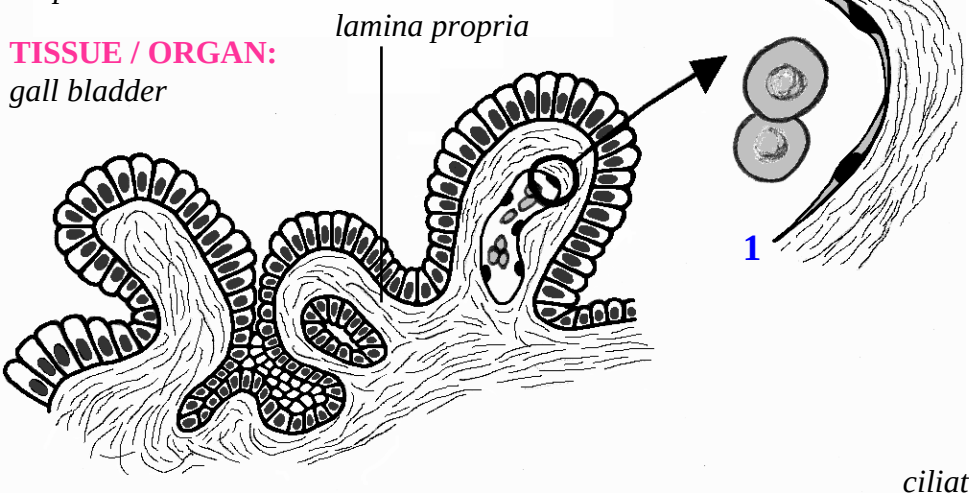
TISSUE / ORGAN:
thyroid





EPITHELIUM:
simple columnar

TISSUE / ORGAN:
gall bladder

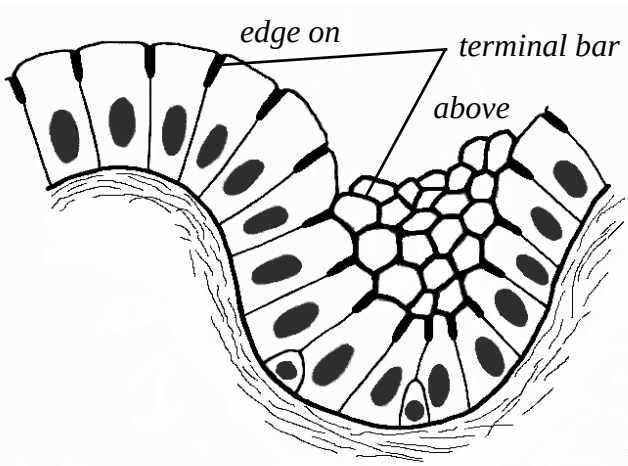


EPITHELIUM:
simple squamous

TISSUES / ORGANS:

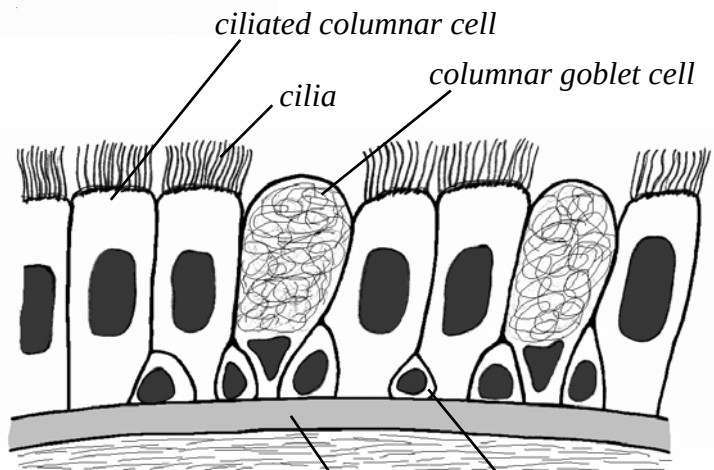
1 *endothelium lining blood vessel*

2 *mesothelium of serosa covering lung*



EPITHELIUM:
simple columnar or pseudostratified columnar

TISSUE / ORGAN:
seminal vesicle (ox)

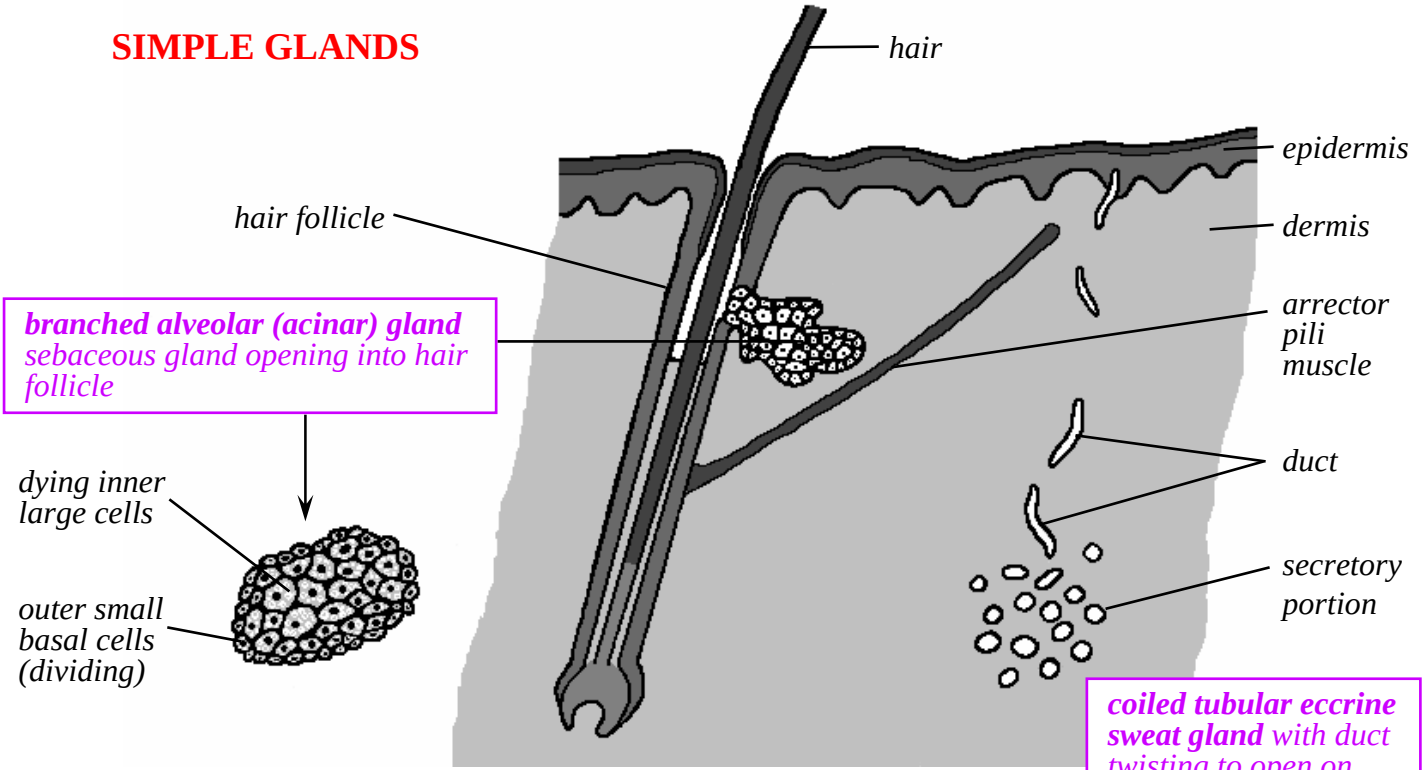


EPITHELIUM:
pseudostratified columnar (respiratory epithelium)
MORE FULLY: *pseudostratified ciliated columnar epithelium with goblet cells*

TISSUE / ORGAN: *trachea*

EXOCRINE GLANDS & DUCTS

SIMPLE GLANDS



branched alveolar (acinar) gland *sebaceous gland opening into hair follicle*

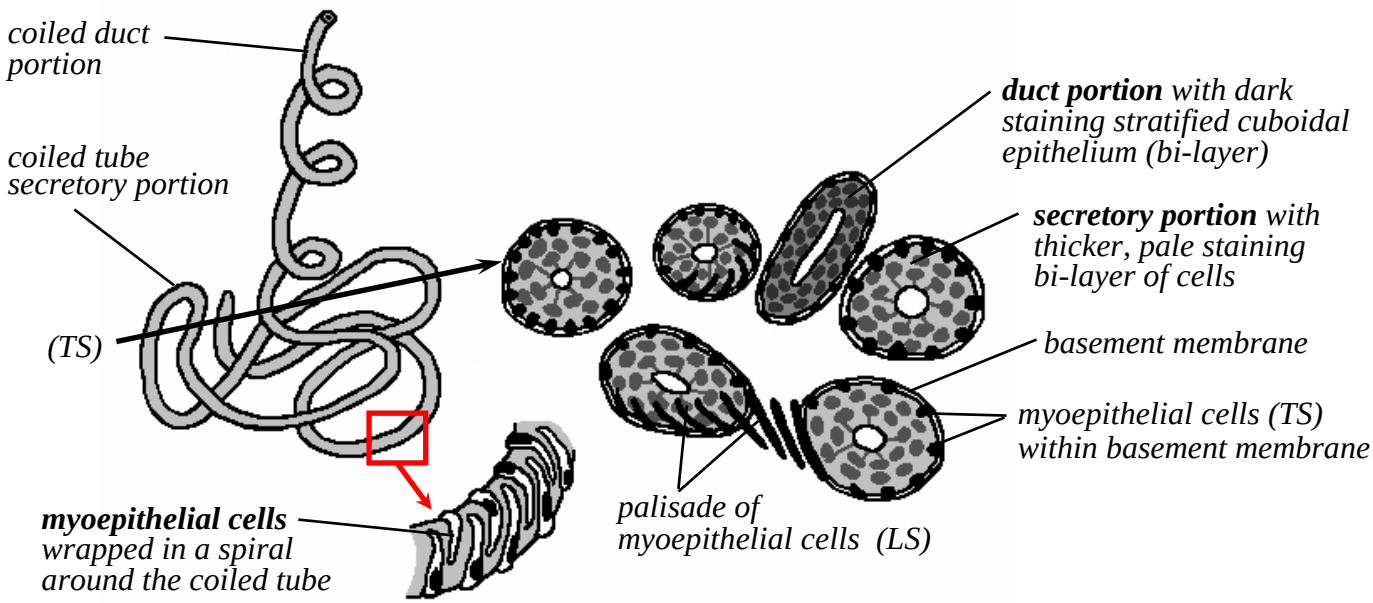
dying inner large cells

outer small basal cells (dividing)

coiled tubular eccrine sweat gland *with duct twisting to open on the skin surface*

FEATURE: *sebaceous gland*
TISSUE / ORGAN: *around hair follicle in dermis of skin*

FEATURE: *eccrine sweat gland*
TISSUE / ORGAN: *dermis of skin (also in hypodermis)*



FEATURE: *duct and secretory portions, myoepithelial cells*
TISSUE / ORGAN: *eccrine sweat gland*

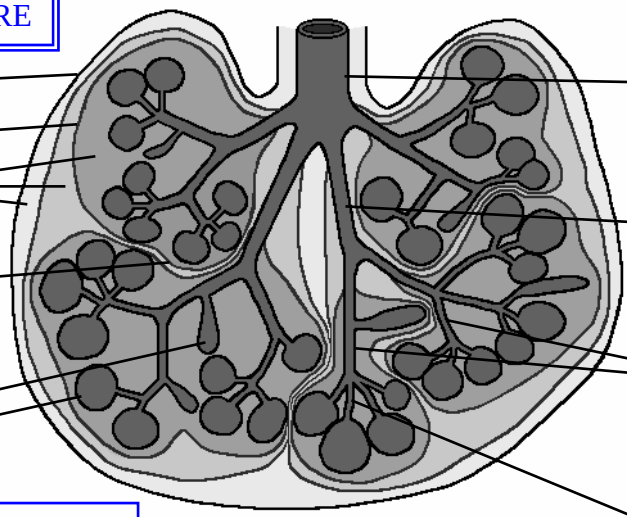
Are myoepithelial cells only present around sweat glands and what is their function?

They are found around the secretory acini and some ducts of many glands. They contract under autonomic nervous control to expel the glandular secretions.

COMPOUND GLAND

GLAND STRUCTURE

DUCT ORGANISATION



lobe

lobule

layers of connective tissue

connective tissue septum (between lobules)

secretory tube and acinus

interlobar duct = excretory duct [drains the lobes of a gland]

interlobular duct = intralobar duct [drains many lobules in a lobe]

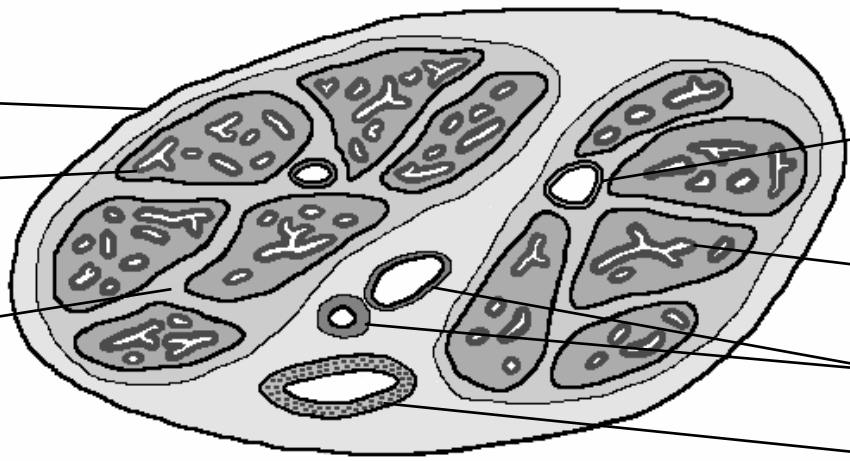
intralobular duct (e.g. striated duct) [drains many acini in a lobule]

intercalated duct [drains each acinus]

acinus = alveolus = adenomere

FEATURE: *lobe, lobules and ducts*

TISSUE / ORGAN: *compound tubulo-alveolar (tubulo-acinar) gland*



part of lobe

lobule

connective tissue septum

interlobular duct = intralobar duct

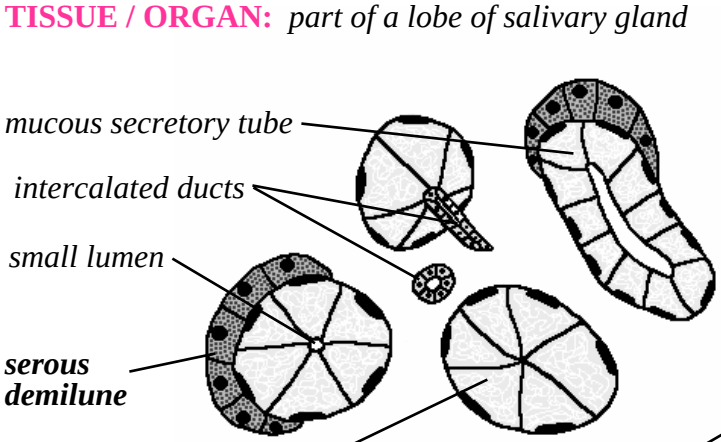
intralobular duct (striated duct in salivary gland)

blood vessels artery & vein

interlobar duct

FEATURE: *lobe, lobules and ducts (TS)*

TISSUE / ORGAN: *part of a lobe of salivary gland*



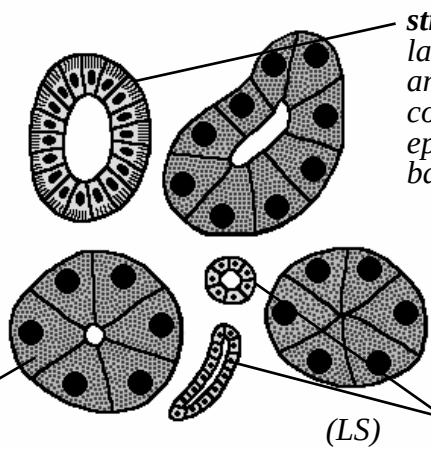
mucous secretory tube

intercalated ducts

small lumen

serous demilune

mucous acinus *wedge-shaped cells filled with pale staining remnant of mucous secretion and flattened basal nuclei*



striated duct *large lumen and simple columnar epithelium with basal striations*

(TS)

(LS)

intercalated ducts

serous acinus *wedge-shaped cells packed with zymogen granules and round nucleus*

FEATURE: *serous and mucous acini and ducts*

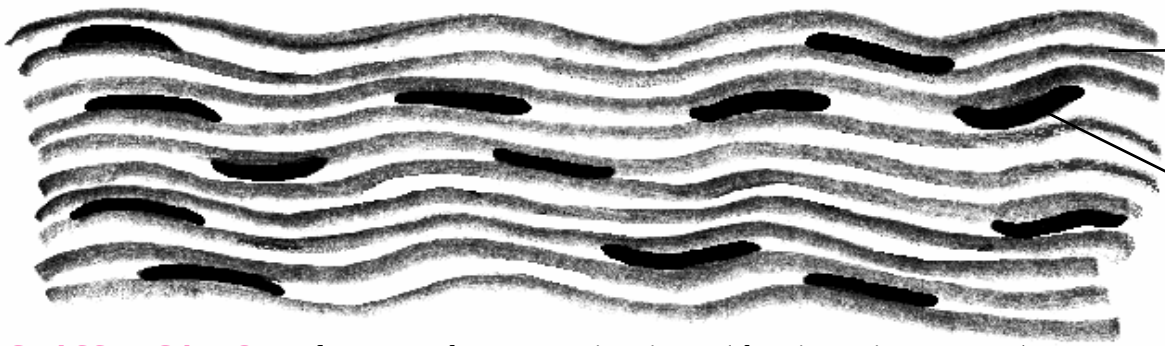
TISSUE / ORGAN: *submandibular salivary gland*

Do all compound glands have striated ducts?

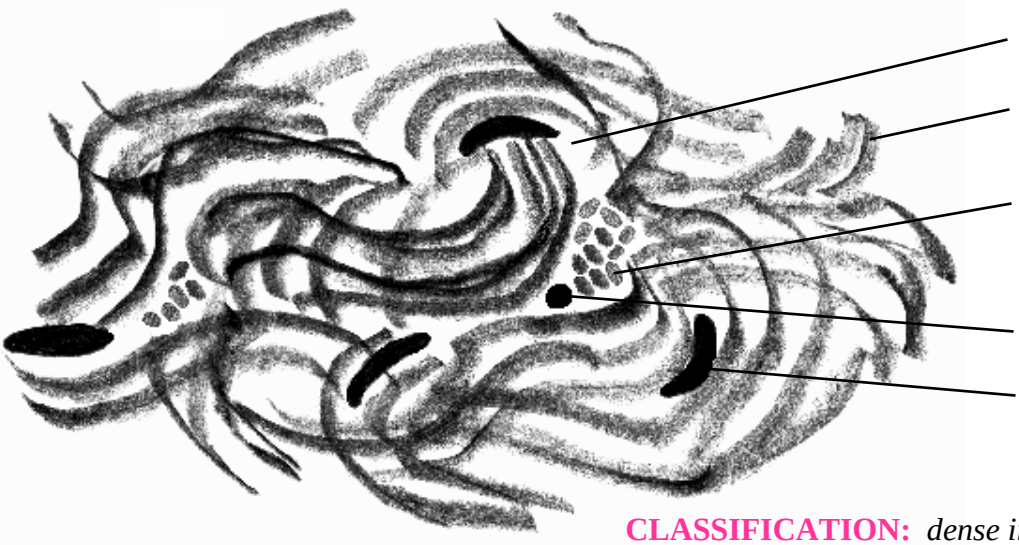
No, they all have intralobular ducts but these have a characteristic appearance in the salivary gland and so have a different name.

CONNECTIVE TISSUE

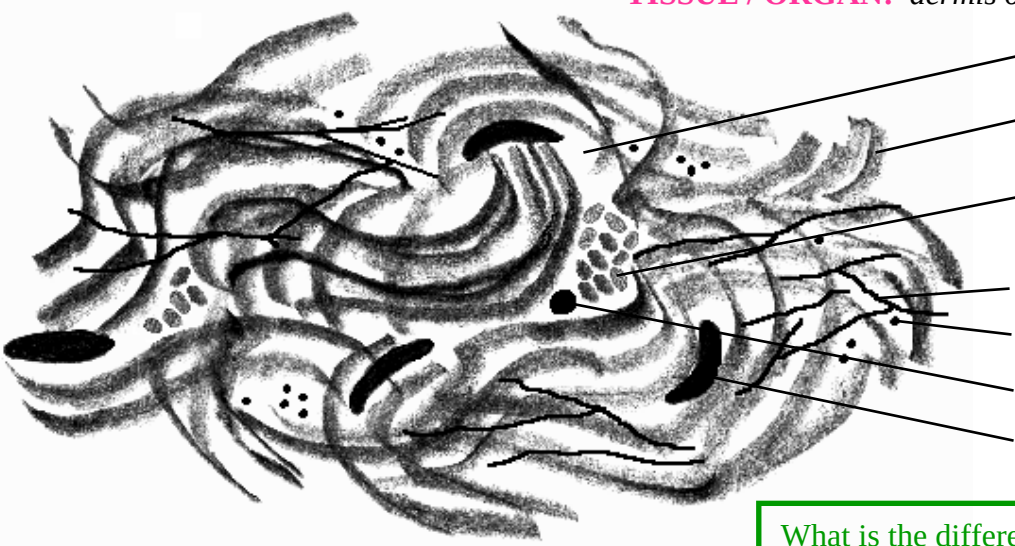
DENSE CONNECTIVE TISSUE



CLASSIFICATION: *dense regular connective tissue (showing crimp pattern)*
TISSUE / ORGAN: *tendon or ligament fascicle*



CLASSIFICATION: *dense irregular connective tissue*
TISSUE / ORGAN: *dermis of skin*

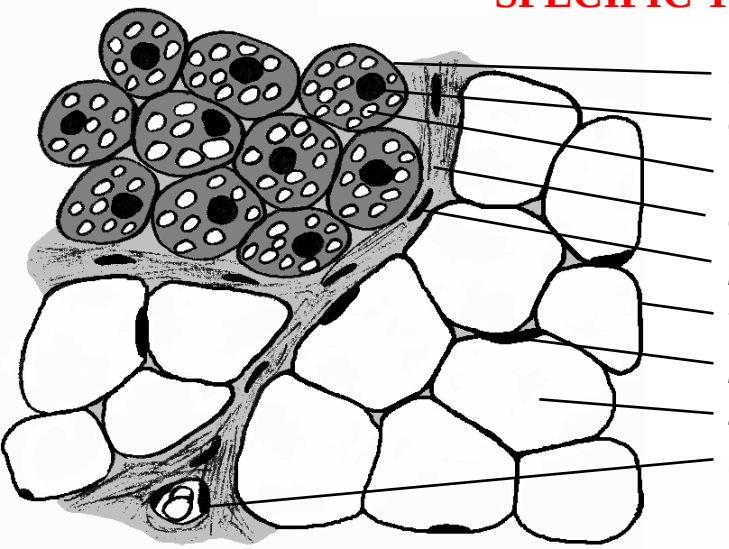


CLASSIFICATION: *dense irregular connective tissue*
TISSUE / ORGAN: *dermis of skin*

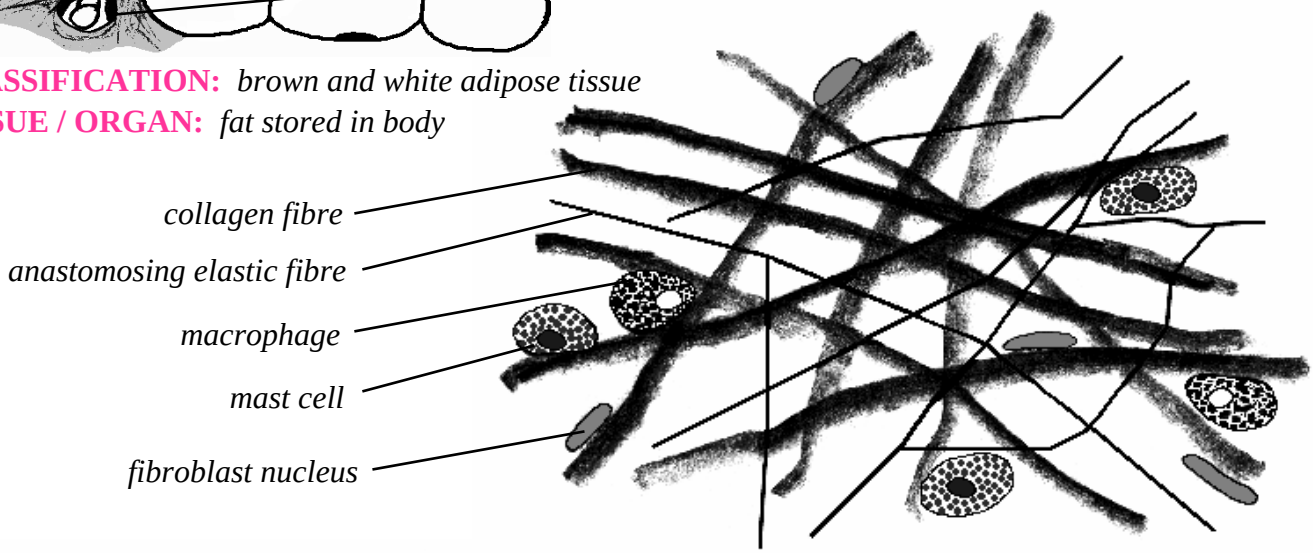
What is the difference between this specimen and the one before?

It is stained to show elastic fibres. These were always present but not seen without the special stain.

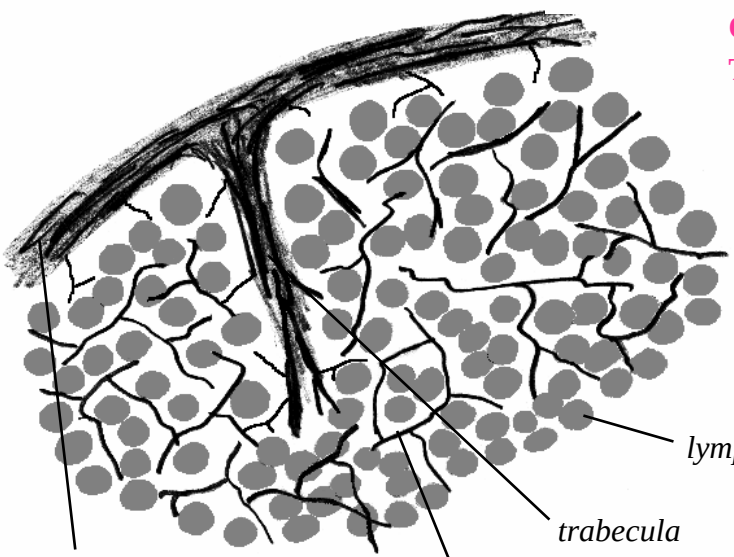
SPECIFIC TISSUES & FIBRES



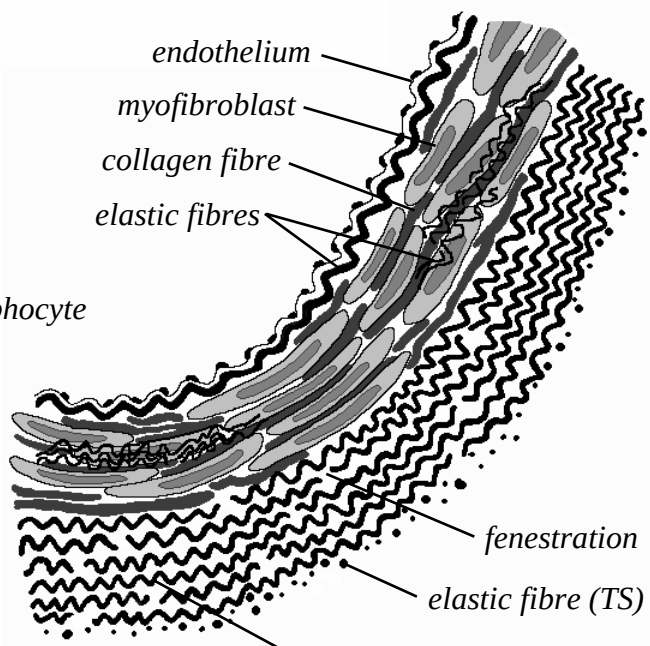
CLASSIFICATION: *brown and white adipose tissue*
TISSUE / ORGAN: *fat stored in body*



CLASSIFICATION: *loose connective tissue*
TISSUE / ORGAN: *mesentery*



CLASSIFICATION: *reticular fibres*
TISSUE / ORGAN: *lymph node*



CLASSIFICATION: *elastic fibres*
TISSUE / ORGAN: *elastic artery (brachial artery)*

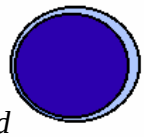
BLOOD CELLS (SMEAR)

FEATURE: *blood cell types*
TISSUE / ORGAN: *peripheral blood*

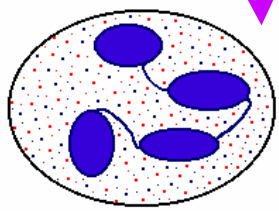
MONONUCLEAR LEUKOCYTES or AGRANULOCYTES

POLYMORPHONUCLEAR LEUKOCYTES or GRANULOCYTES

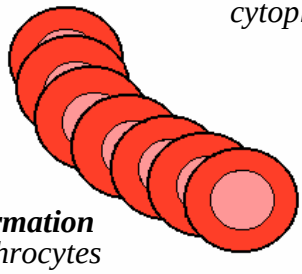
erythrocyte
biconcave disc with pale centre



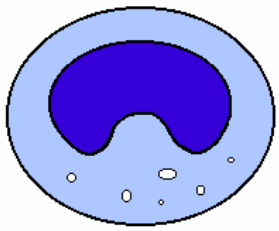
small lymphocyte
with a large, round nucleus and blue cytoplasmic rim

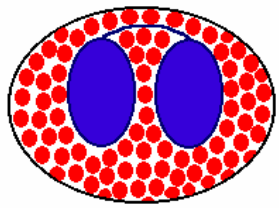


neutrophil
with multi-lobed nucleus and many small granules



rouleaux formation
stack of erythrocytes

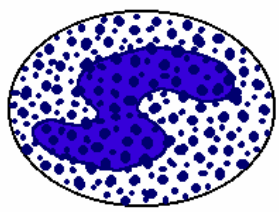




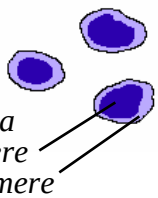
eosinophil
with bi-lobed nucleus and many large red granules of similar size

monocyte
with a single nucleus that may be irregular or bean shaped and blue cytoplasm which may have tiny granules or vacuoles

Indentation of the nucleus (monocyte or lymphocyte) is caused by proximity to the Golgi apparatus.

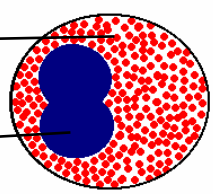


basophil
with many blue granules of different size that obscure the nucleus

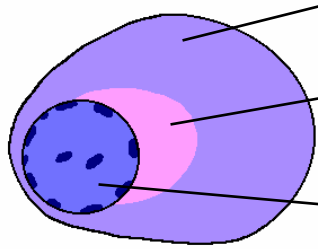


platelets
cytoplasmic fragments with a dark chromomere and pale hyalomere

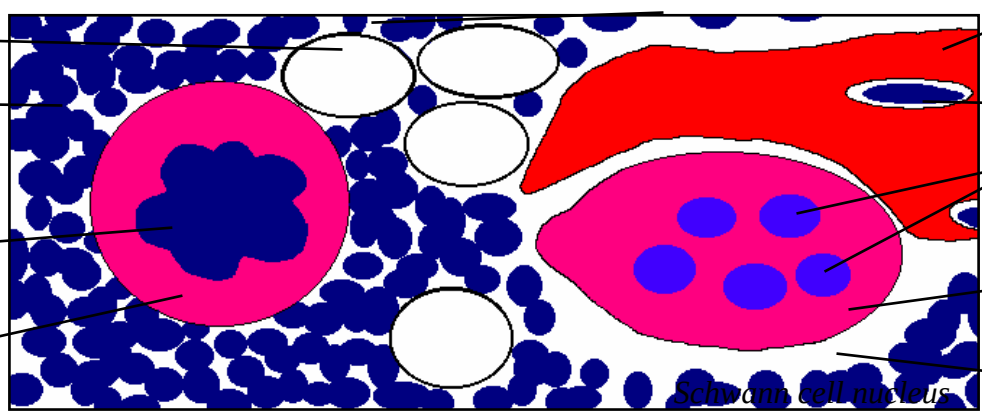
BLOOD-RELATED CELLS (SECTION)



FEATURE: *tissue eosinophil (and plasma cells)*
TISSUE / ORGAN: *lamina propria of glands of stomach mucosa*



FEATURE: *plasma cell*
TISSUE / ORGAN: *lamina propria of salivary gland secretory acini*



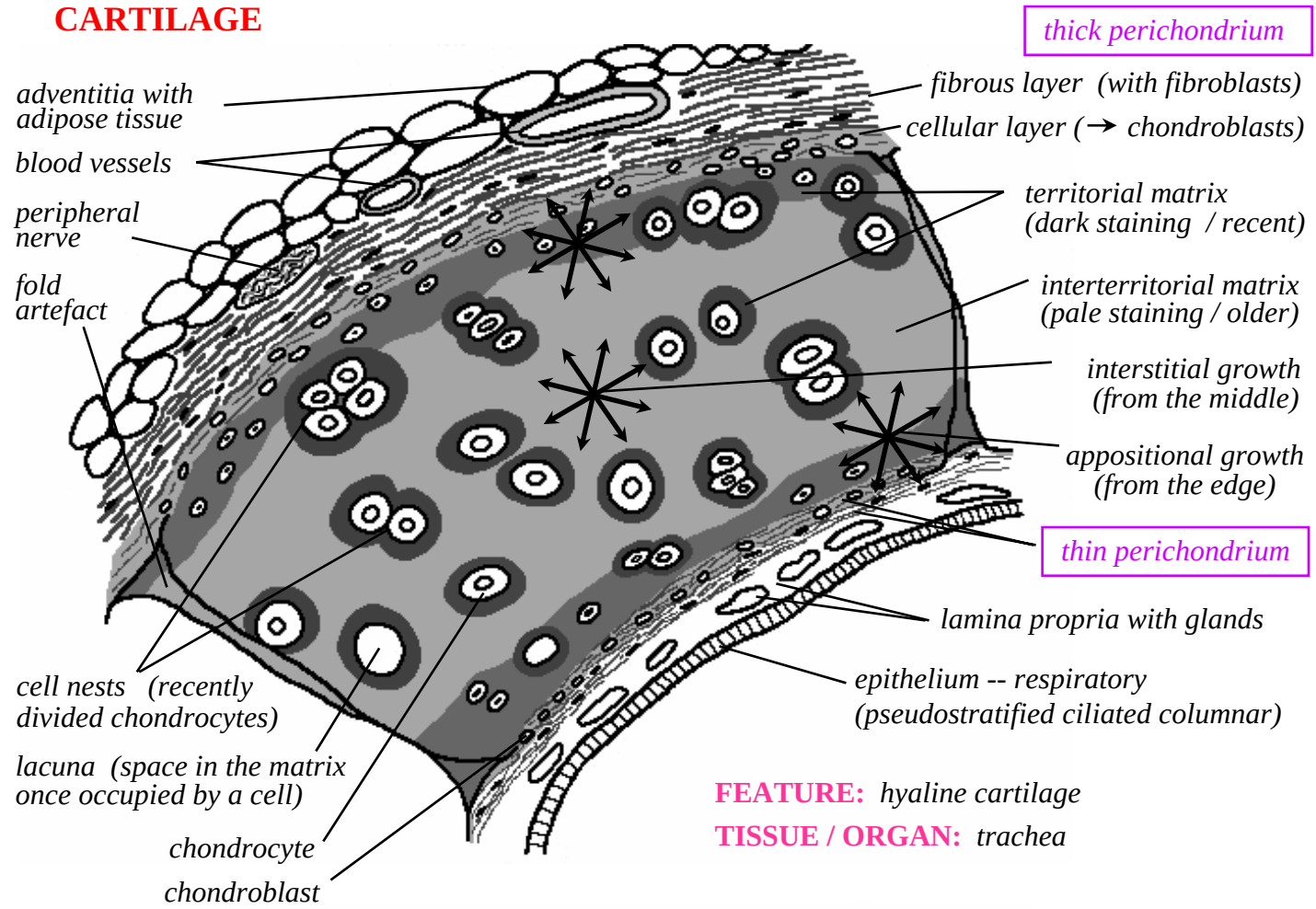
FEATURE: *megakaryocyte*
TISSUE / ORGAN: *bone marrow*

not to be confused with

FEATURE: *osteoclast*
TISSUE / ORGAN: *bone trabecula*

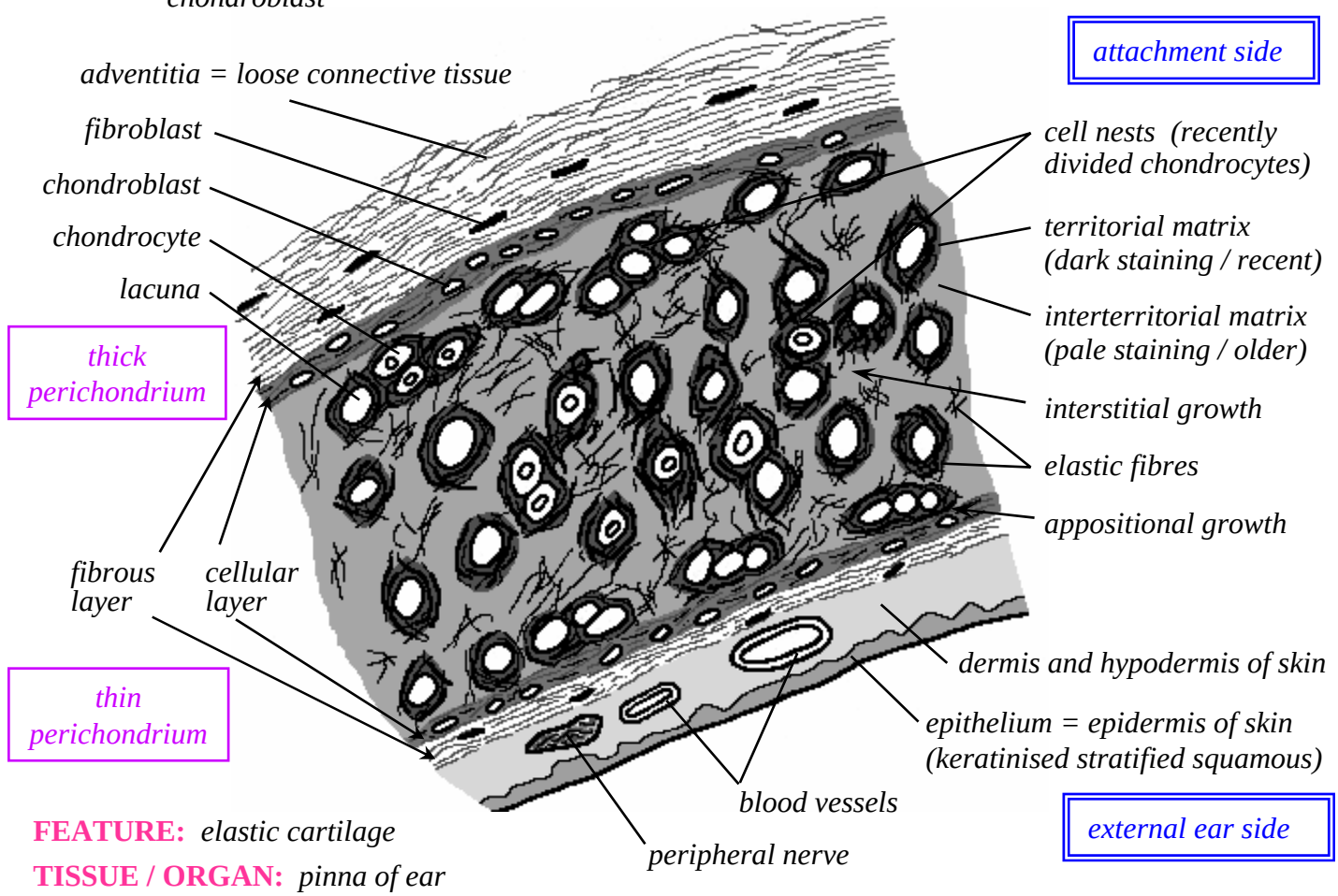
CARTILAGE AND BONE

CARTILAGE



FEATURE: *hyaline cartilage*

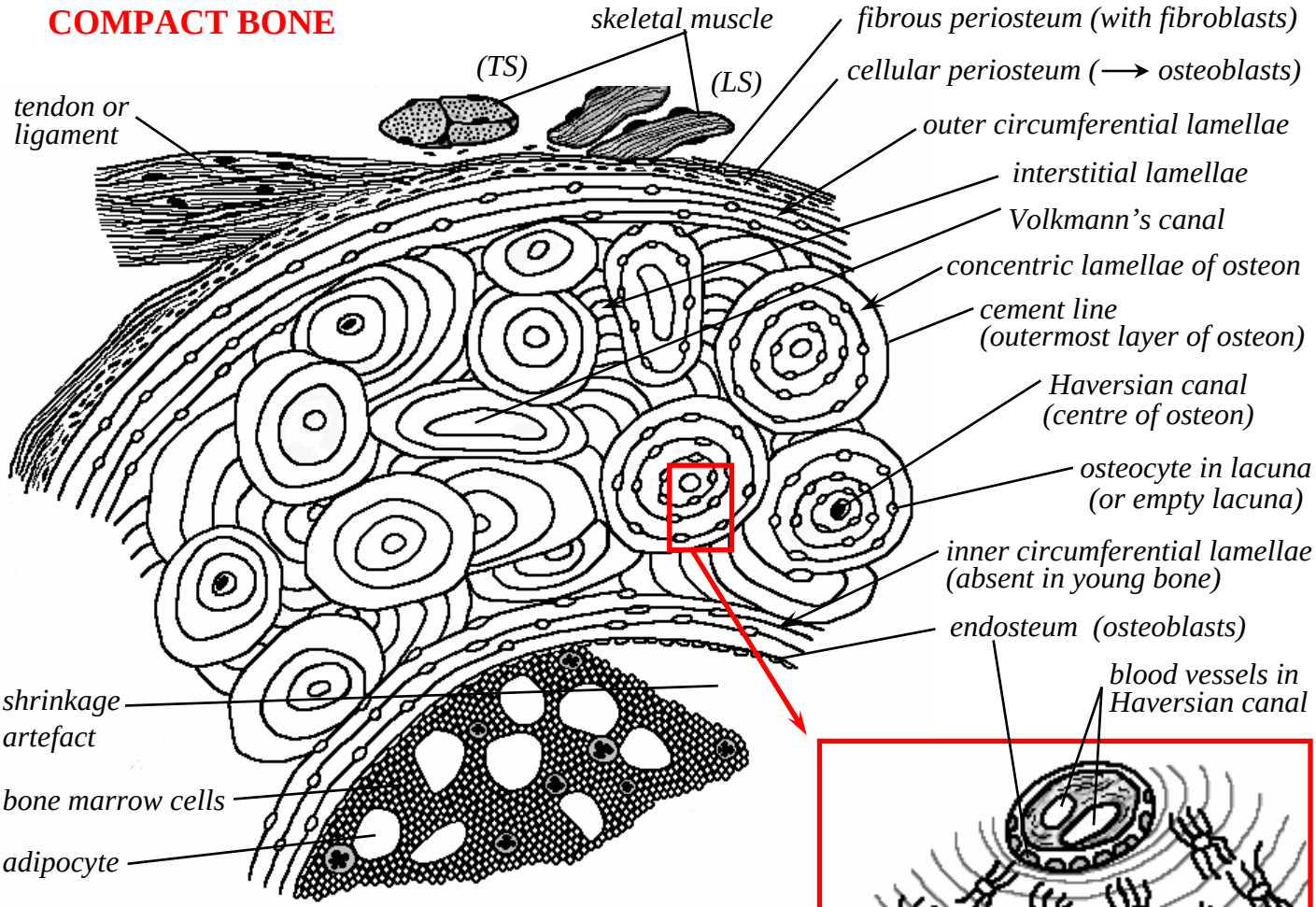
TISSUE / ORGAN: *trachea*



FEATURE: *elastic cartilage*

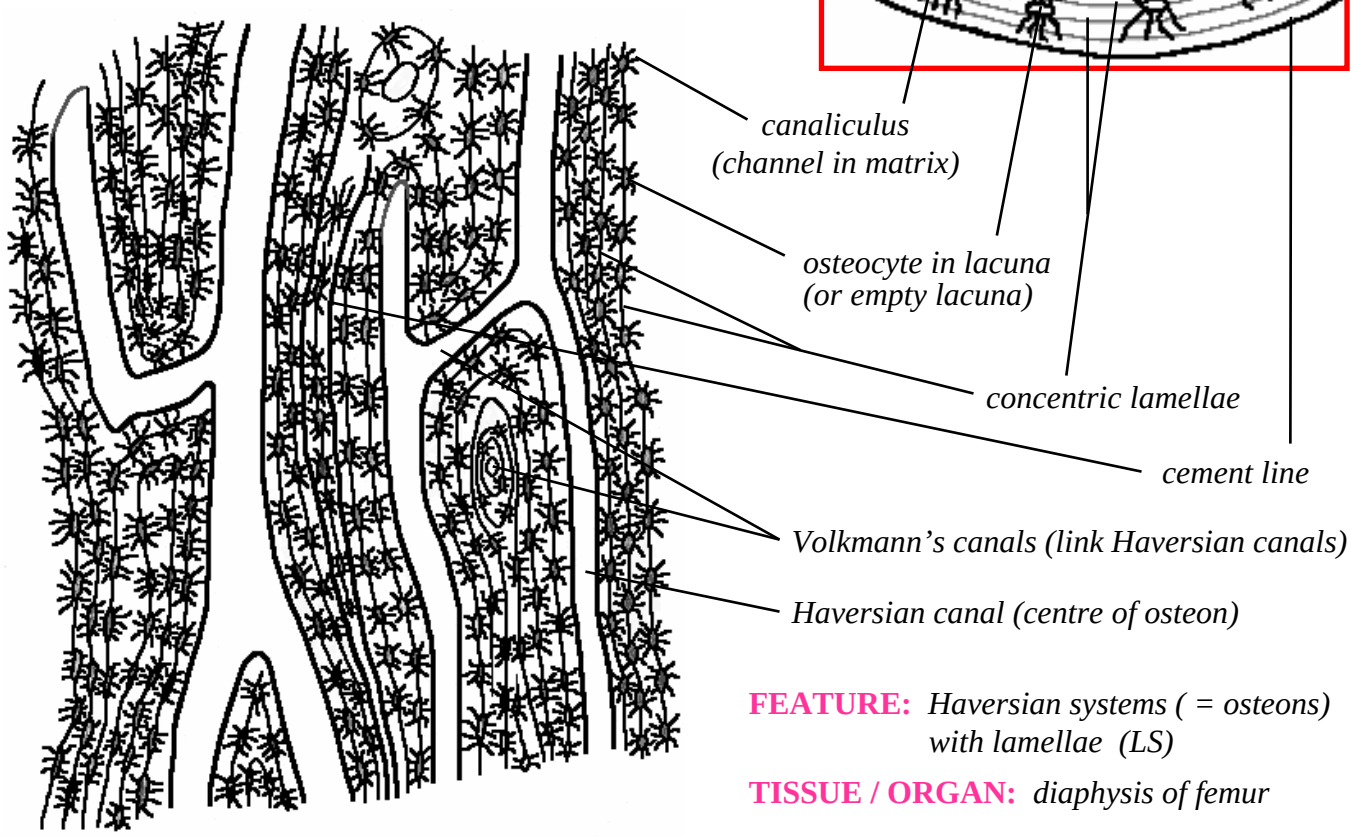
TISSUE / ORGAN: *pinna of ear*

COMPACT BONE



FEATURE: *Haversian systems (= osteons) with lamellae (TS)*

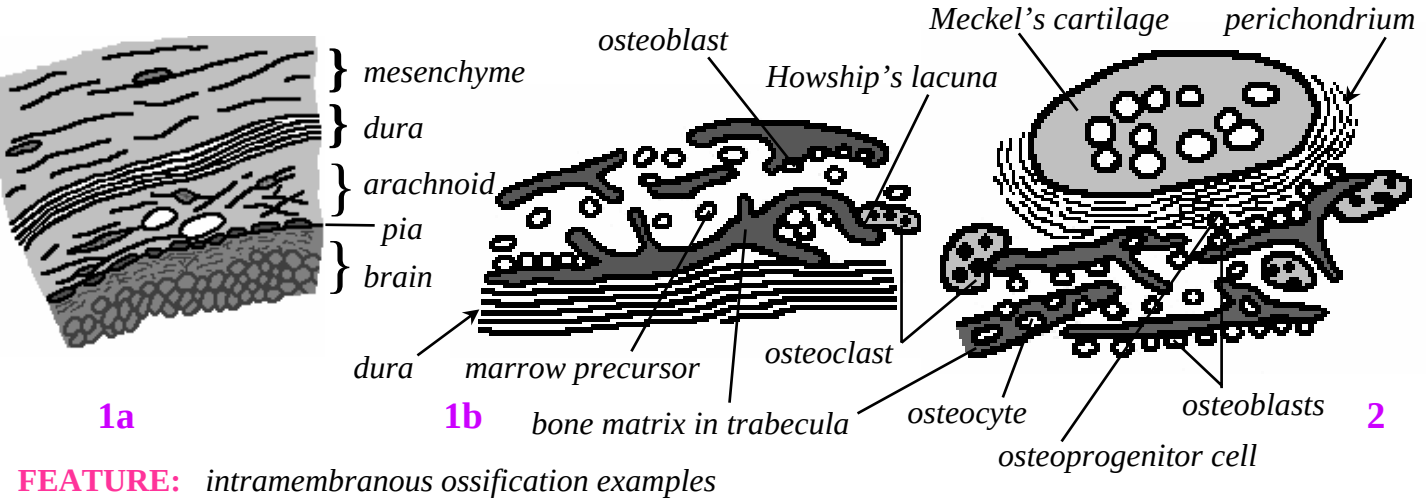
TISSUE / ORGAN: *diaphysis (shaft) of femur*



FEATURE: *Haversian systems (= osteons) with lamellae (LS)*

TISSUE / ORGAN: *diaphysis of femur*

BONE / MUSCLE FORMATION & JOINTS



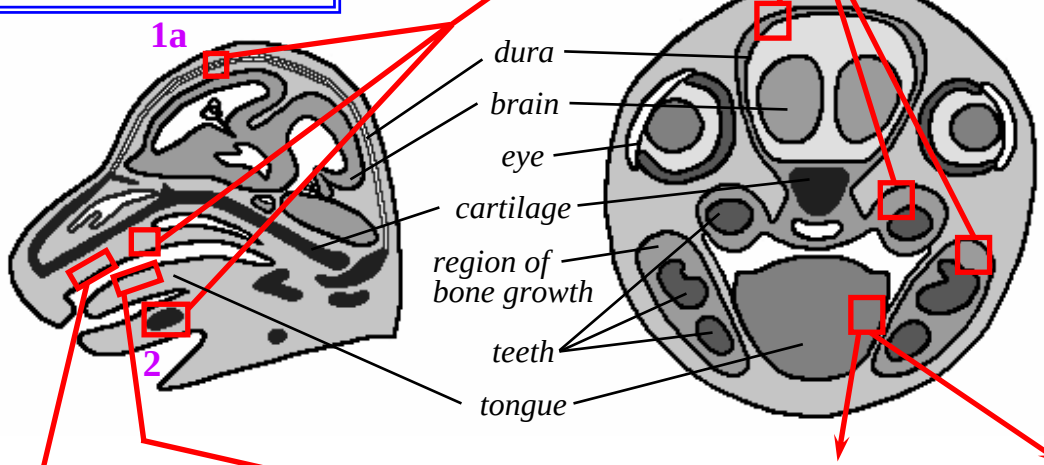
FEATURE: *intramembranous ossification examples*

TISSUE / ORGAN: **1** *dura mater and calvaria*
2 *Meckel's cartilage and mandible*

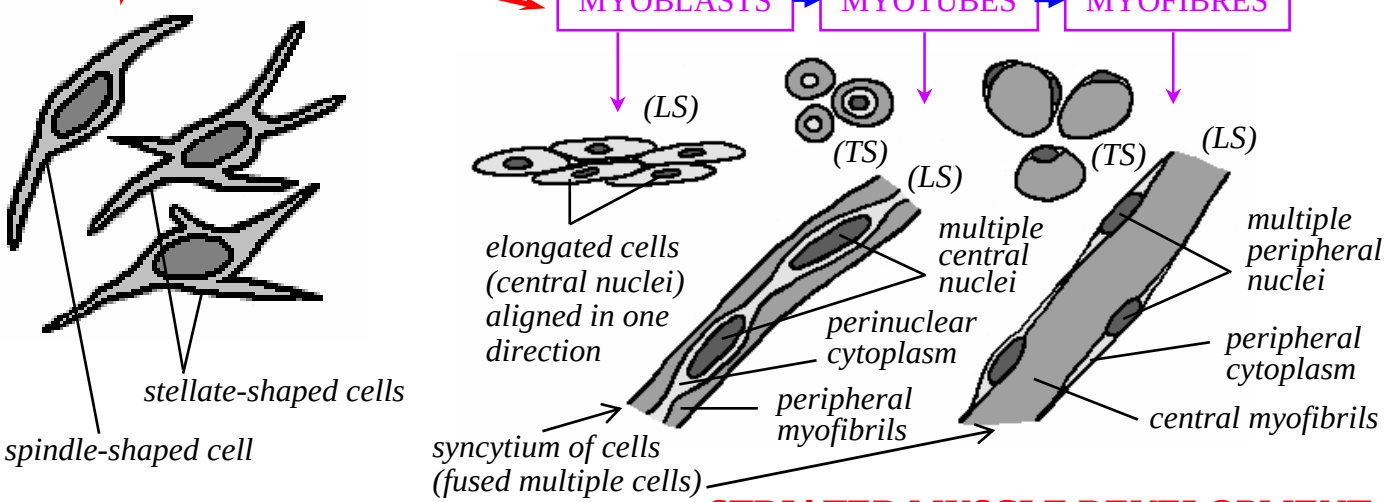
INTRAMEMBRANOUS OSSIFICATION

YOUNG FETAL RAT HEAD (sagittal section)

OLDER FETAL RAT HEAD (coronal section)



MYOBLASTS → MYOTUBES → MYOFIBRES



FEATURE: *spindle- and stellate-shaped cells*

TISSUE / ORGAN: *mesenchyme (undifferentiated mesoderm)*

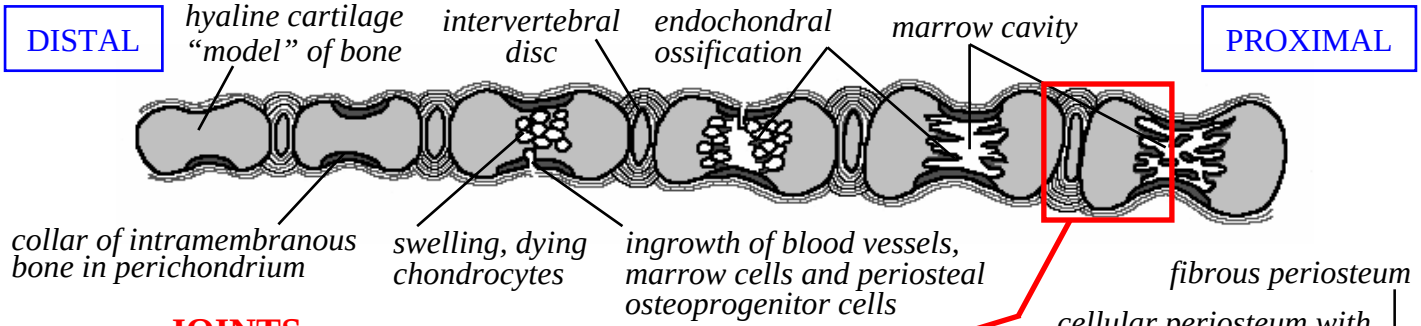
STRIATED MUSCLE DEVELOPMENT

FEATURE: *myoblasts and myotubes (developing striated muscle cells)*

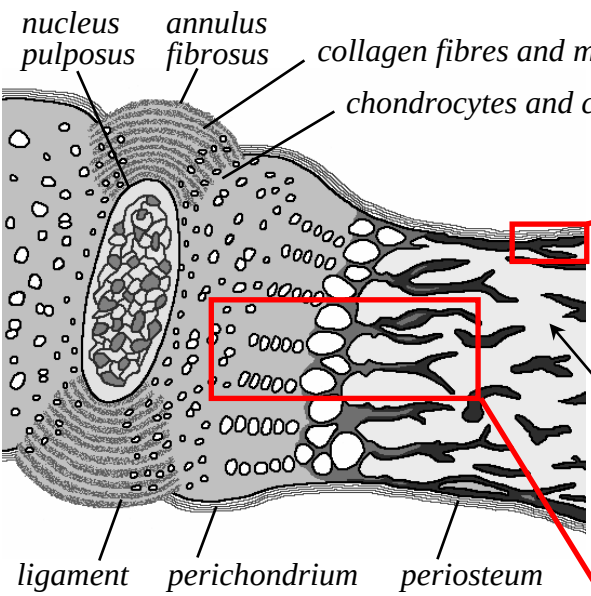
TISSUE / ORGAN: *fetal tongue*

OSSIFICATION & JOINTS

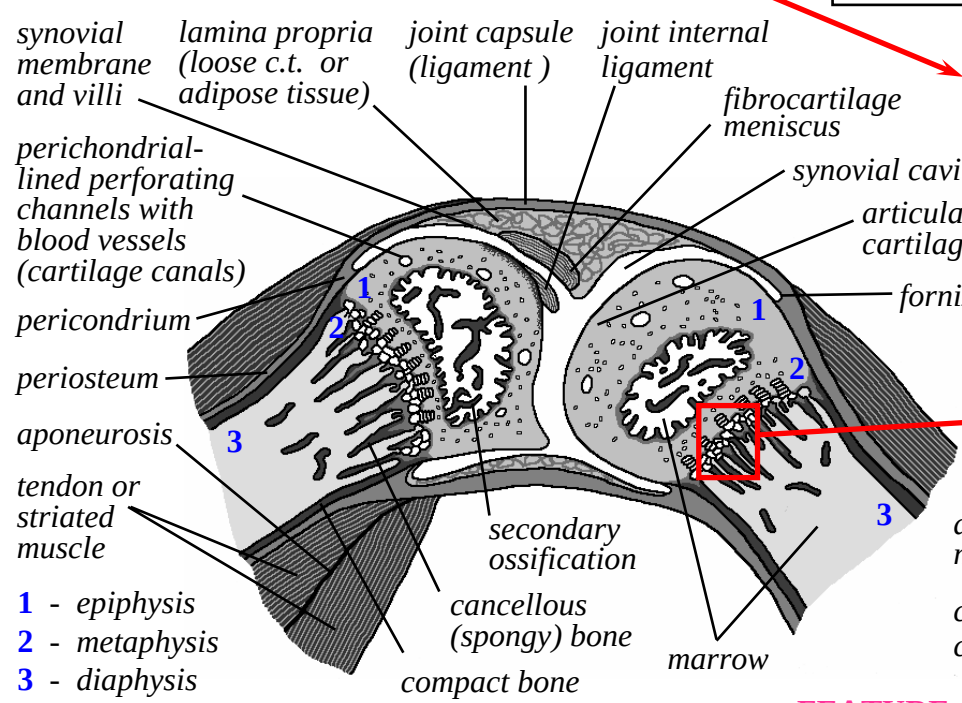
FEATURE: *stages in long bone development*
TISSUE / ORGAN: *fetal rat tail*



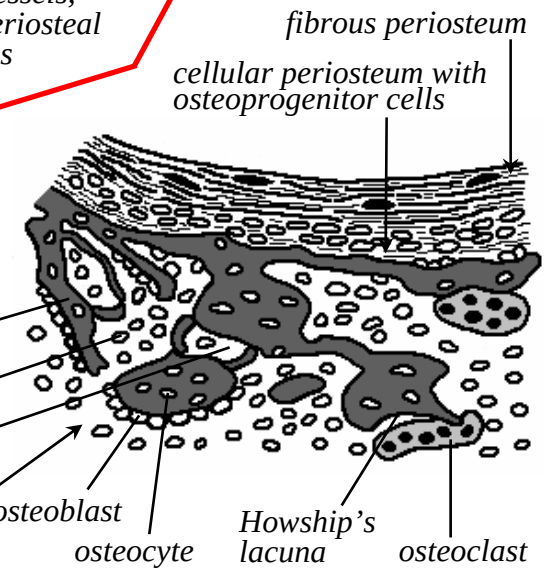
JOINTS



FEATURE: *developing symphysis joint*
TISSUE / ORGAN: *intervertebral disc*

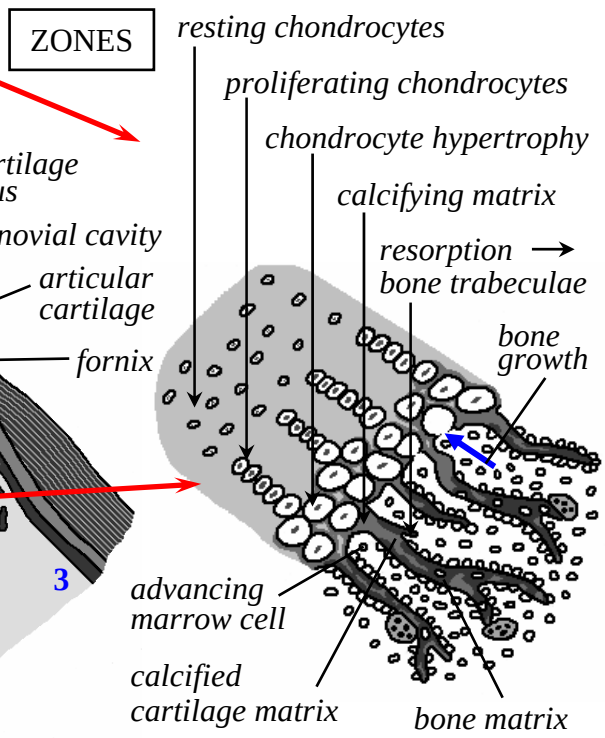


FEATURE: *generalised synovial joint*
TISSUE / ORGAN: *knee (or elbow)*



FEATURE: *bone growth and remodelling*
TISSUE / ORGAN: *periosteal collar of vertebra*

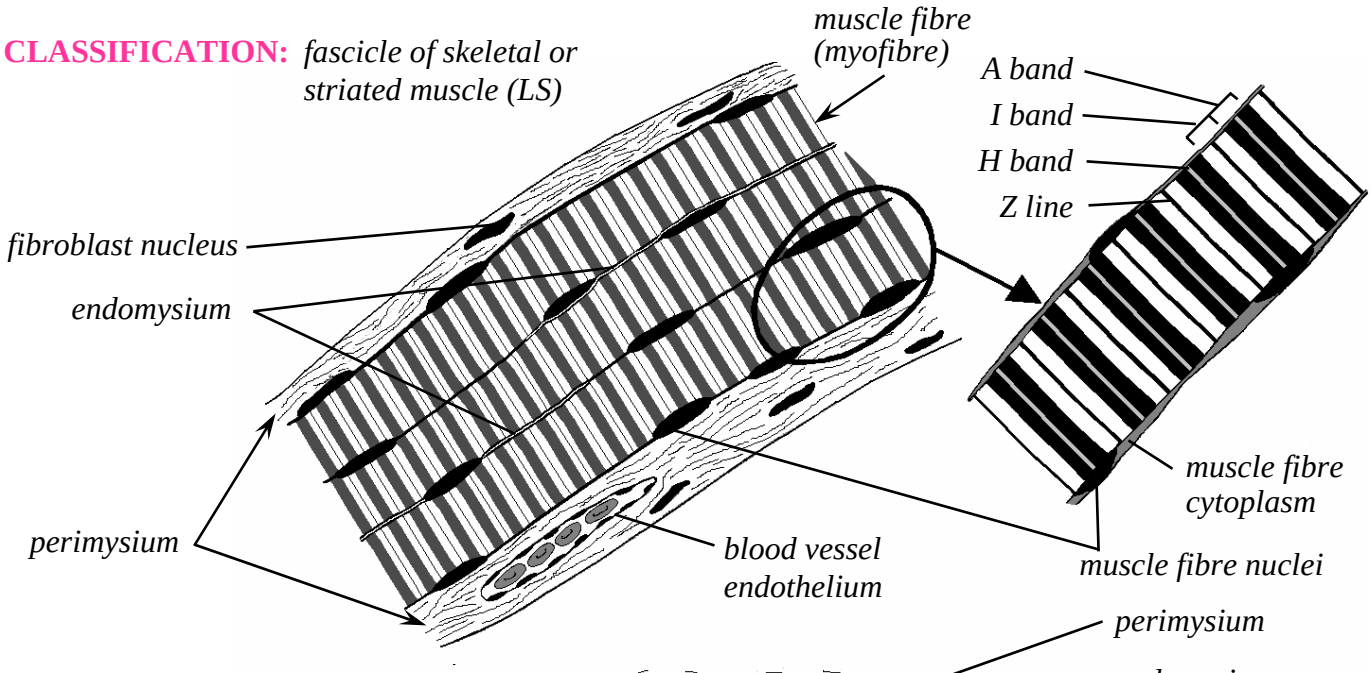
ENDOCHONDRAL OSSIFICATION



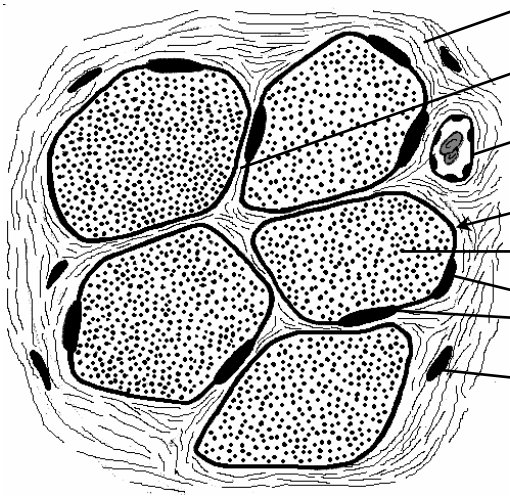
FEATURE: *epiphyseal disc (growth plate)*
TISSUE / ORGAN: *growth zone of long bone*

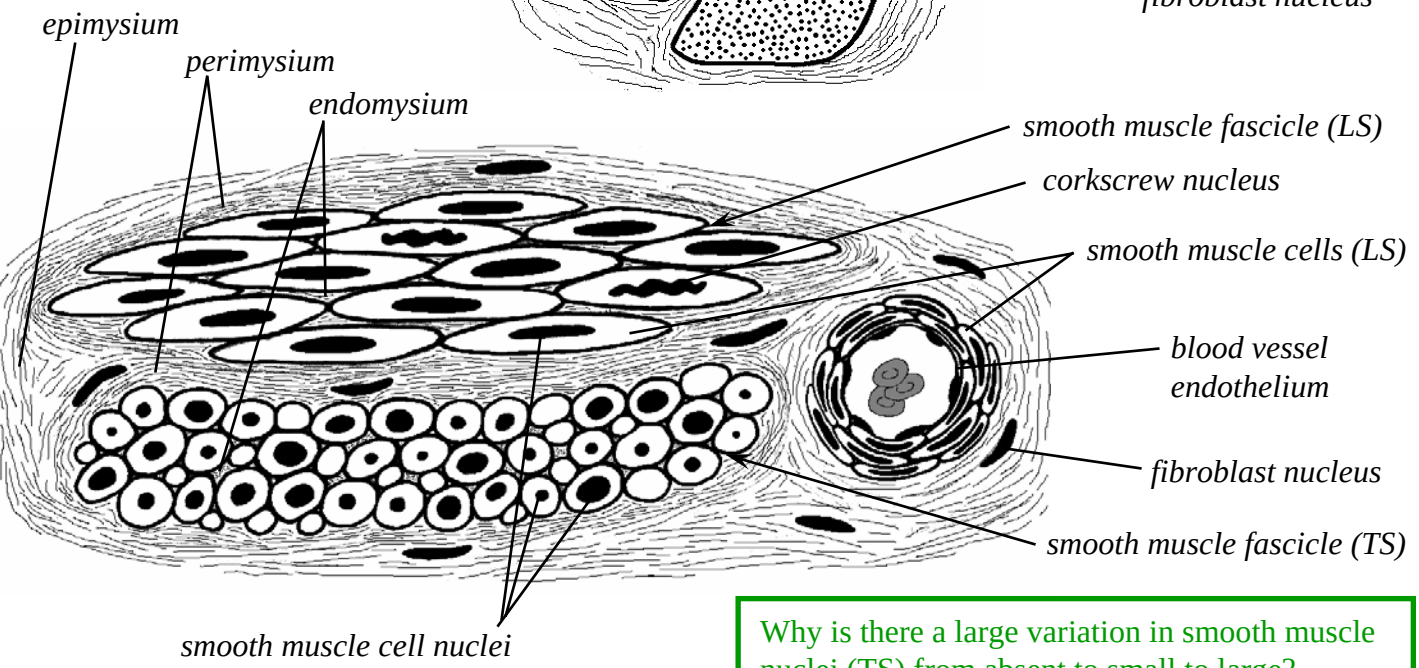
MUSCLE

CLASSIFICATION: *fascicle of skeletal or striated muscle (LS)*



CLASSIFICATION: *fascicle of skeletal or striated muscle (TS)*





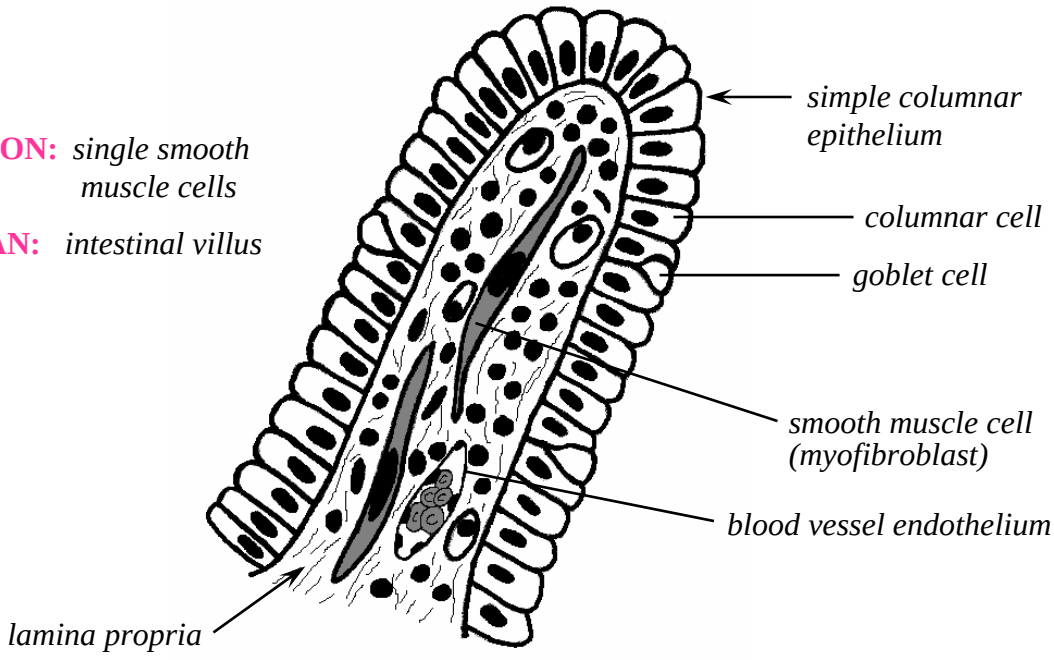
CLASSIFICATION: *smooth muscle in fascicles (LS & TS) and arteriole wall*

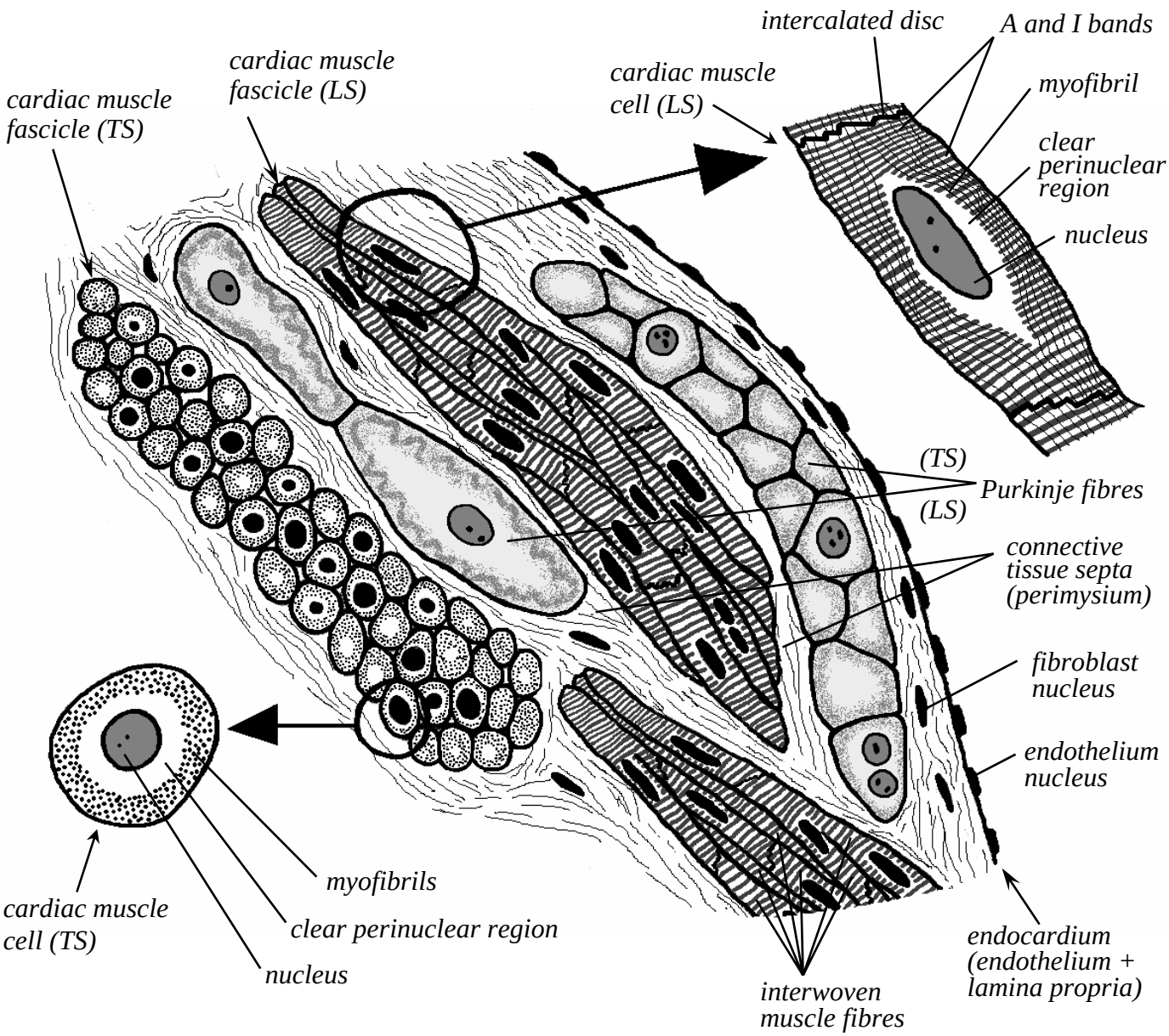
Why is there a large variation in smooth muscle nuclei (TS) from absent to small to large?

The cells are so long that sections cut the ovoid nucleus from centre to edge or even miss it.

CLASSIFICATION: *single smooth muscle cells*

TISSUE / ORGAN: *intestinal villus*



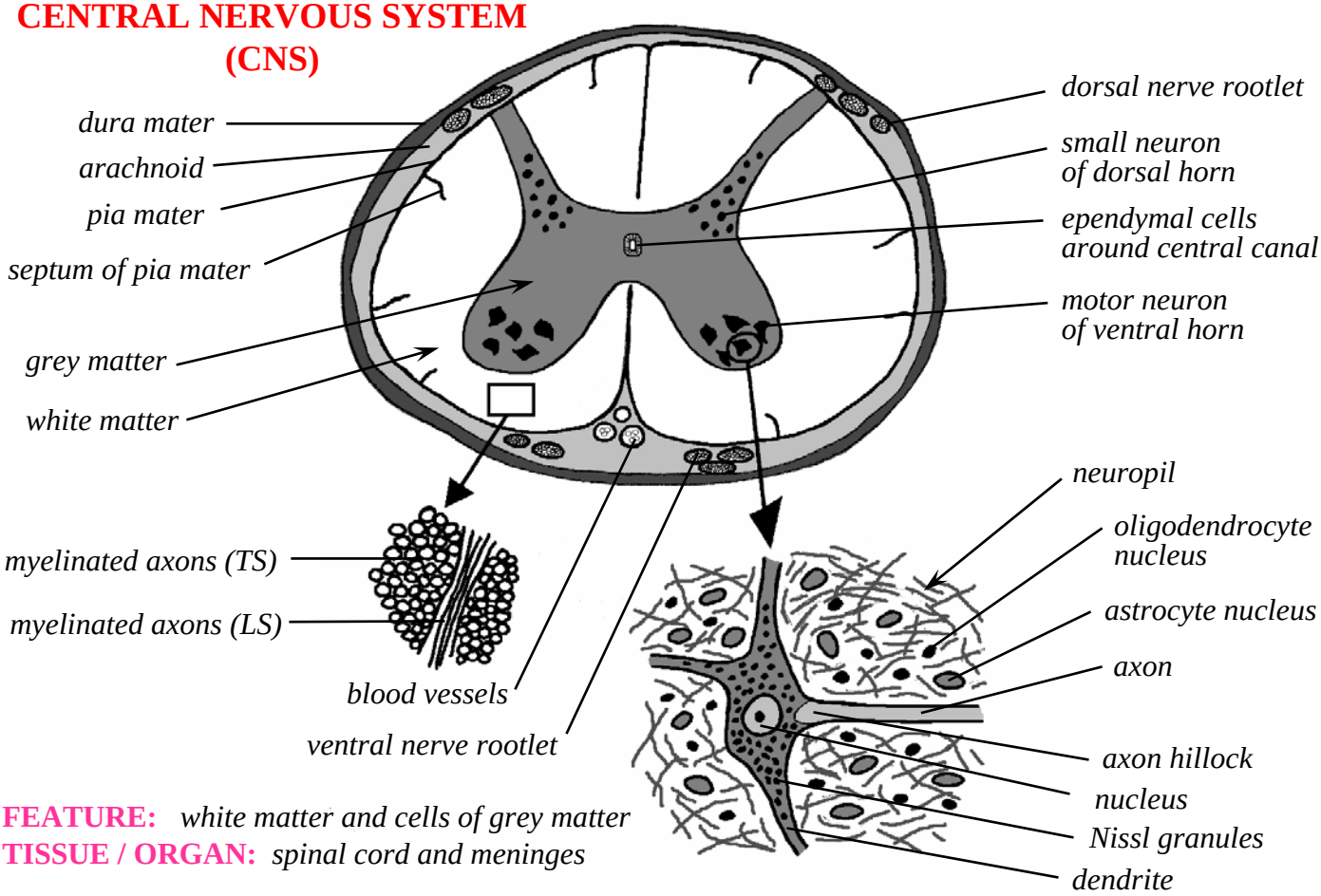


CLASSIFICATION: *cardiac muscle fascicles*

TISSUE / ORGAN: *heart (interventricular septum)*

NERVOUS TISSUE

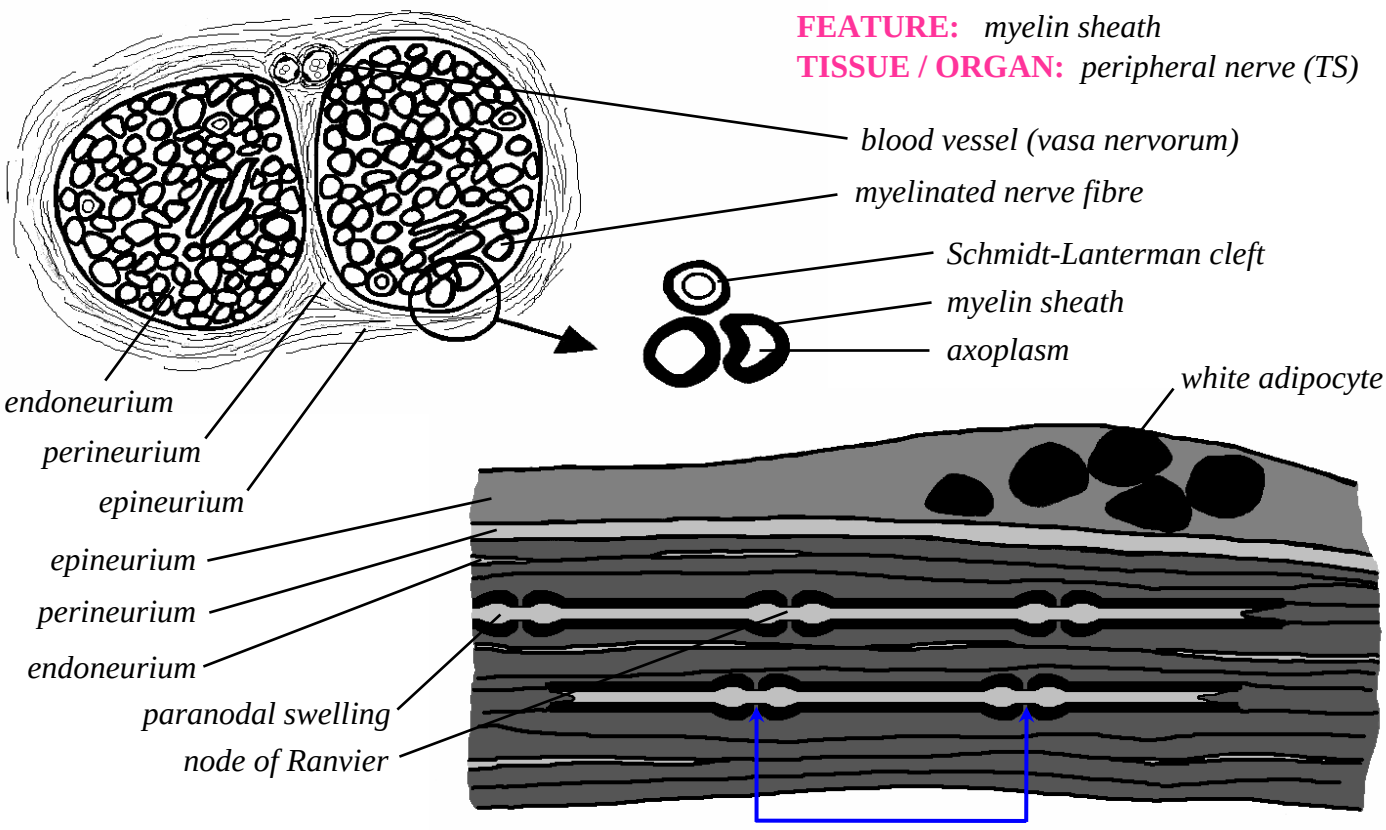
CENTRAL NERVOUS SYSTEM (CNS)



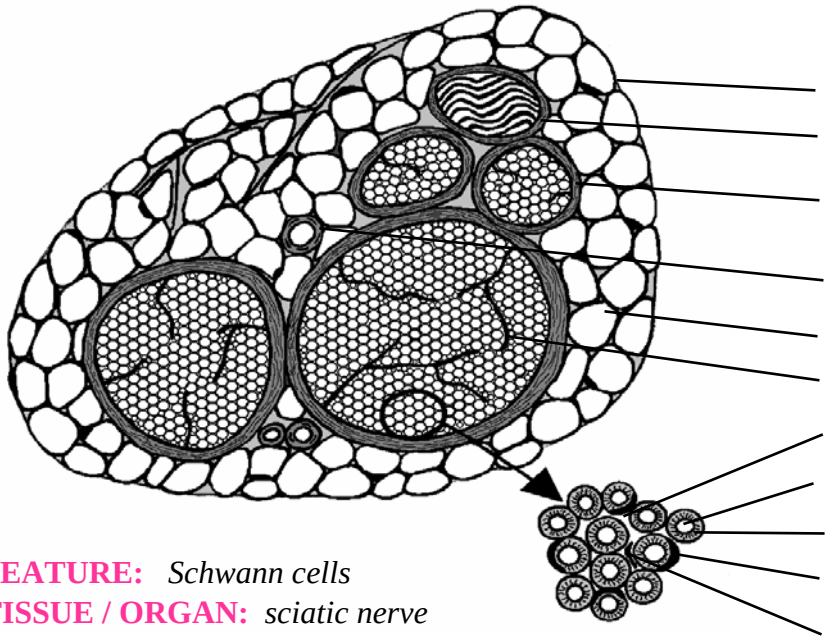
FEATURE: *white matter and cells of grey matter*
TISSUE / ORGAN: *spinal cord and meninges*

PERIPHERAL NERVOUS SYSTEM (PNS)

FEATURE: *myelin sheath*
TISSUE / ORGAN: *peripheral nerve (TS)*

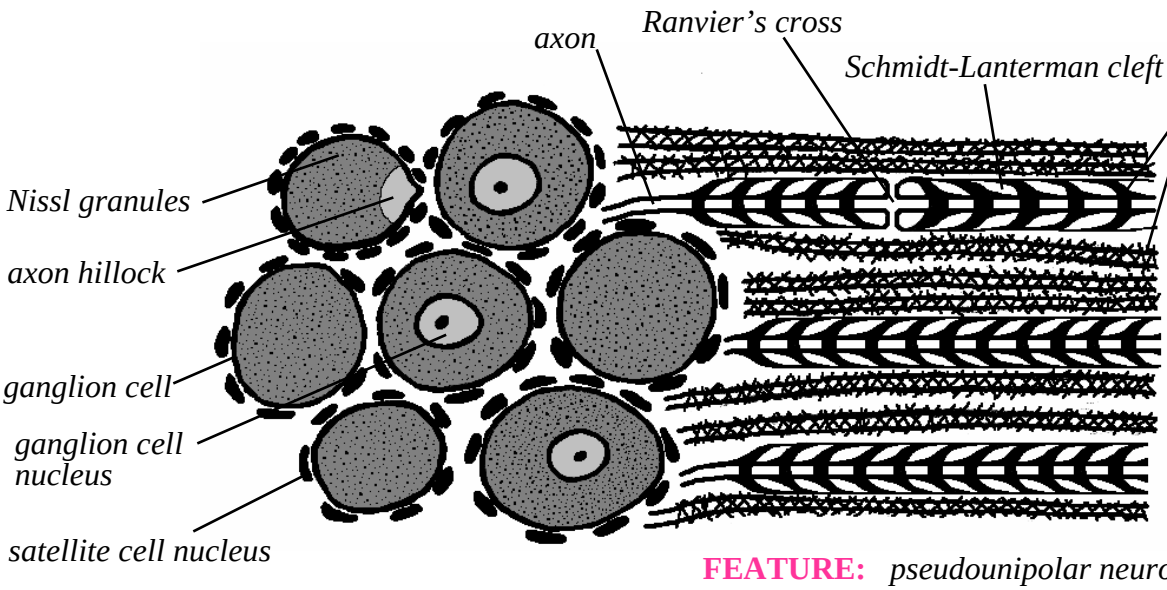


FEATURE: *Nodes of Ranvier*
TISSUE / ORGAN: *peripheral nerve (LS)*



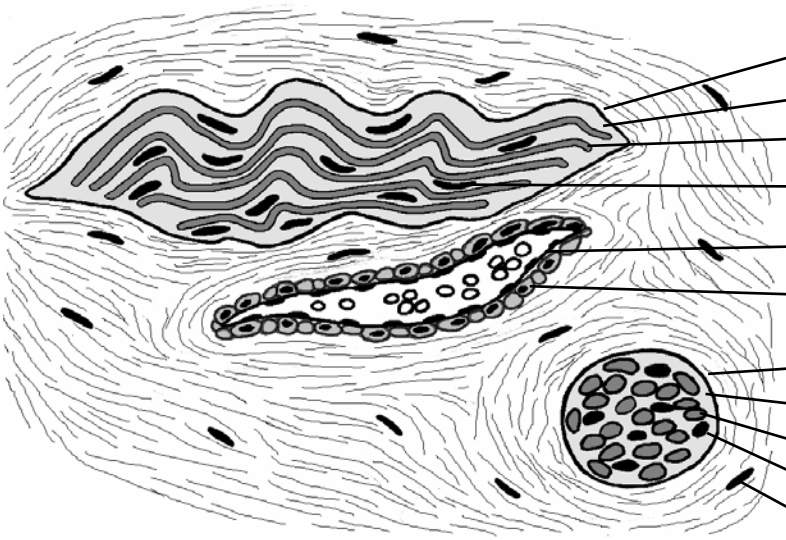
epineurium
perineurium around nerve fascicle (LS)
perineurium around nerve fascicle (TS)
blood vessel (vasa nervorum)
white fat cell (white adipocyte)
septum of perineurium
endoneurium
axoplasm
neurokeratin remnant of myelin sheath
Schwann cell nucleus
fibroblast nucleus

FEATURE: *Schwann cells*
TISSUE / ORGAN: *sciatic nerve*



axon
Ranvier's cross
Schmidt-Lanterman cleft
neurokeratin of myelin sheath
Nissl granules
axon hillock
ganglion cell
ganglion cell nucleus
satellite cell nucleus

FEATURE: *pseudounipolar neurons and myelin*
TISSUE / ORGAN: *trigeminal sensory ganglion*



perineurium around nerve fascicle (LS)
endoneurium
myelinated axon
Schwann cell nucleus
blood vessel endothelium
smooth muscle (TS)
perineurium around nerve fascicle (TS)
endoneurium
myelinated axon
Schwann cell nucleus
fibroblast nucleus

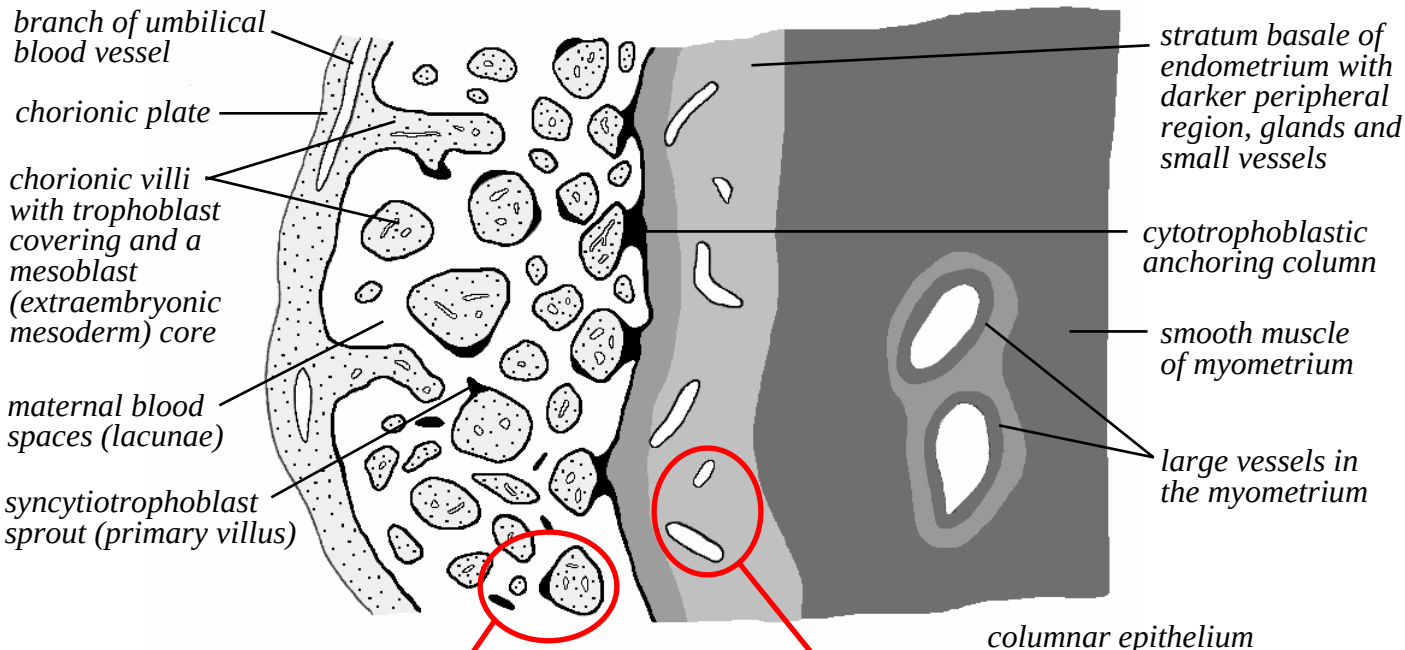
FEATURE: *peripheral nerve fascicles*
TISSUE / ORGAN: *connective tissue (tongue)*

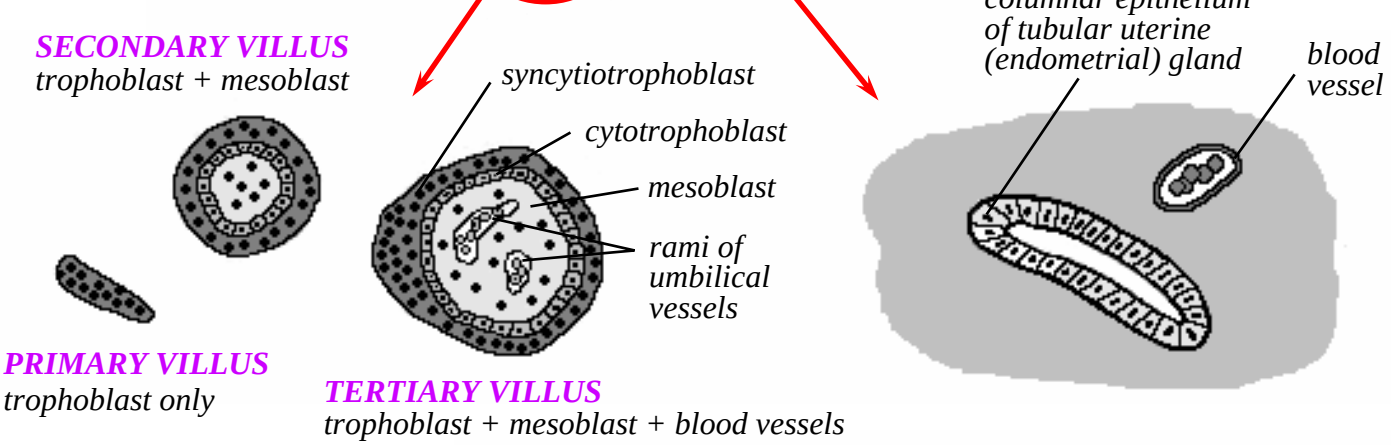
FETAL MEMBRANES

PLACENTA

FEATURE: *chorionic plate, villi, uterine wall*
TISSUE / ORGAN: *placenta (3 months)*

FETAL SIDE | *MATERNAL SIDE*





UMBILICAL CORD

FEATURE: *vessels and Wharton's jelly*
TISSUE / ORGAN: *umbilical cord (TS)*

Warton's jelly is an artefact of "dead" umbilical cord. What should "living" cord look like and why is this different?

Before birth the cord has three large vessels and very little connective tissue. After birth the blood flow stops and without blood pressure the vessels collapse. The connective tissue swells with fluid that leaks from the vessels.