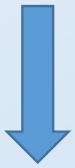
# Physiology

## Physiology

- From 1560's, French and directly from Latin **physiologia**.
- "Study and description of natural objects, natural philosophy".
- Derived from **physios** = "nature, natural, physical"; and **logia** = "study".
- This gives the meaning of "science of the normal function of living things".

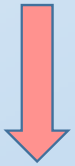
Compare **Function** and **Process** in terms of **Physiology**

**Functional Questions**:
Purpose of event?

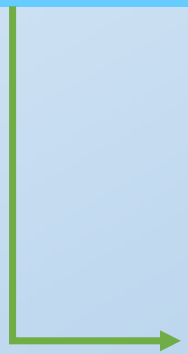


Why does blood flow?
Why do RBCs transport $O_2$?
Why do we breathe?

**Process Questions**:
How is event achieved?



How does blood flow?
How do RBCs transport $O_2$?
How do we breathe?



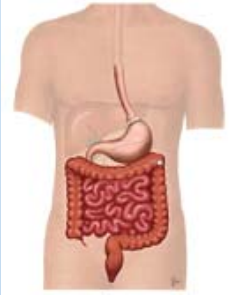
Integration of both
to get the
holistic picture!

## 3 Types of Muscle Tissue

Skeletal – attached to bone

Cardiac – the heart

Smooth – internal organs
blood vessels



## Properties of Muscle Tissue

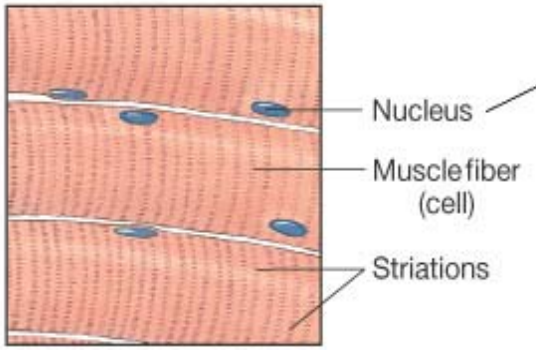
- Contractility
- Excitability
- Extensibility
- Elasticity

- Long & cylindrical
- Multinucleated
- Striated
- Voluntary

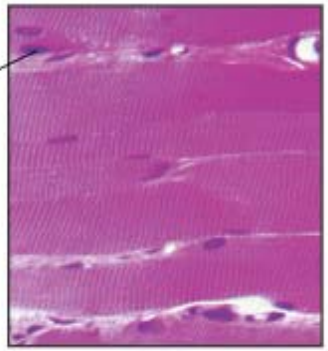
- Shorter & branched
- Uninucleated
- Striated
- Involuntary
- Intercalated disks

- Spindle-shaped
- Uninucleated
- Non-striated
- Involuntary

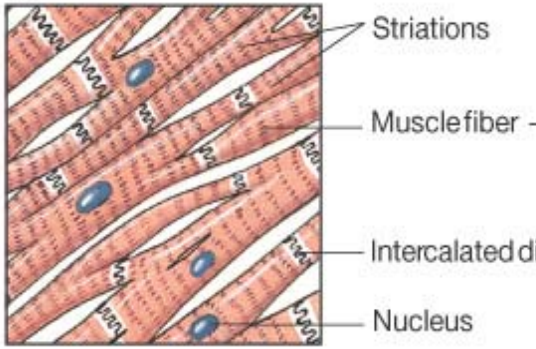
**Skeletal muscle**




**Skeletal muscle**

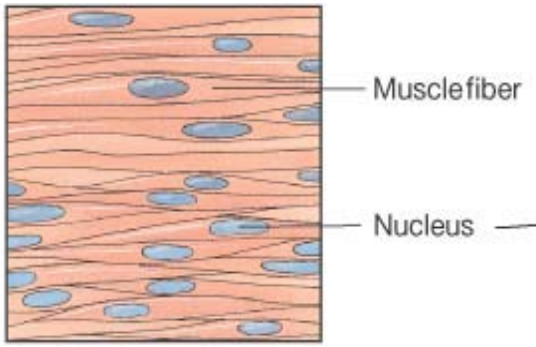


**Cardiac muscle**

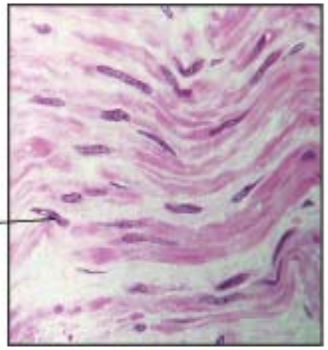



**Cardiac muscle**

**Smooth muscle**




**Smooth muscle**



**Control**

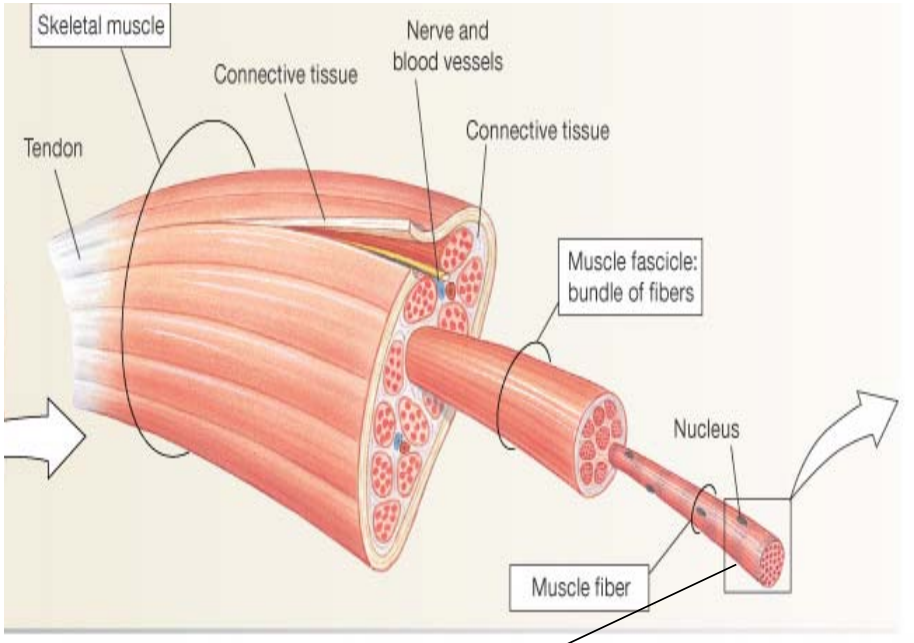
**SNS**

**Intrinsic Myogenic**

**ANS Paracrine Endocrine**

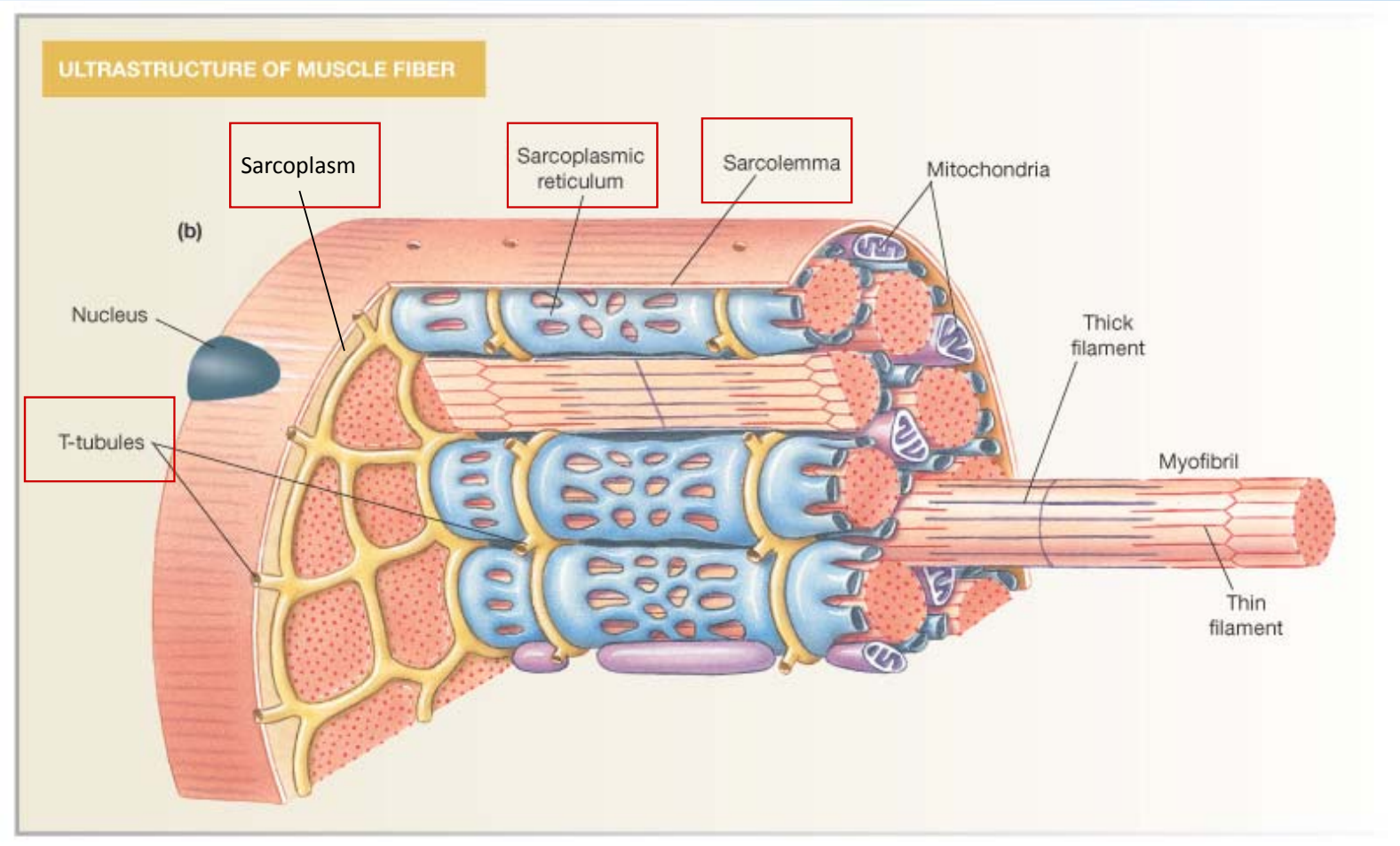
# Facts and Functions of Skeletal Muscle

- Movement of Body & Posture
- Heat Production ($T_b$)
- Protection of Body
- Controls Entrances/Exits
- About 40% body mass
- Muscle fiber = Muscle cell

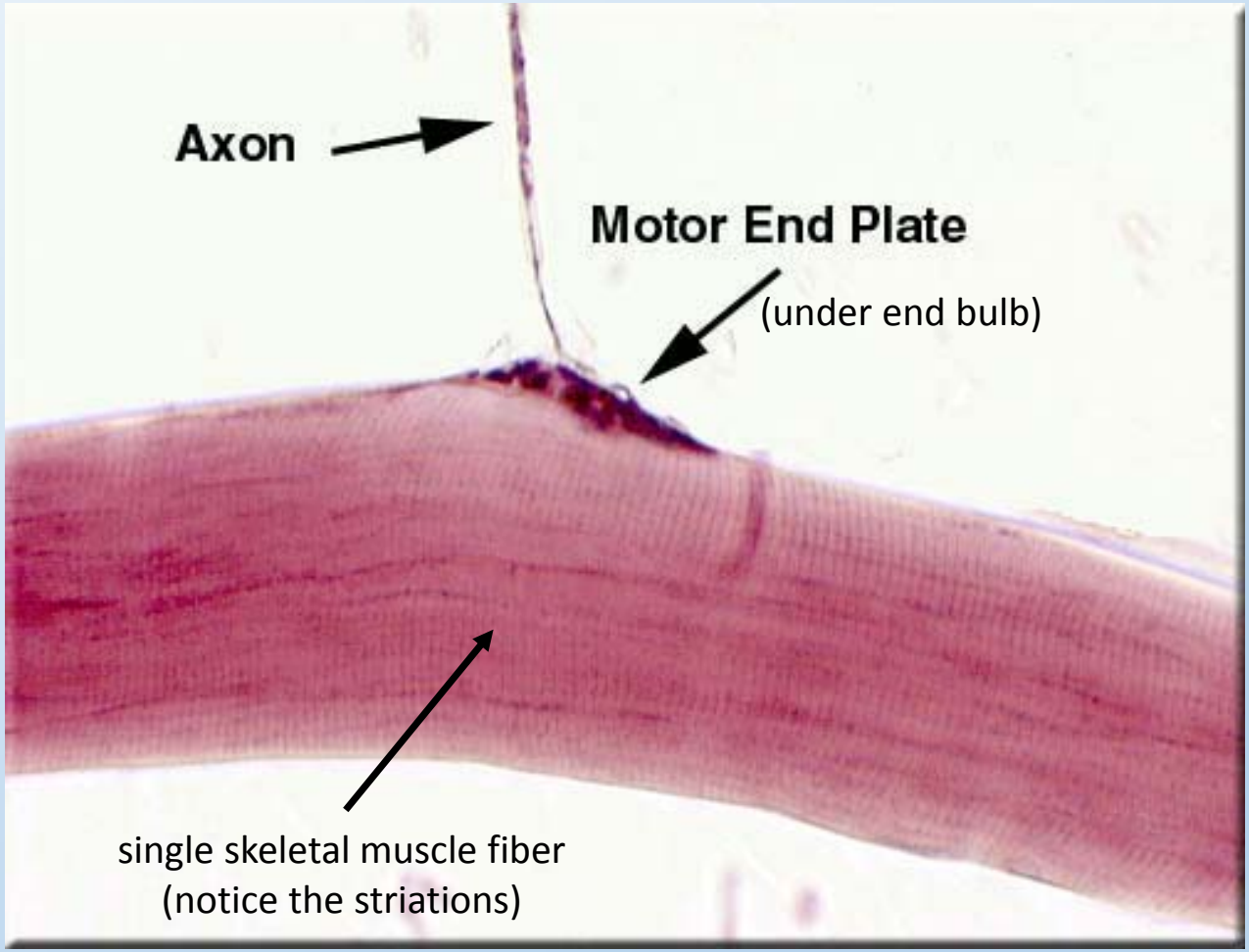



One muscle cell
(see next slide)

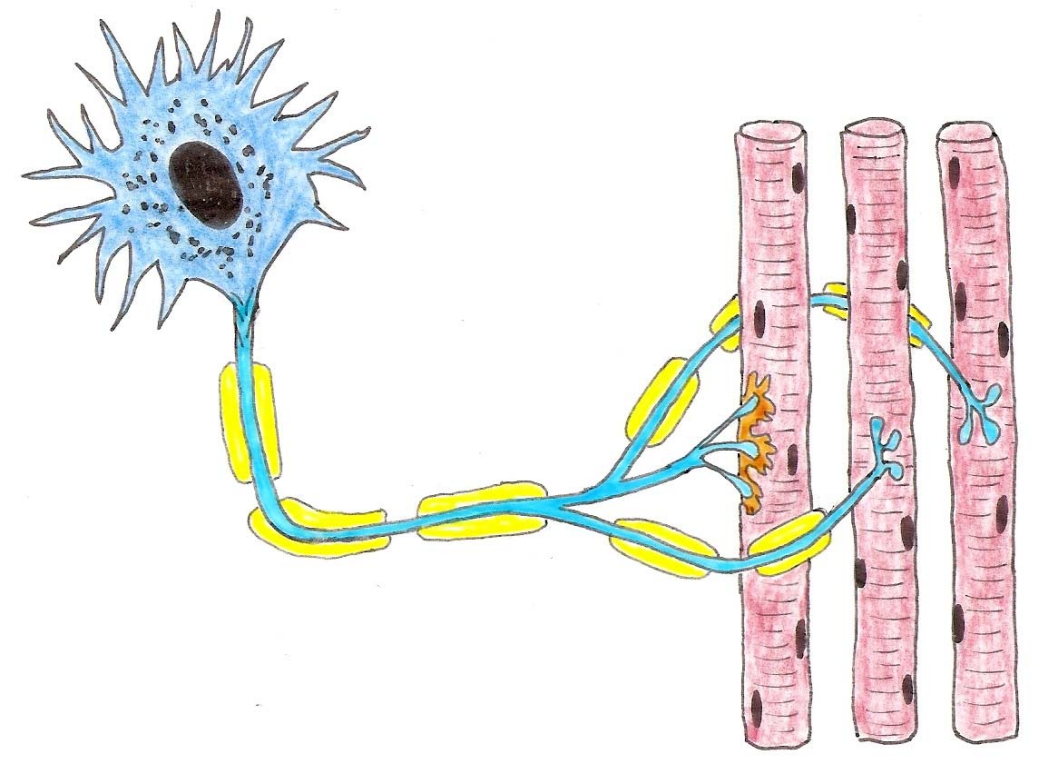
# A Muscle Fiber (= A Muscle Cell)

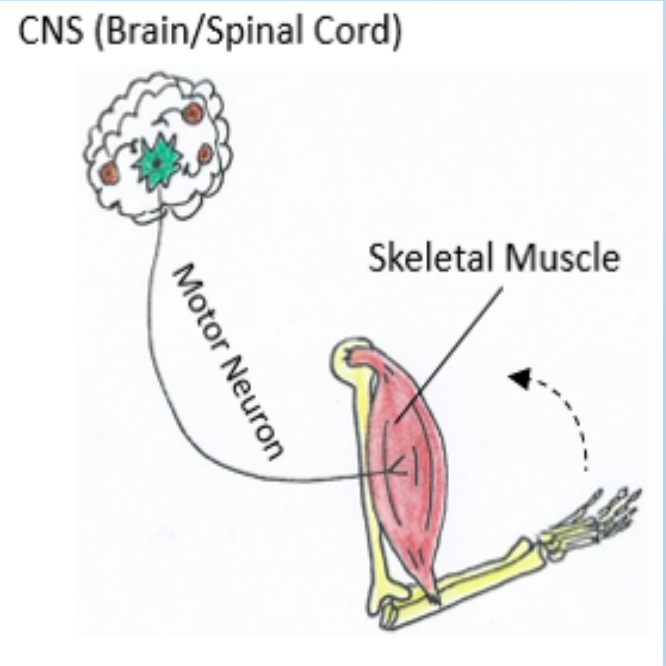


# Neuromuscular Junction of Skeletal Muscle

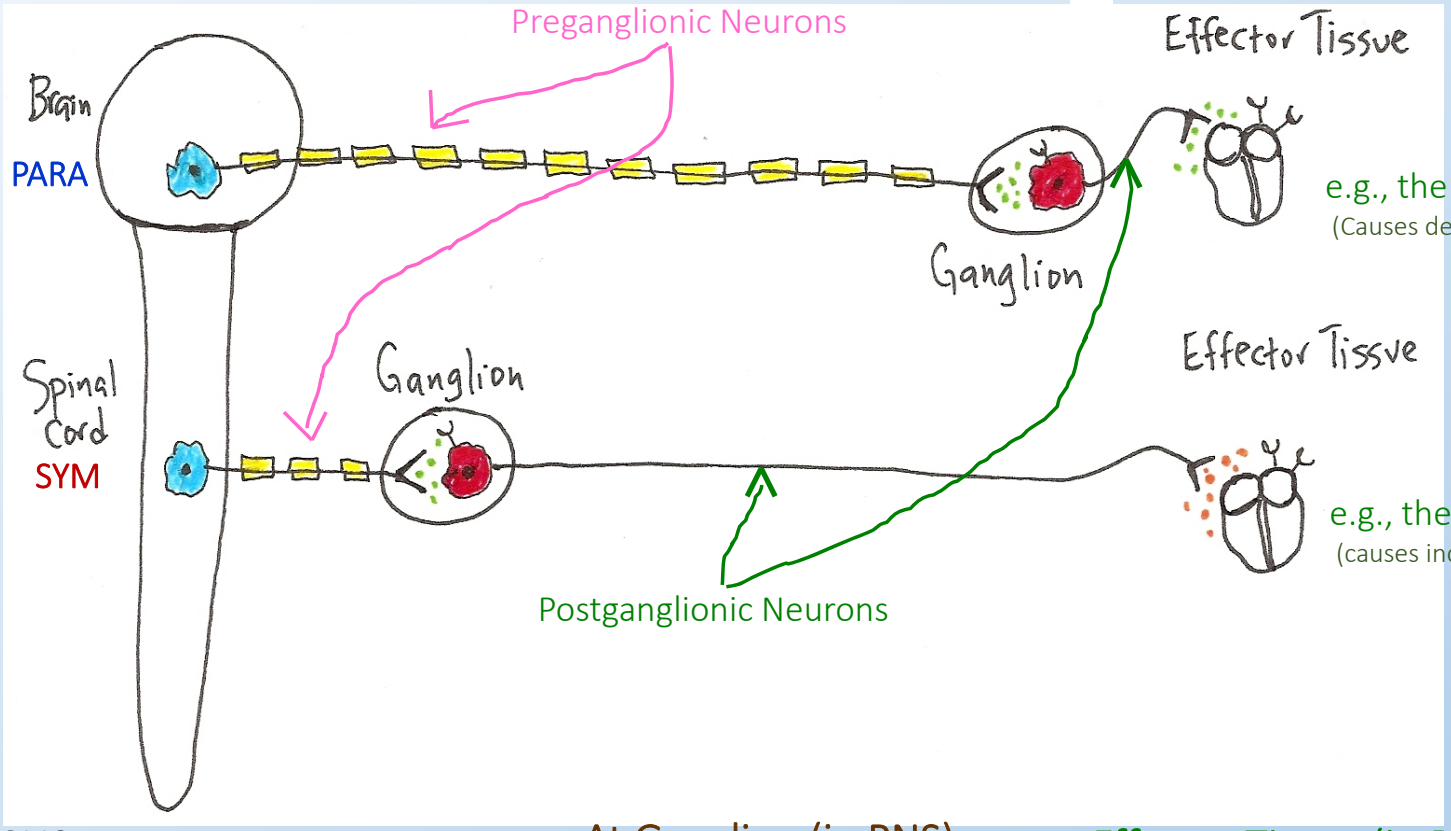


# Diagrammatic Neuromuscular Junctions





CNS PNS Tissue




**In CNS**: Preganglionic Neurons

Para = Craniosacral Origin*

Sym = Thoracolumbar Origin*

*The term 'origin' means where in the CNS do these first ANS neurons come from.

**At Ganglion (in PNS)**:

Postganglionic

Nerve cell bodies

Note that the same actions occur at the ganglion for both divisions, they are identical.

**Effector Tissue (in PNS)**:

Cardiac Muscle

Smooth Muscle

Glands

Here at the effector tissue is where the 2 divisions (Para and Sym) of the ANS differ.

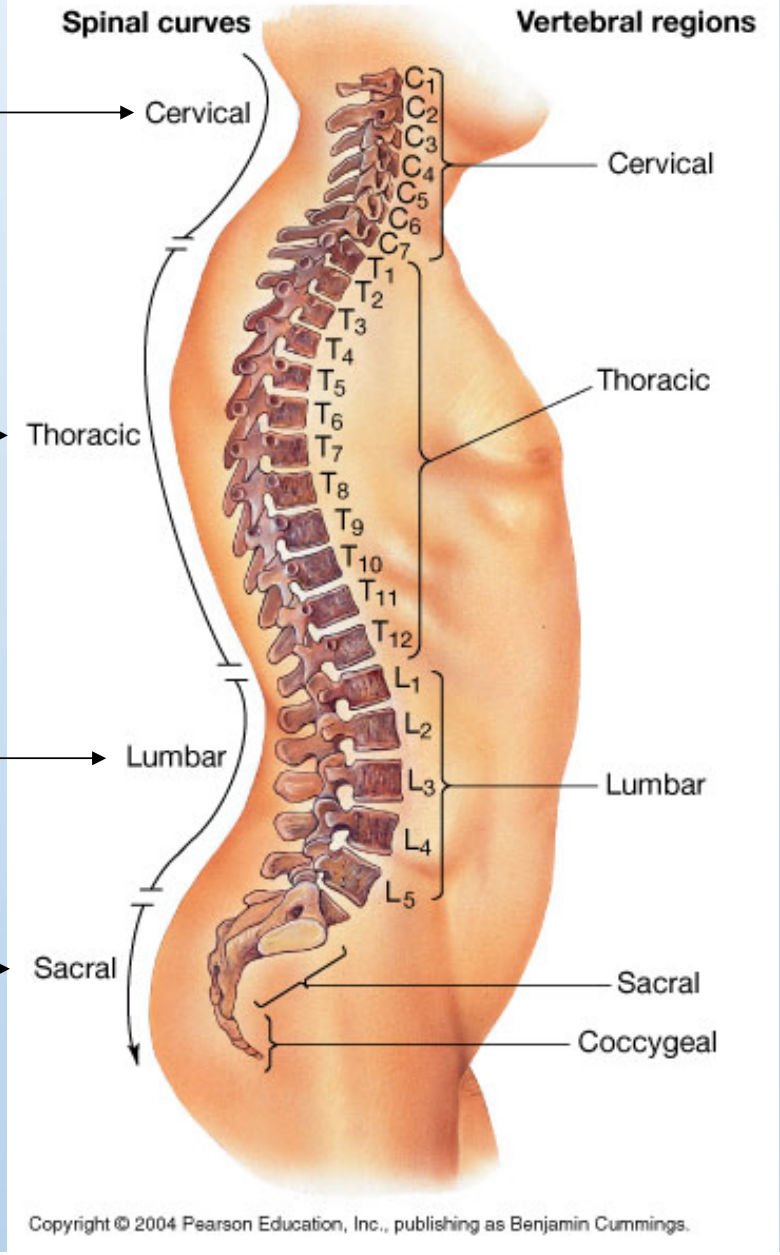
# Normal Spinal Curvature

2º → Cervical

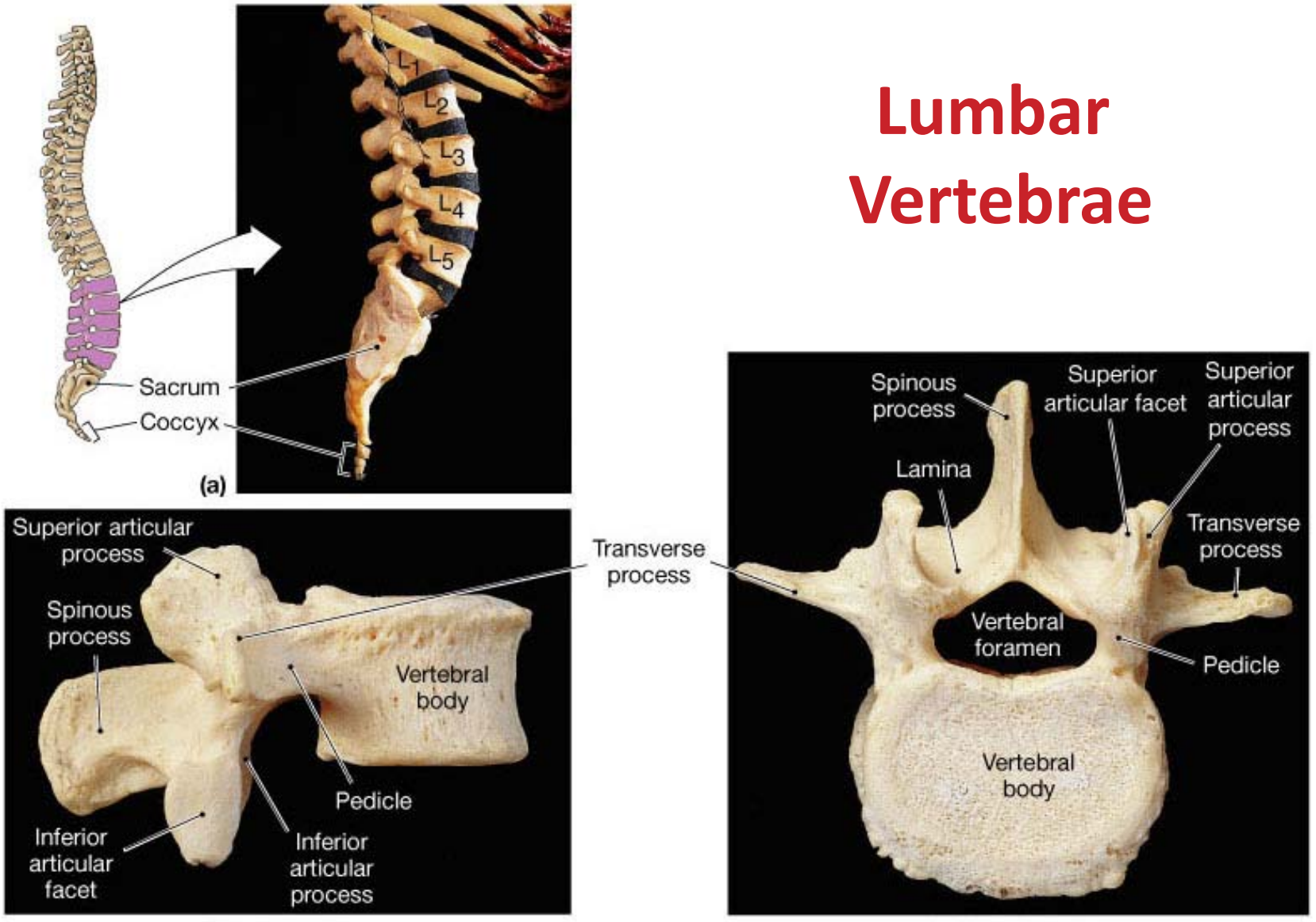
1º → Thoracic

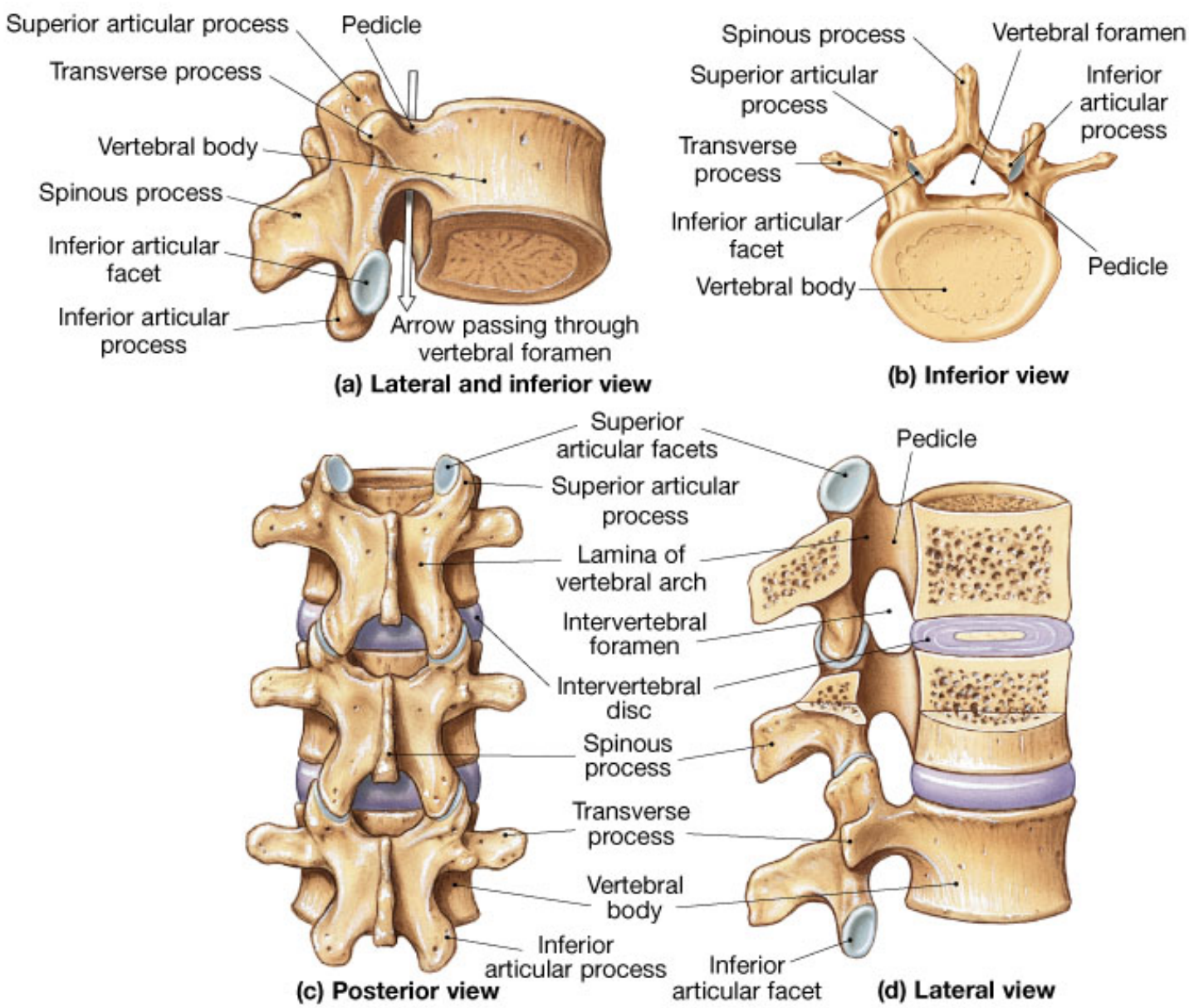
2º → Lumbar

1º → Sacral

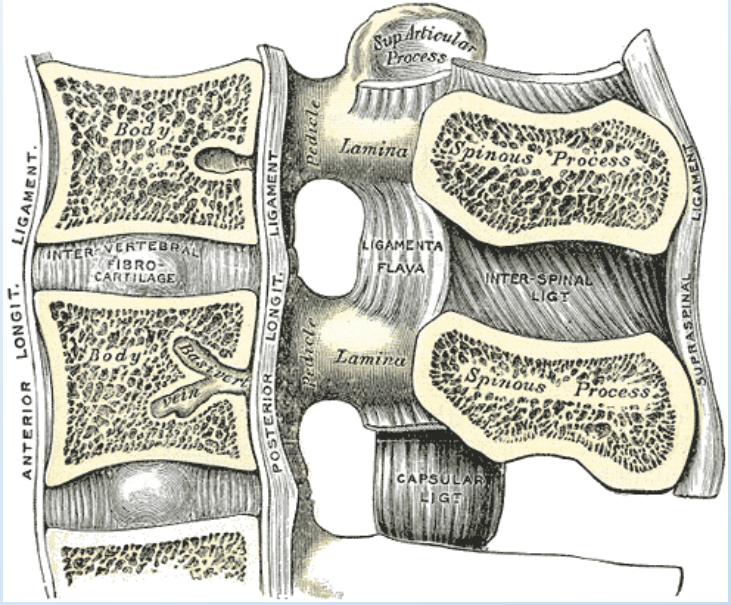


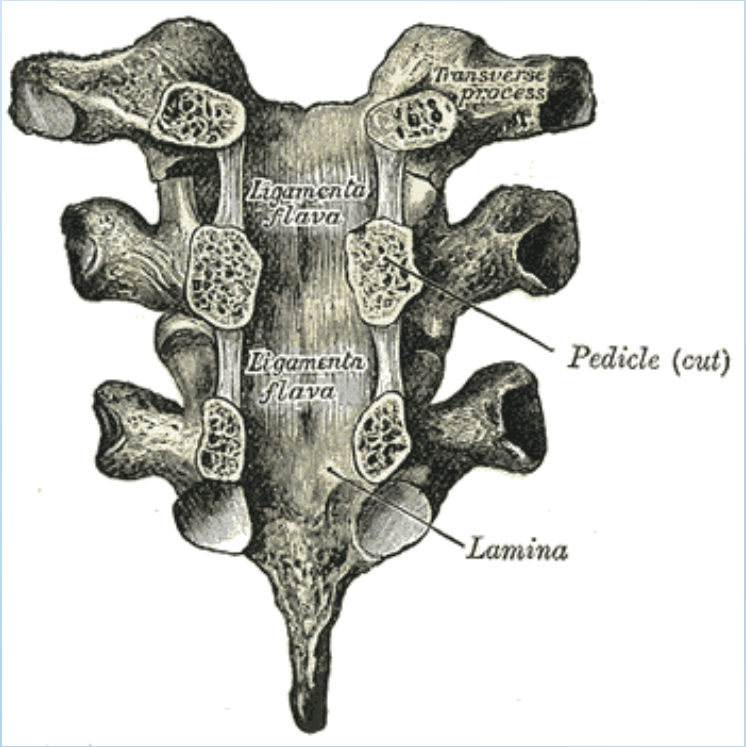
# Lumbar Vertebrae





# Ligaments of the Vertebral Column



# Spinal Meninges

- Dura Mater

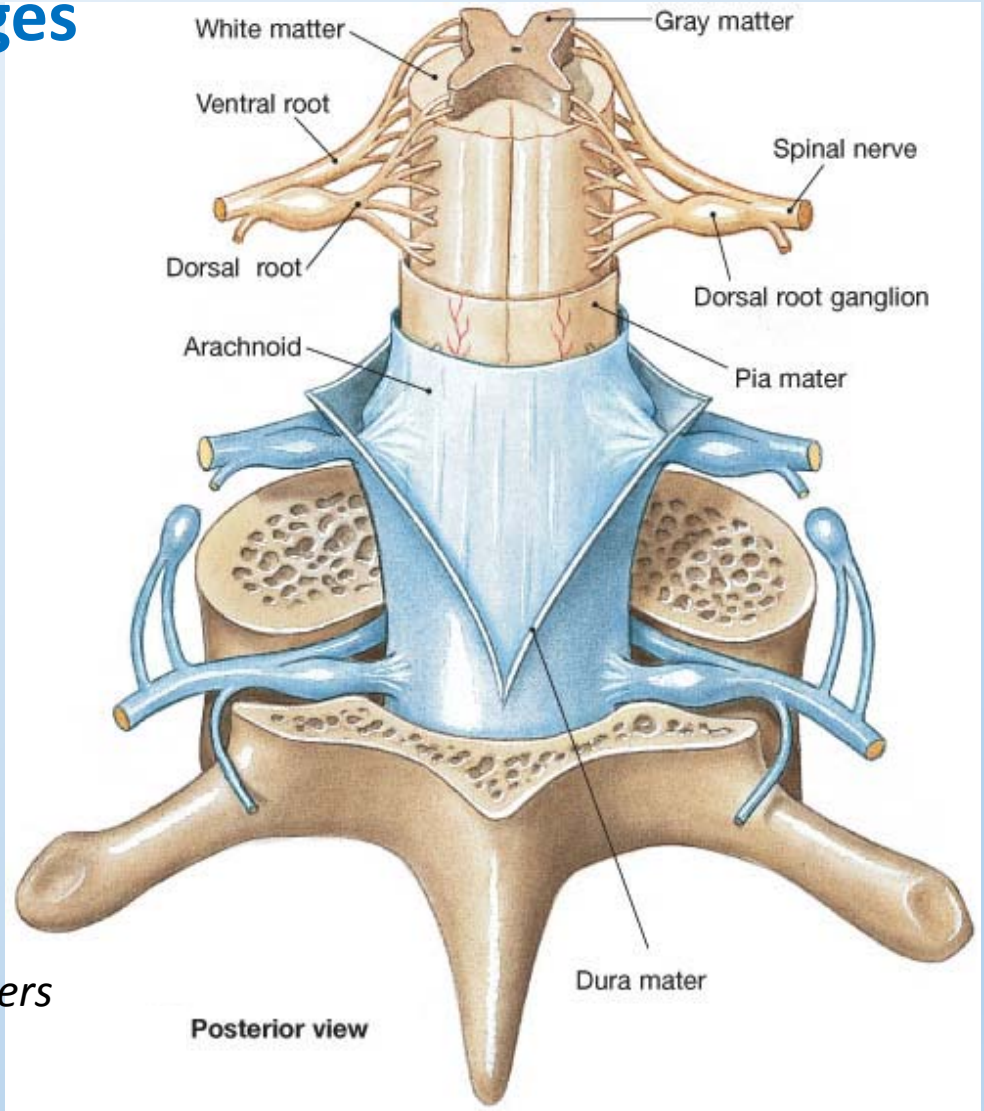
*Dense irregular CT + Simple squamous epithelium*

- Arachnoid

*Simple squamous epithelium*

- Pia Mater

*Collagen and elastic fibers*



# Spinal Plexus:

(in the Nervous System)

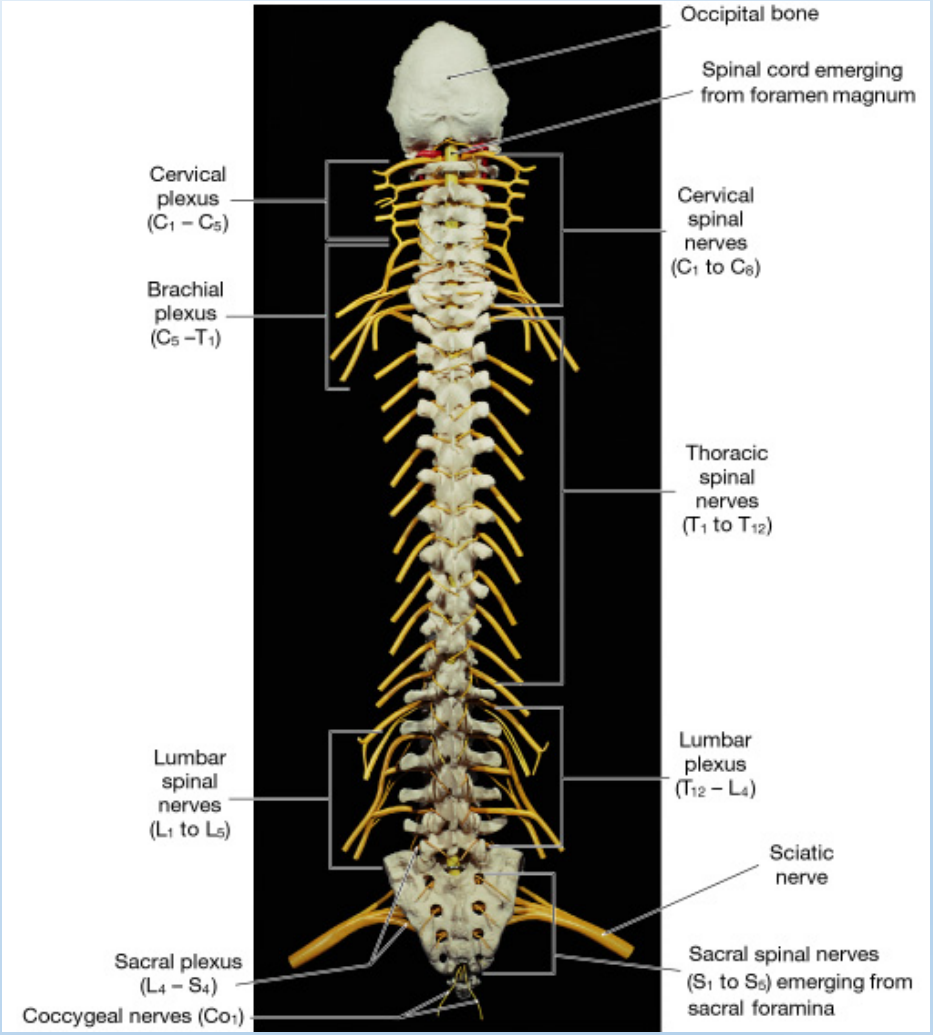
is a re-arrangement of spinal nerves into functional groups.

Cervical ($C_1$-$C_5$)

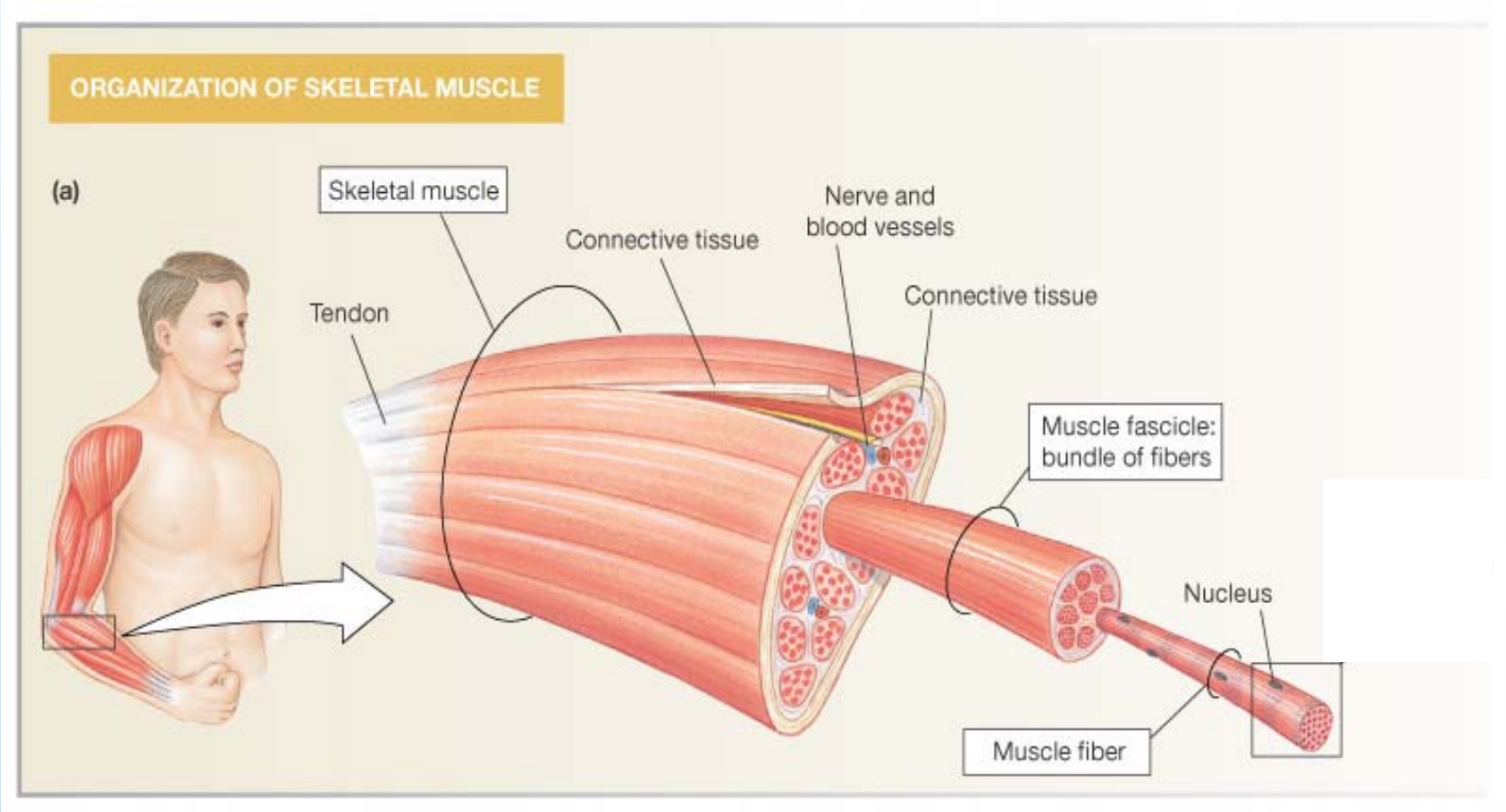
Brachial ($C_5$-$T_1$)

Lumbar ($T_{12}$-$L_4$ )

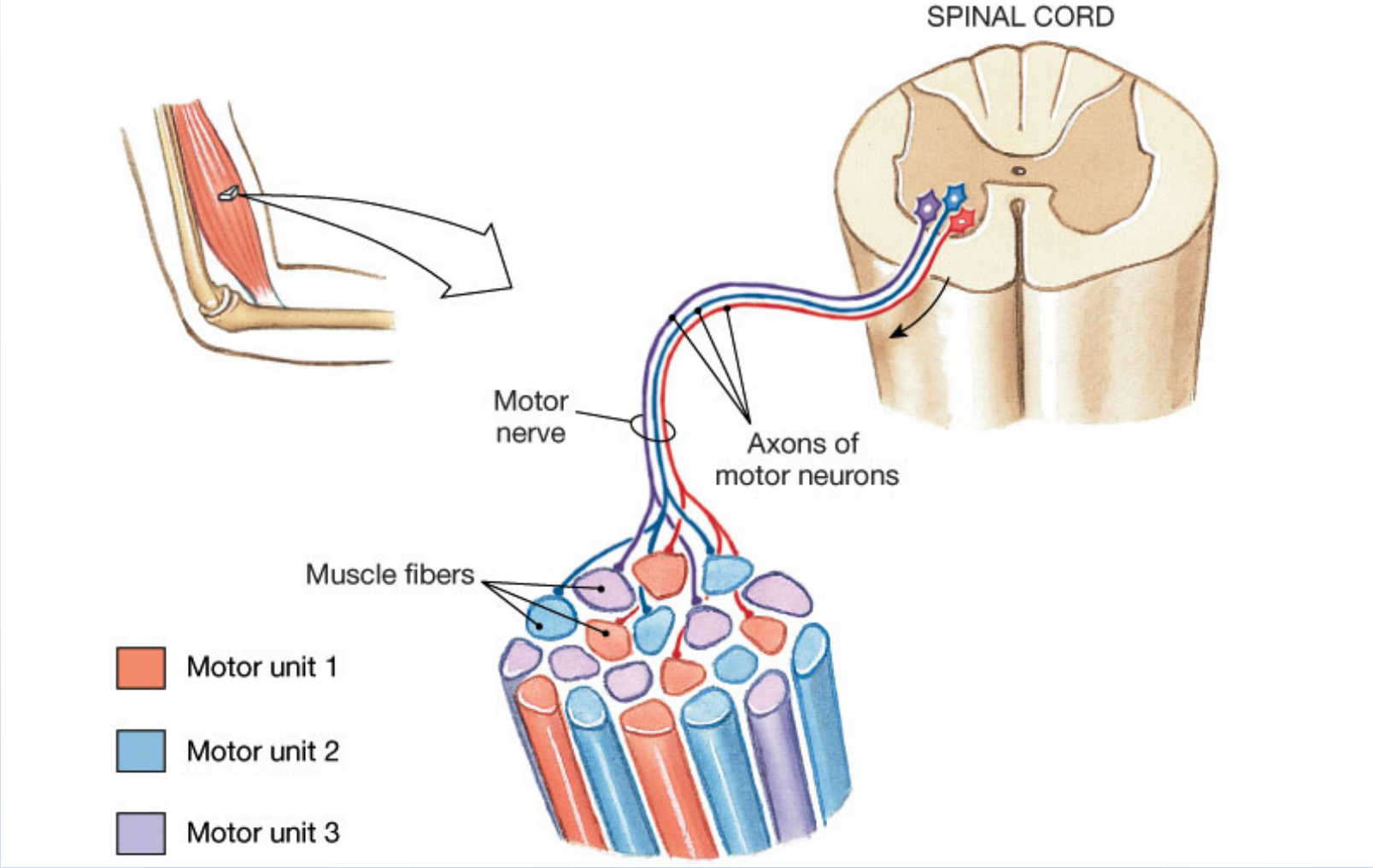
Sacral ($L_4$-$S_4$)



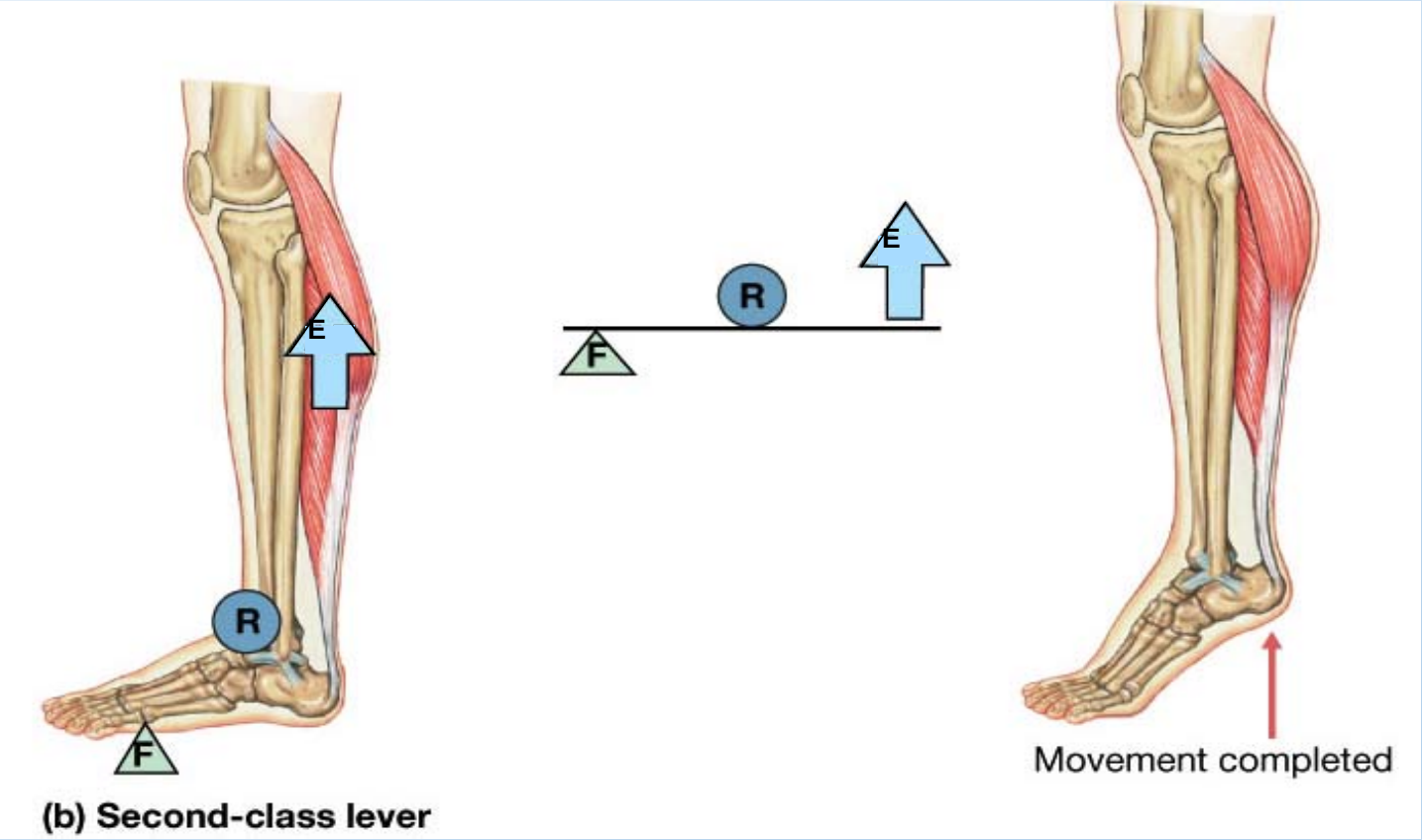
# Anatomy of Skeletal Muscle

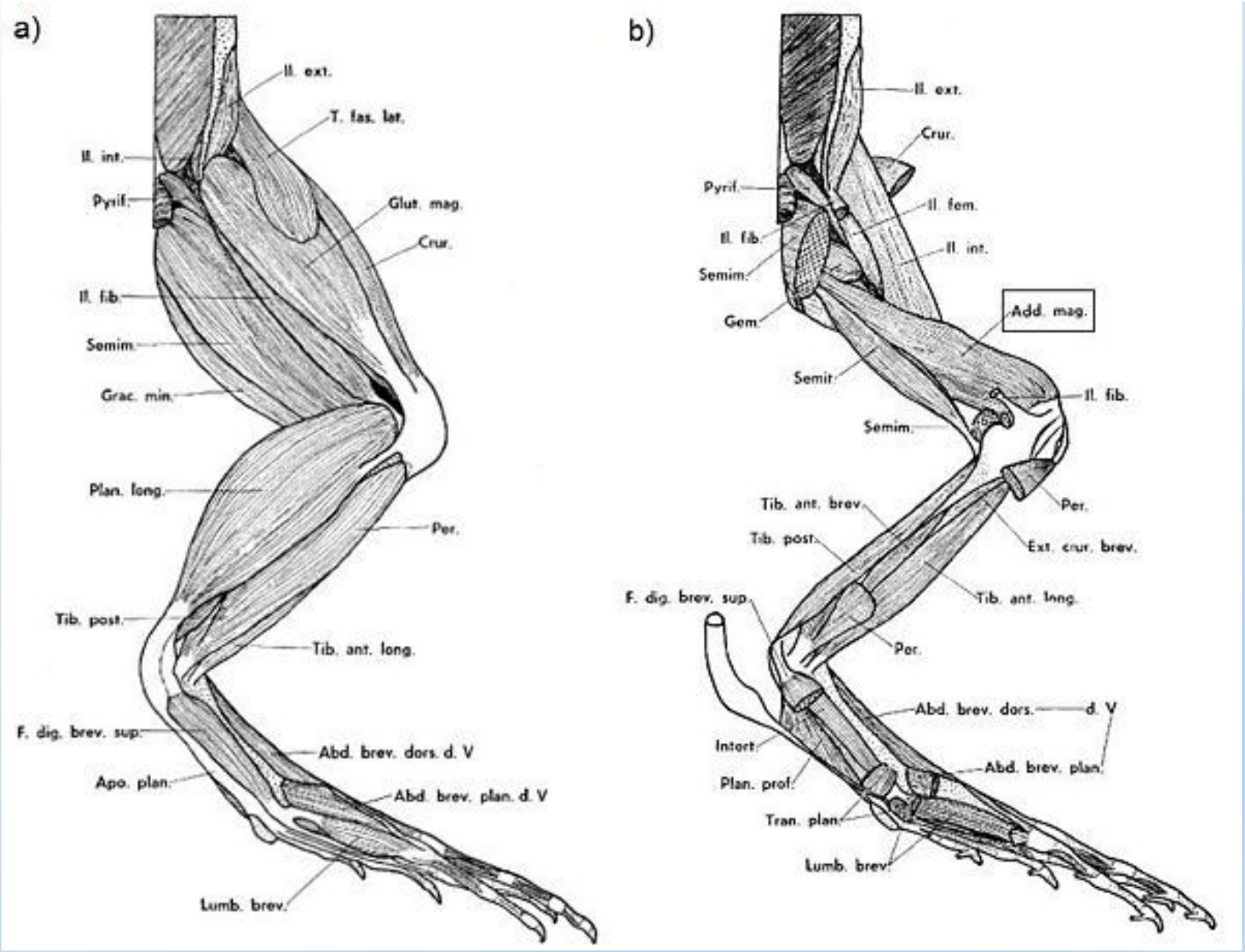


# Motor Unit Recruitment

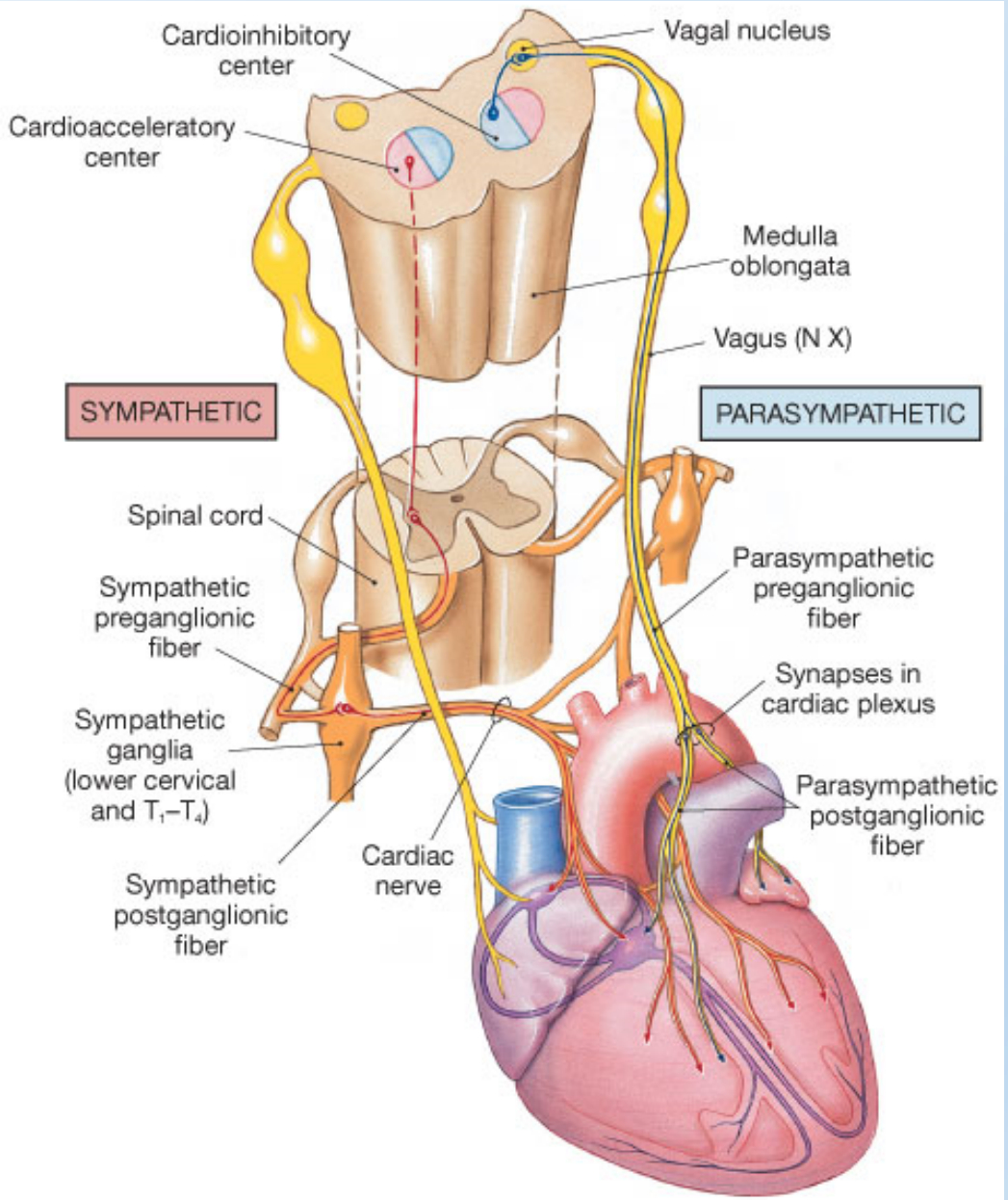


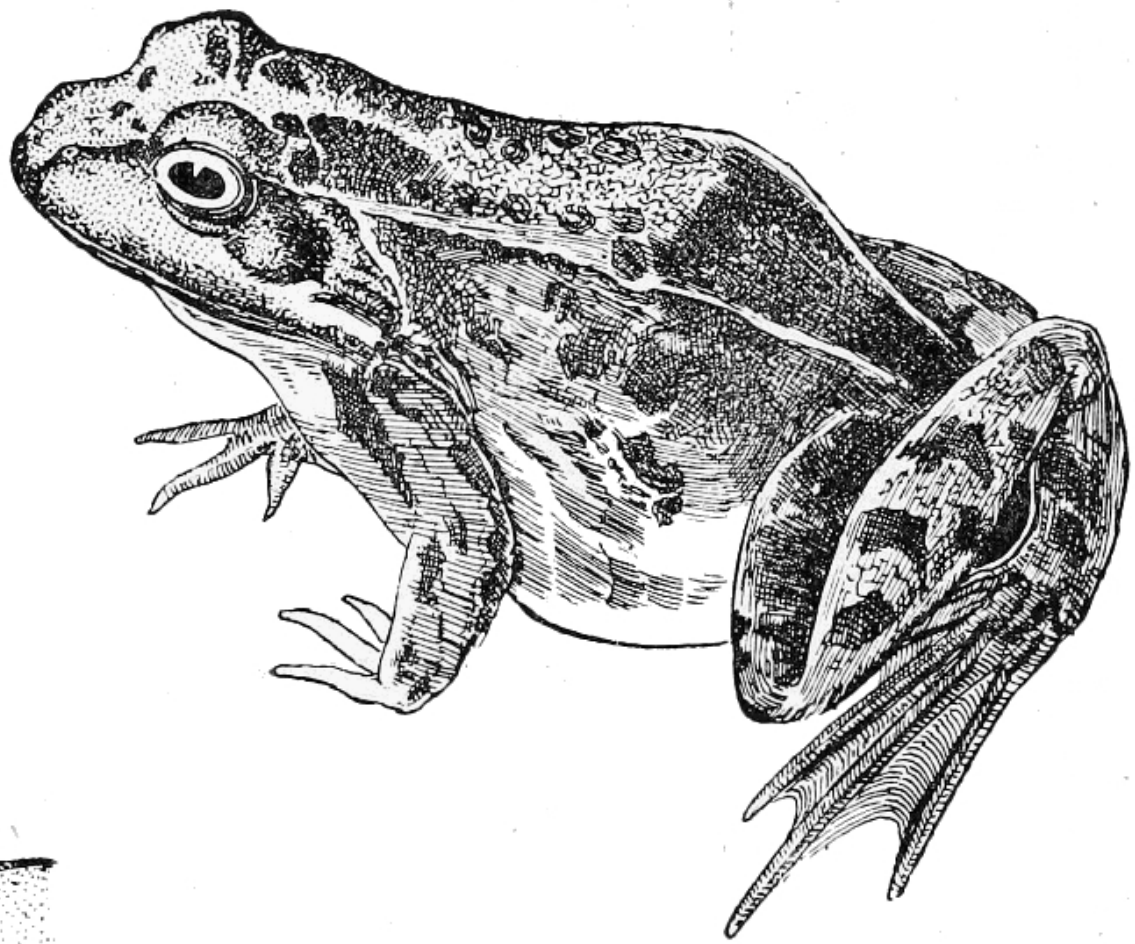
# 2nd Class Lever: FRE

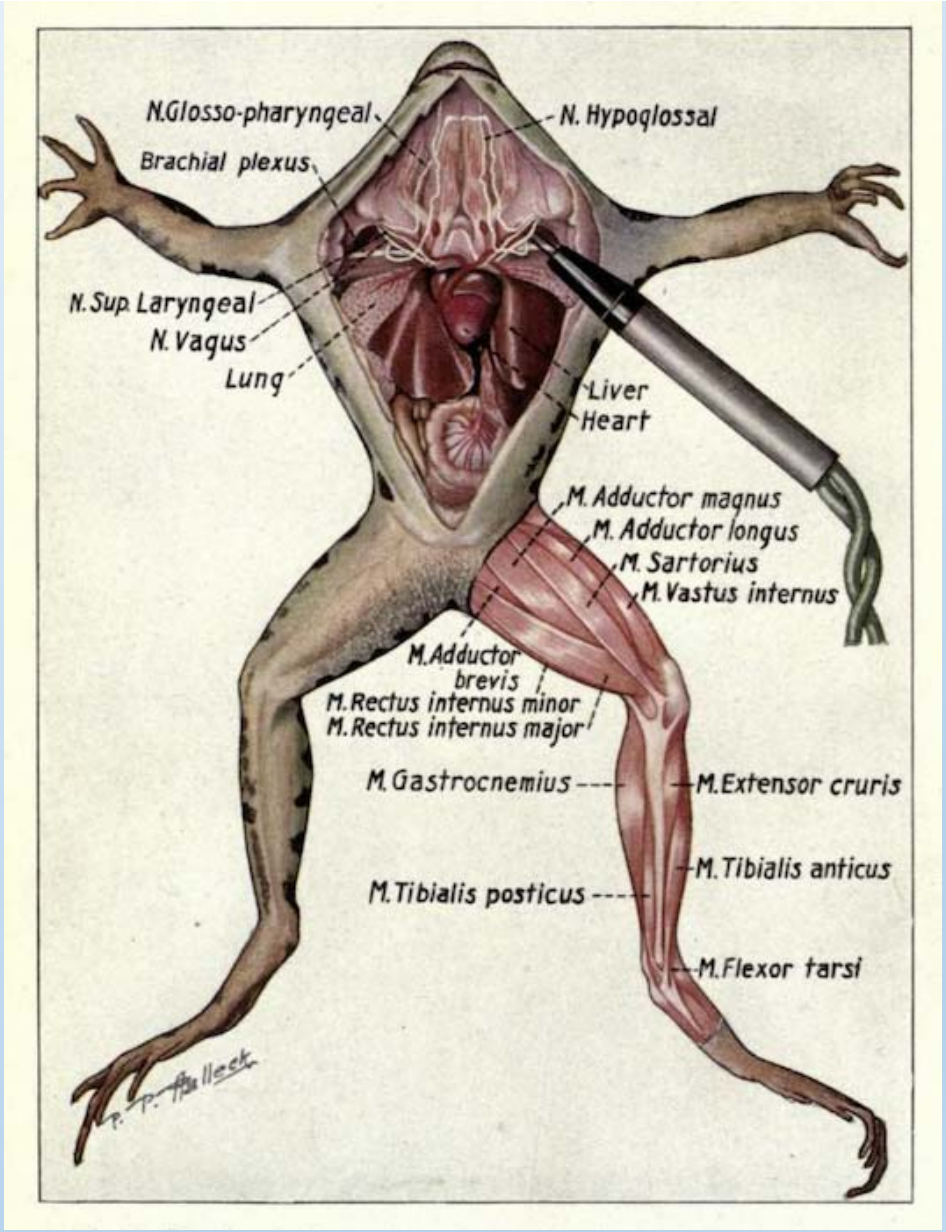


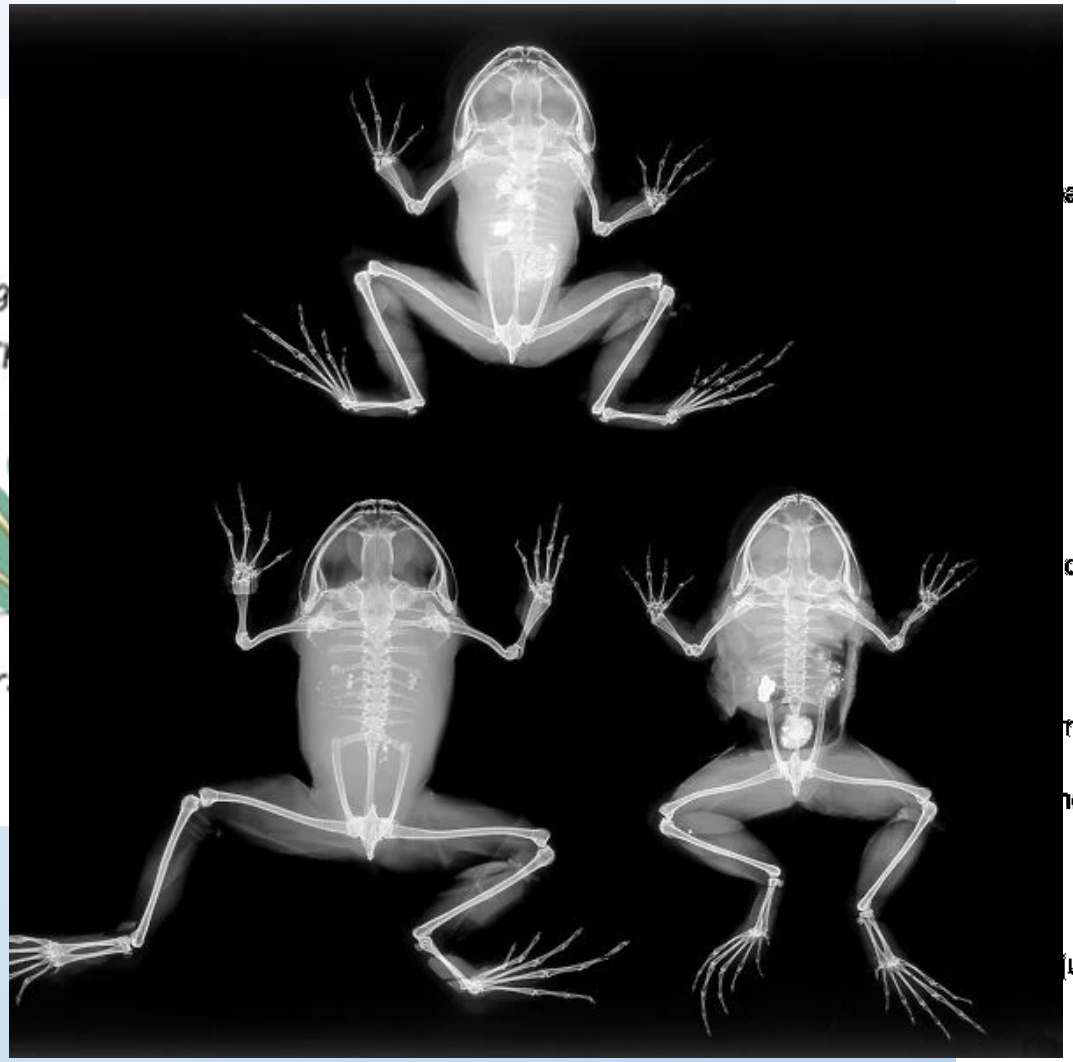

a)
Il. ext.
T. fas. lat.
Il. int.
Pyrif.
Glut. mag.
Crur.
Il. fib.
Semim.
Grac. min.
Plan. long.
Per.
Tib. post.
Tib. ant. long.
F. dig. brev. sup.
Abd. brev. dors. d. V
Apo. plan.
Abd. brev. plan. d. V
Lumb. brev.
b)
Il. ext.
Crur.
Pyrif.
Il. fem.
Il. fib.
Il. int.
Semim.
Add. mag.
Gem.
Semit.
Il. fib.
Semim.
Per.
Tib. ant. brev.
Tib. post.
Ext. crur. brev.
Tib. ant. long.
F. dig. brev. sup.
Per.
Abd. brev. dors.
d. V
Intort.
Abd. brev. plan.
Plan. prof.
Tran. plan.
Lumb. brev.

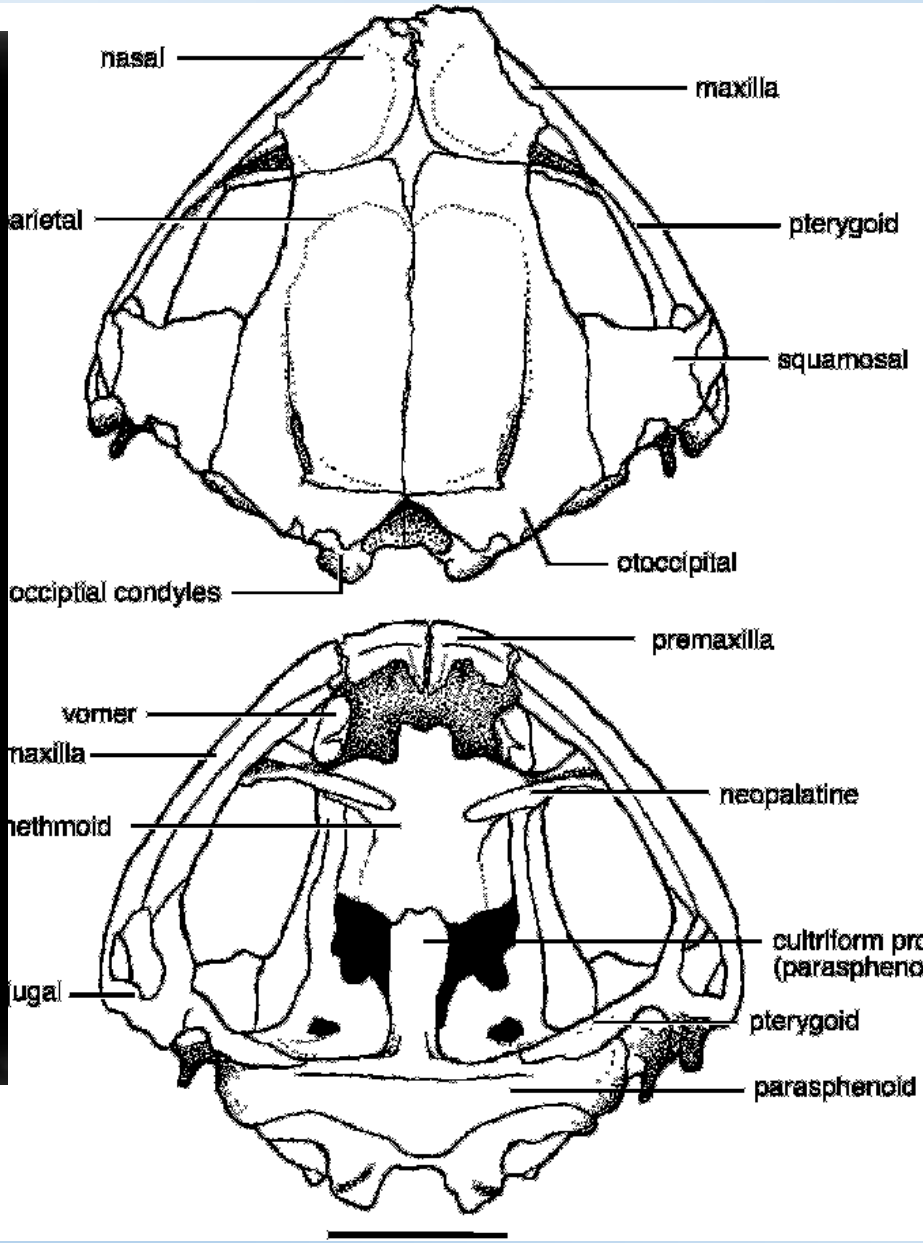
# The Autonomic Innervation of the Heart

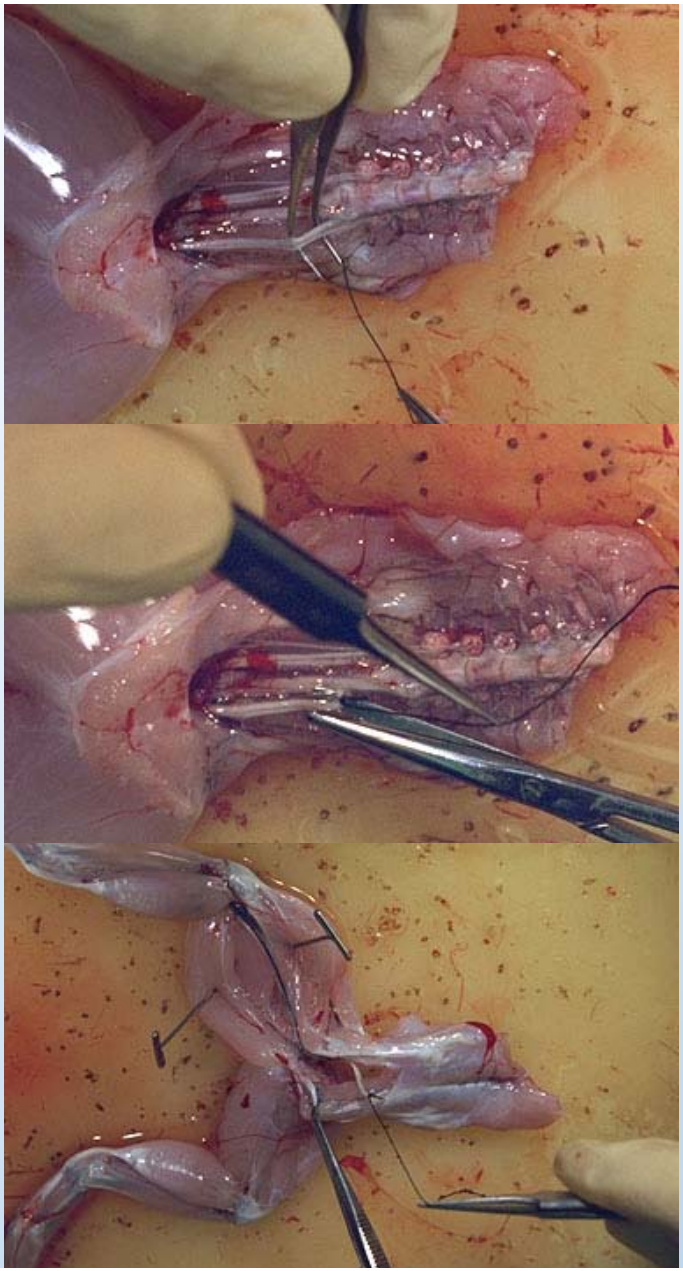


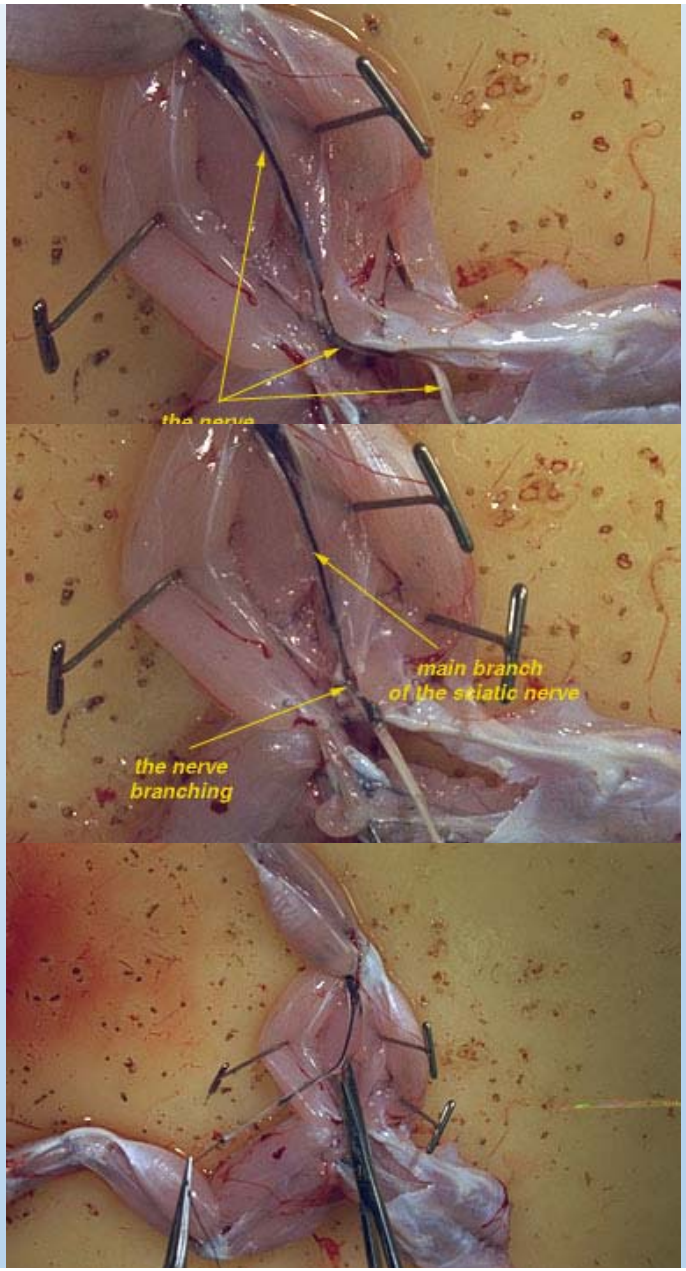


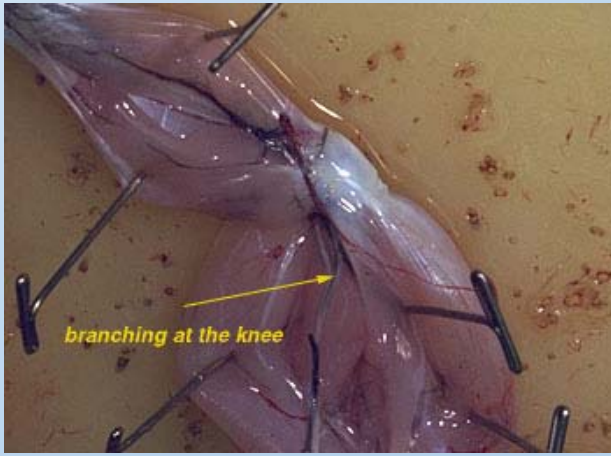

N.Glosso-pharyngeal
N. Hypoglossal
Brachial plexus
N. Sup. Laryngeal
N. Vagus
Lung
Liver
Heart
M. Adductor magnus
M. Adductor longus
M. Sartorius
M. Vastus internus
M. Adductor brevis
M. Rectus internus minor
M. Rectus internus major
M. Gastrocnemius
M. Extensor cruris
M. Tibialis anticus
M. Tibialis posticus
M. Flexor tarsi

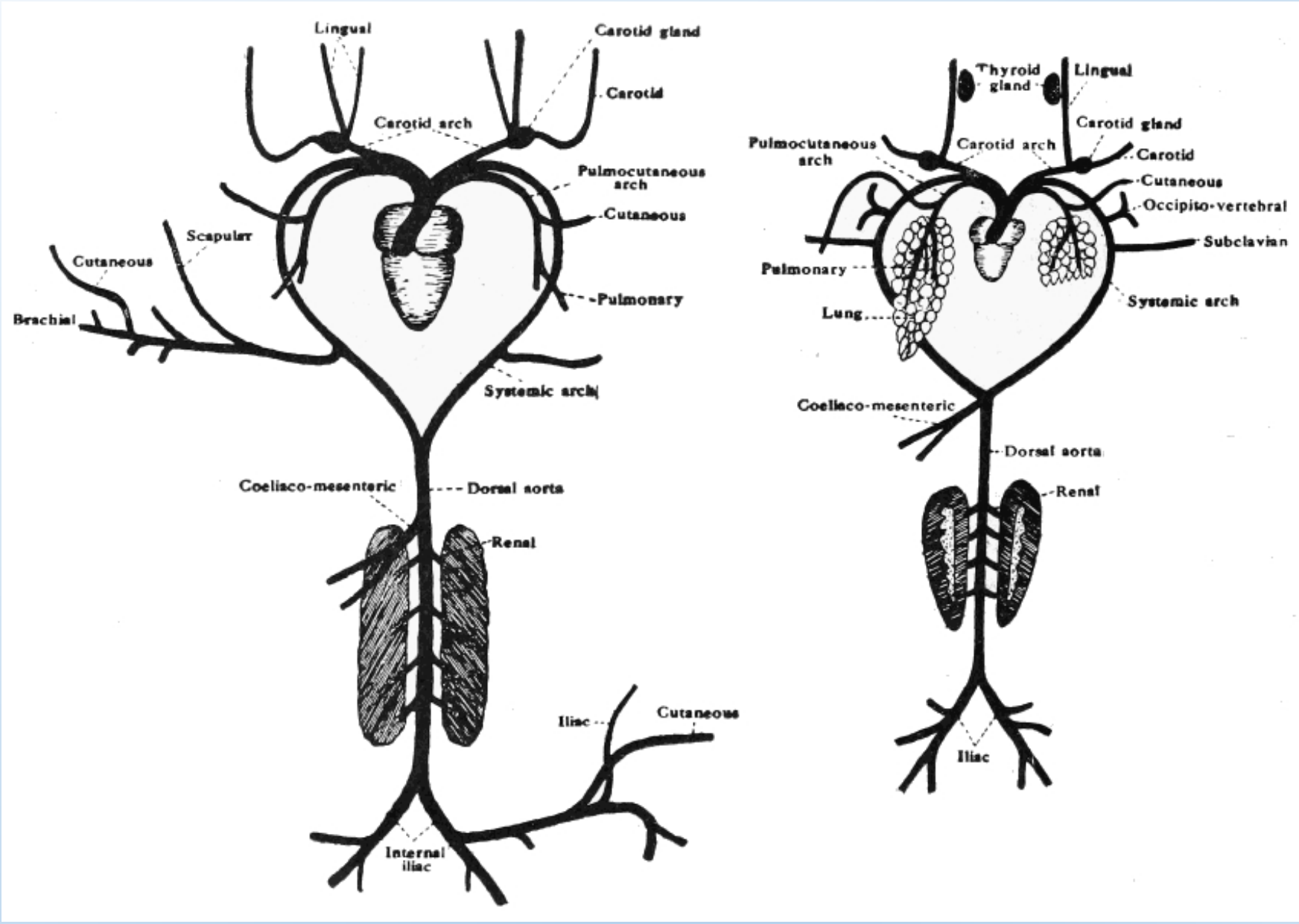


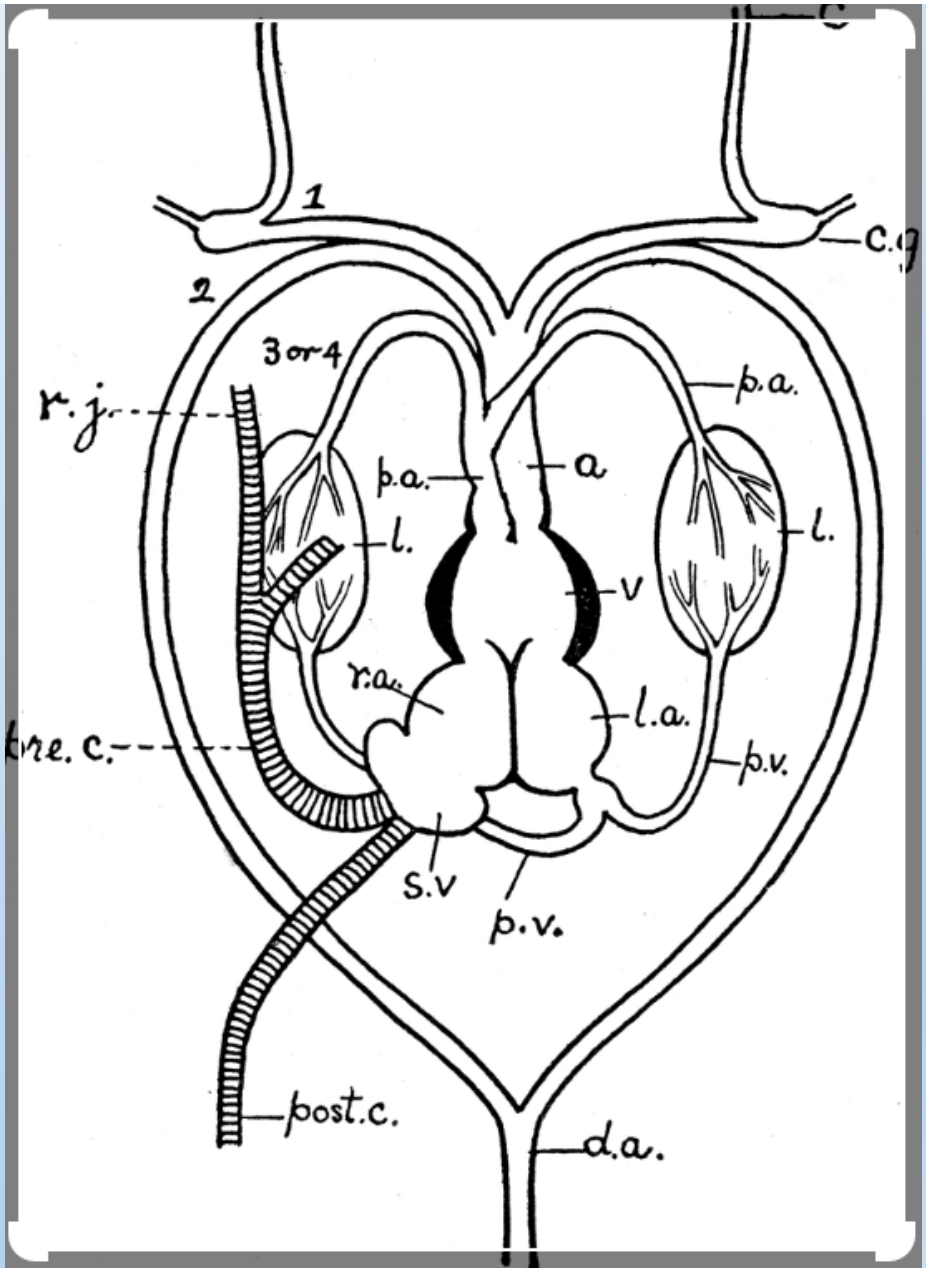

nasal
maxilla
arietal
pterygoid
squamosal
otoccipital
occiptial condyles
premaxilla
vomer
maxilla
neopalatine
ethmoid
cultriform process
(parasphenoid)
jugal
pterygoid
parasphenoid

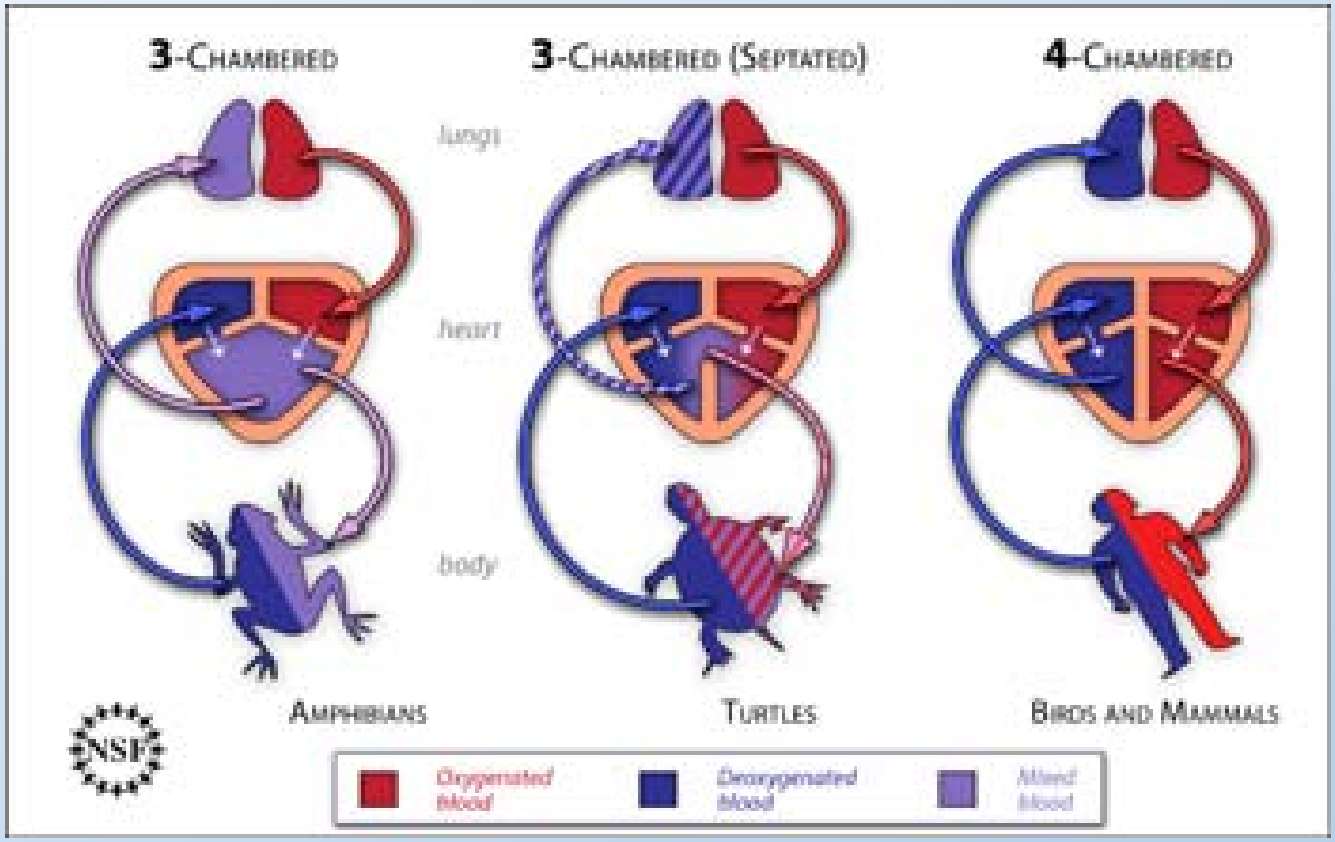


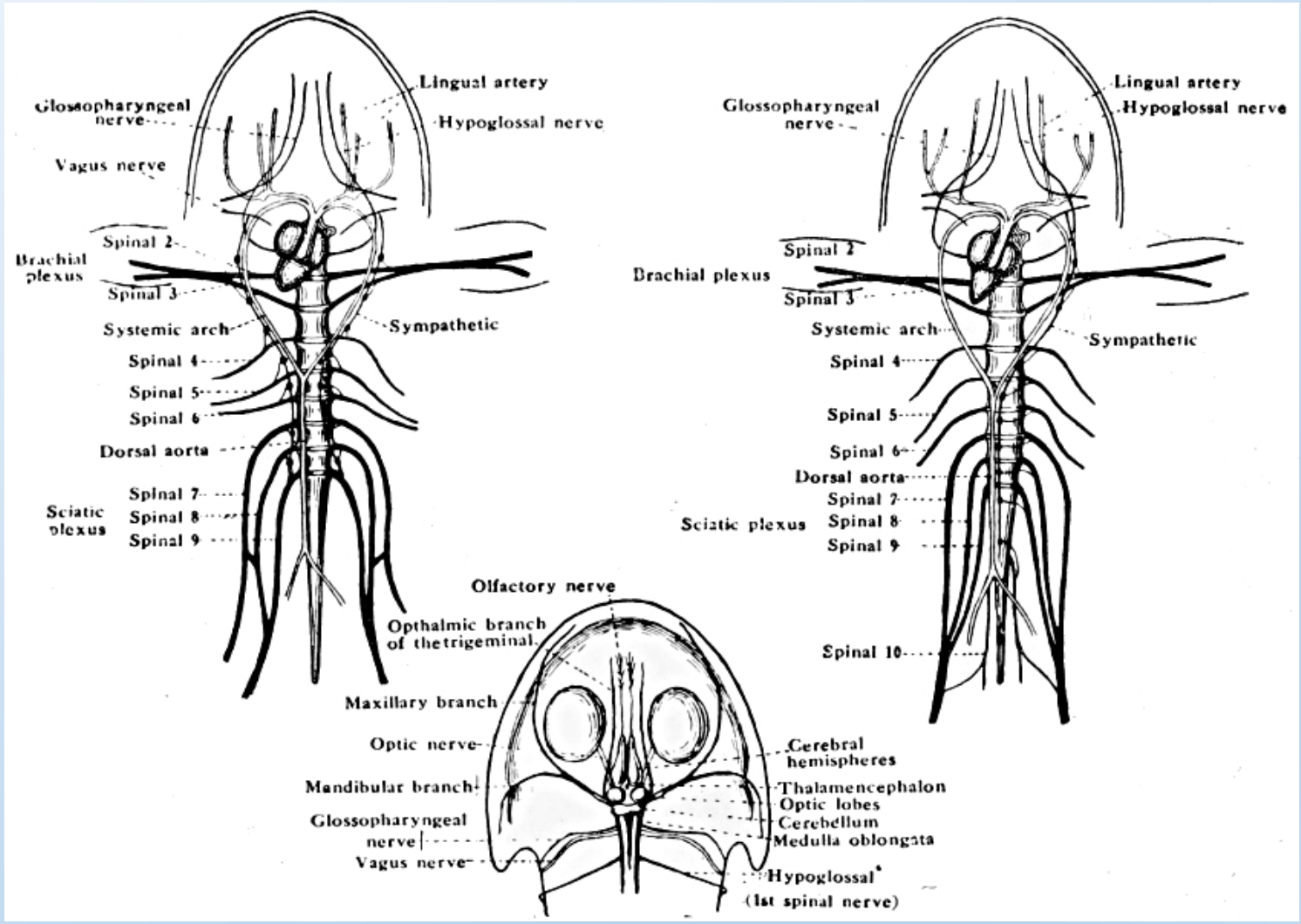

main branch
of the sciatic nerve
the nerve
branching

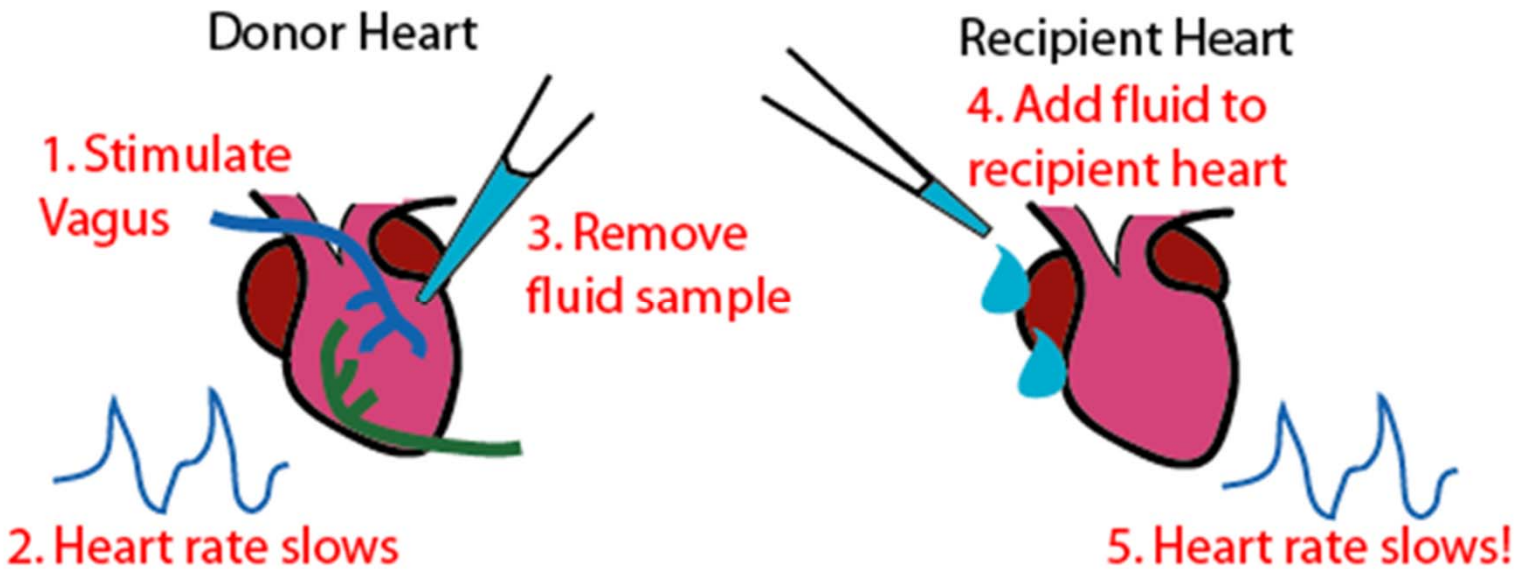

branching at the knee


Lingual
Carotid gland
Carotid
Carotid arch
Pulmocutaneous arch
Cutaneous
Scapular
Cutaneous
Brachial
Pulmonary
Systemic arch
Coeliaco-mesenteric
Dorsal aorta
Renal
Iliac
Cutaneous
Internal iliac
Thyroid gland
Lingual
Carotid gland
Pulmocutaneous arch
Carotid arch
Carotid
Cutaneous
Occipito-vertebral
Subclavian
Pulmonary
Lung
Systemic arch
Coeliaco-mesenteric
Dorsal aorta
Renal
Iliac

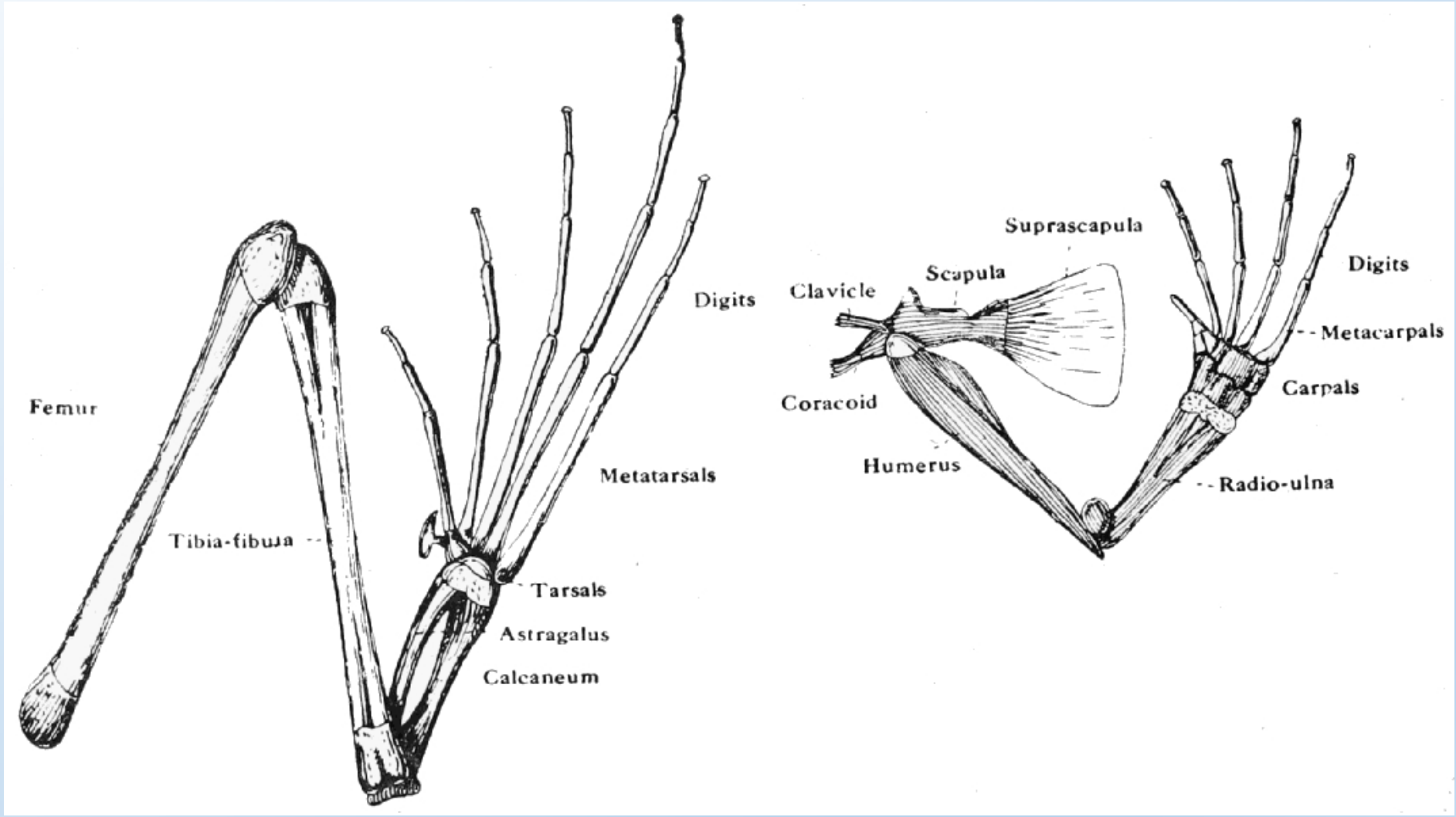

1
2
3 or 4
r. j.
p.a.
a
l.
v
r.a.
l.a.
p.v.
S.V
post.c.
d.a.


3-Chambered
3-Chambered (Septated)
4-Chambered
lungs
heart
body
Amphibians
Turtles
Birds and Mammals
NSF
Oxygenated blood
Deoxygenated blood
Mixed blood


Glossopharyngeal nerve
Lingual artery
Hypoglossal nerve
Vagus nerve
Spinal 2
Brachial plexus
Spinal 3
Systemic arch
Sympathetic
Spinal 4
Spinal 5
Spinal 6
Dorsal aorta
Spinal 7
Sciatic plexus
Spinal 8
Spinal 9
Olfactory nerve
Opthalmic branch of thetrigeminal
Maxillary branch
Optic nerve
Mandibular branch
Glossopharyngeal nerve
Vagus nerve
Cerebral hemispheres
Thalamencephalon
Optic lobes
Cerebellum
Medulla oblongata
Hypoglossal
(1st spinal nerve)
Glossopharyngeal nerve
Lingual artery
Hypoglossal nerve
Brachial plexus
Spinal 2
Spinal 3
Systemic arch
Sympathetic
Spinal 4
Spinal 5
Spinal 6
Dorsal aorta
Spinal 7
Sciatic plexus
Spinal 8
Spinal 9
Spinal 10




**Stannius ligature**


Femur
Tibia-fibula
Digits
Metatarsals
Tarsals
Astragalus
Calcaneum
Suprascapula
Scapula
Clavicle
Coracoid
Humerus
Digits
Metacarpals
Carpals
Radio-ulna