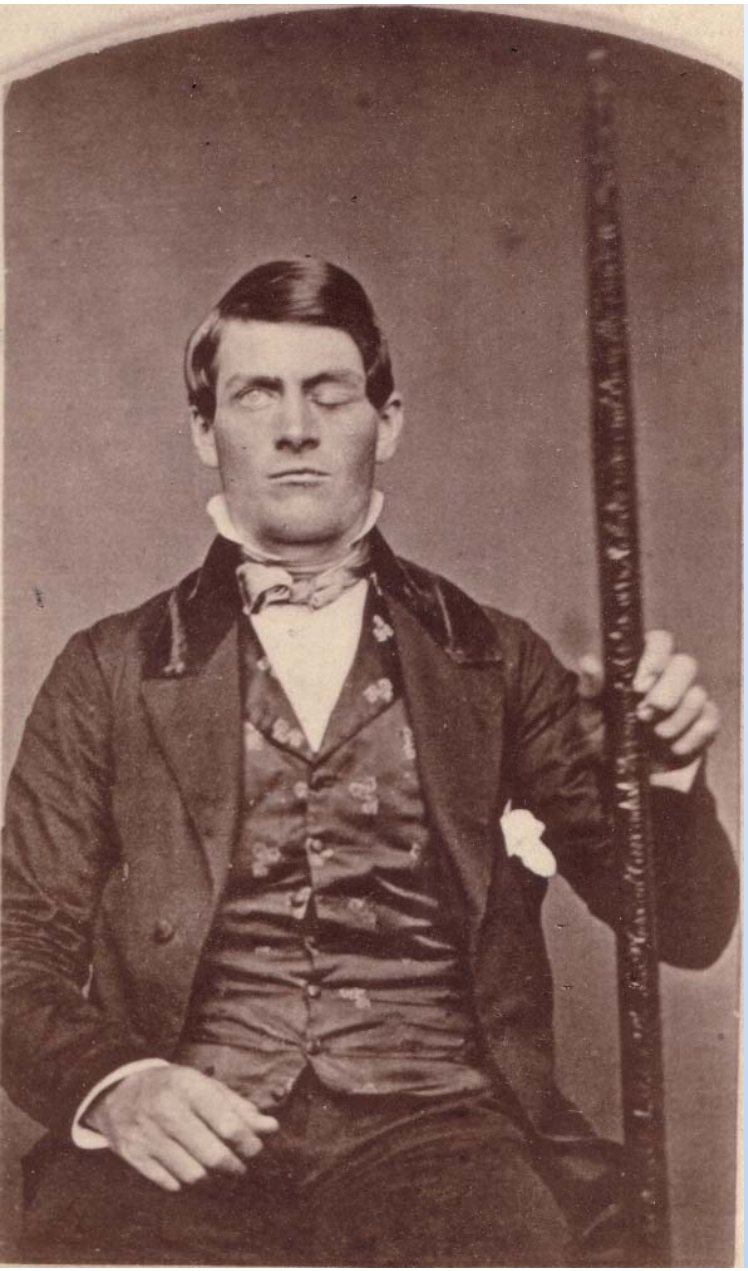
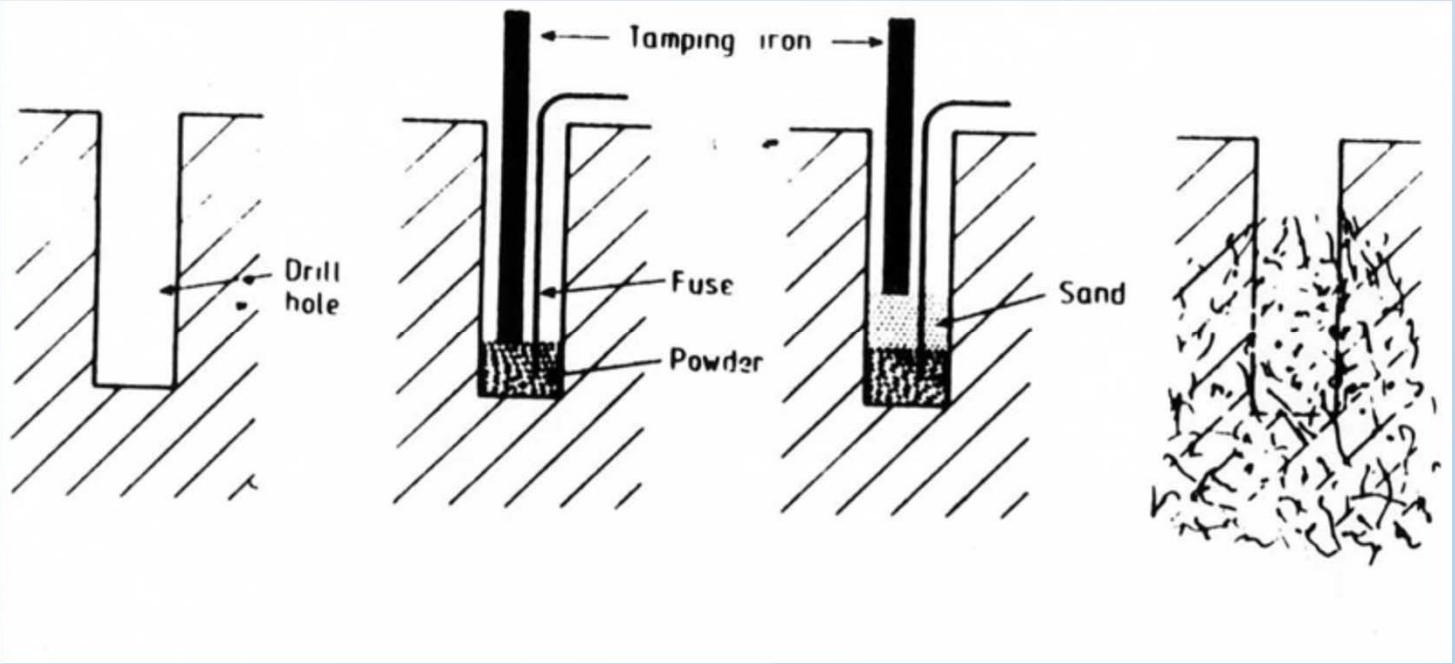
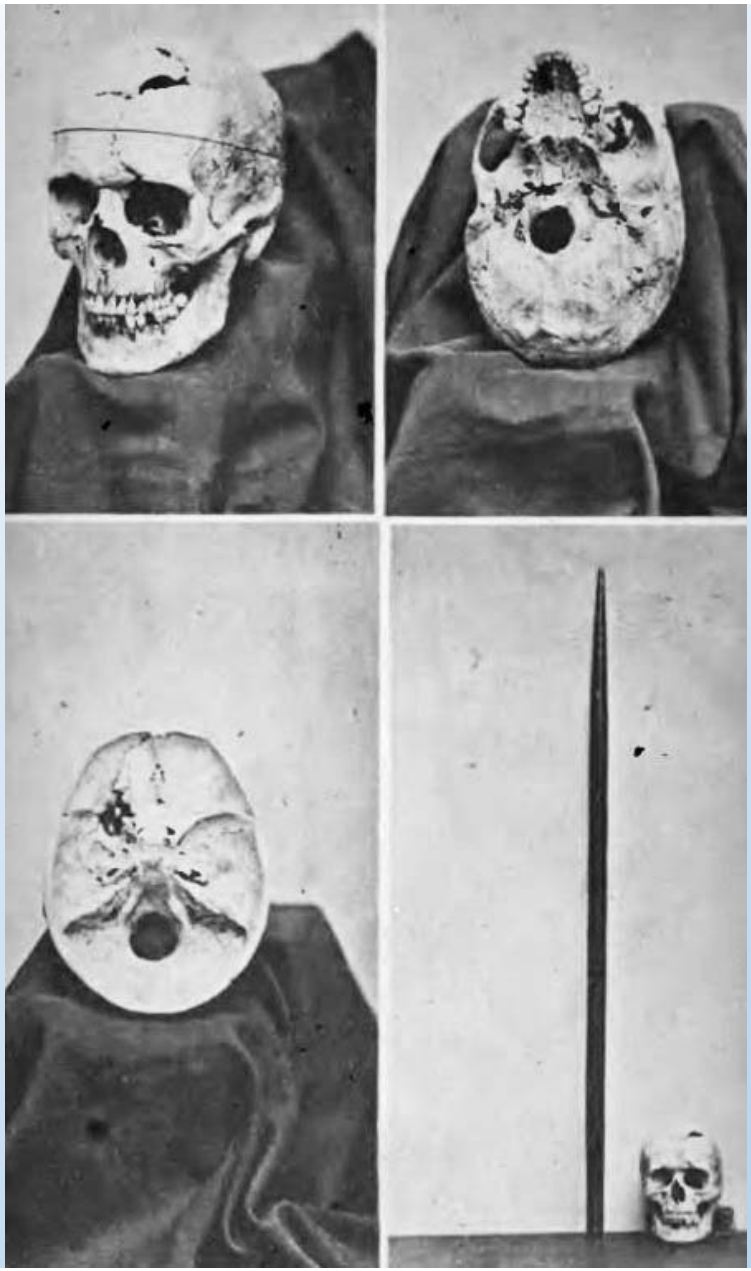


Neuroanatomy

Phineas P. Gage (1823 –1860), age 25 in 1848

The accident





The mother and friends, … placed this skull in my hands, for the benefit of science.

Resources

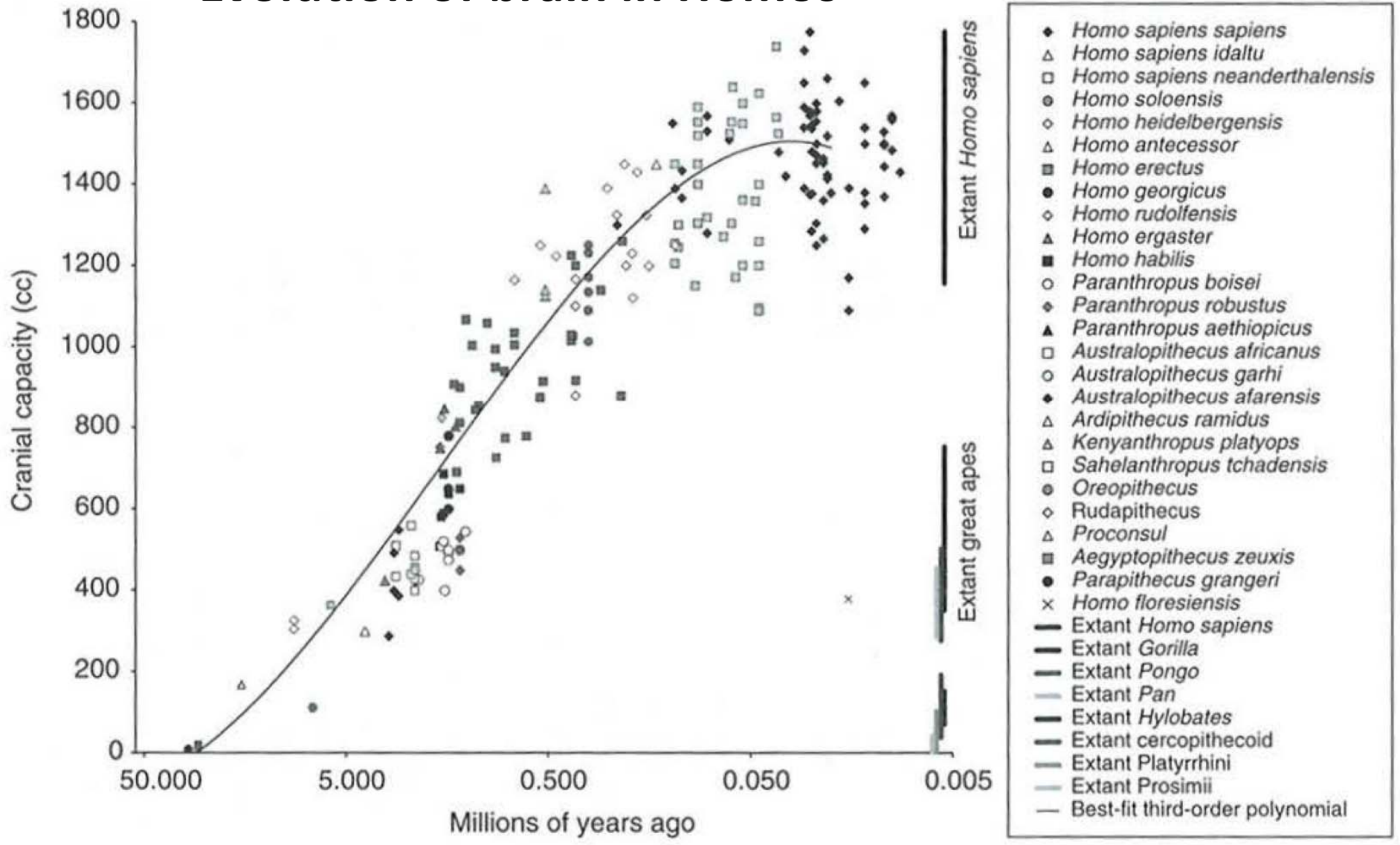
3-D Brain App, by Cold Spring Harbor Laboratory.

A very useful 3D model of the brain. It has descriptions of various brain structures, associated functions, associated cognitive disorders, research reviews etc. It was accessible with the internet browser, but that site used Flash, it does not work anymore. You have to download the App. The The You can get the free 3D Brain app from Google play and Windows Phone and the App Store from Apple.

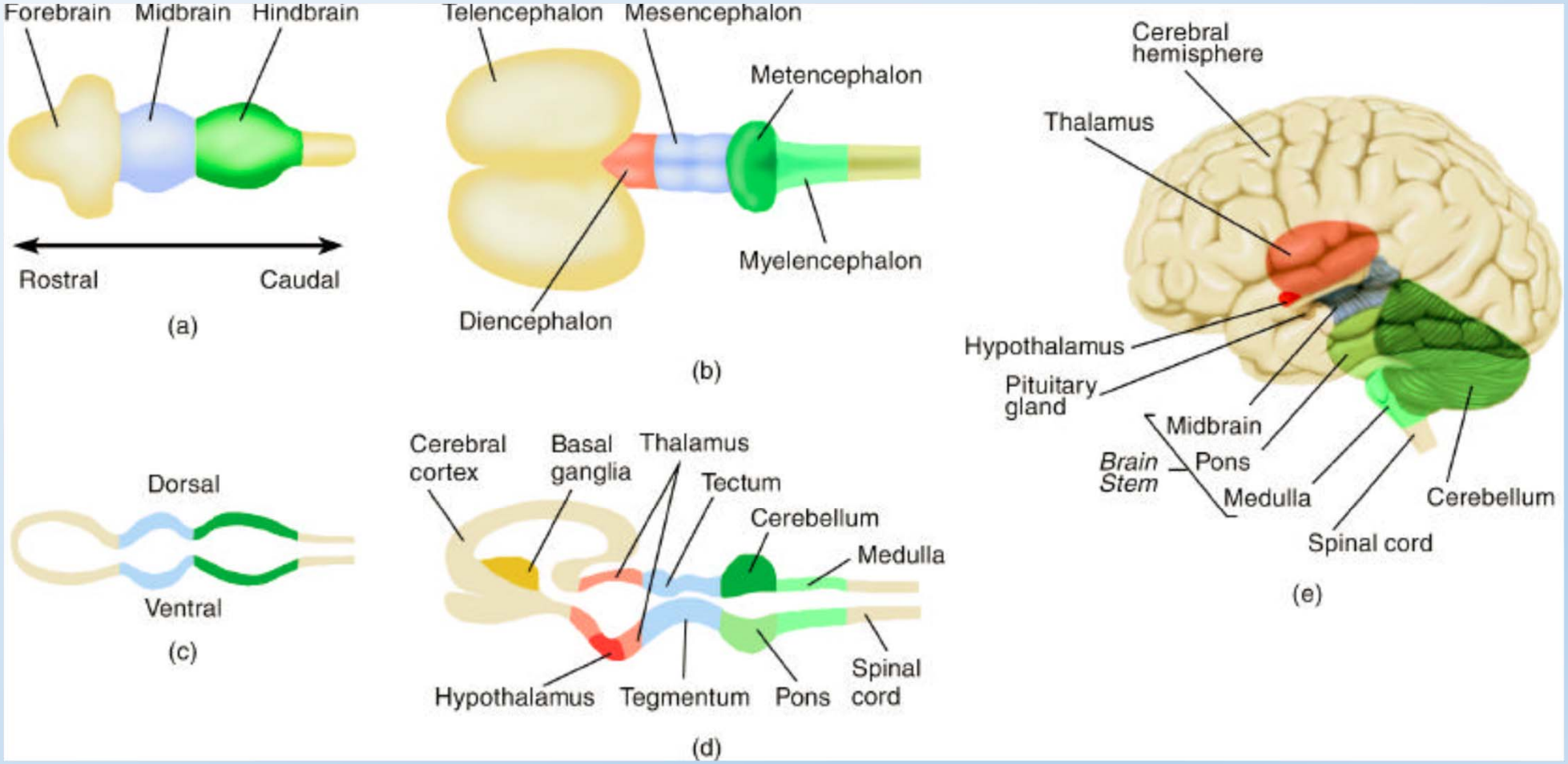
The Human Brain by Anatomie-Amsterdam
https://anatomy-neurosciences.com/education/humanbrain/

Brain atlas for educational purposes, with clear interactive images. Includes external views of the brain and cerebellum, cerebrum slices , white matter, tracts and MRI scans. (Move the cursor over the image to see the labels).

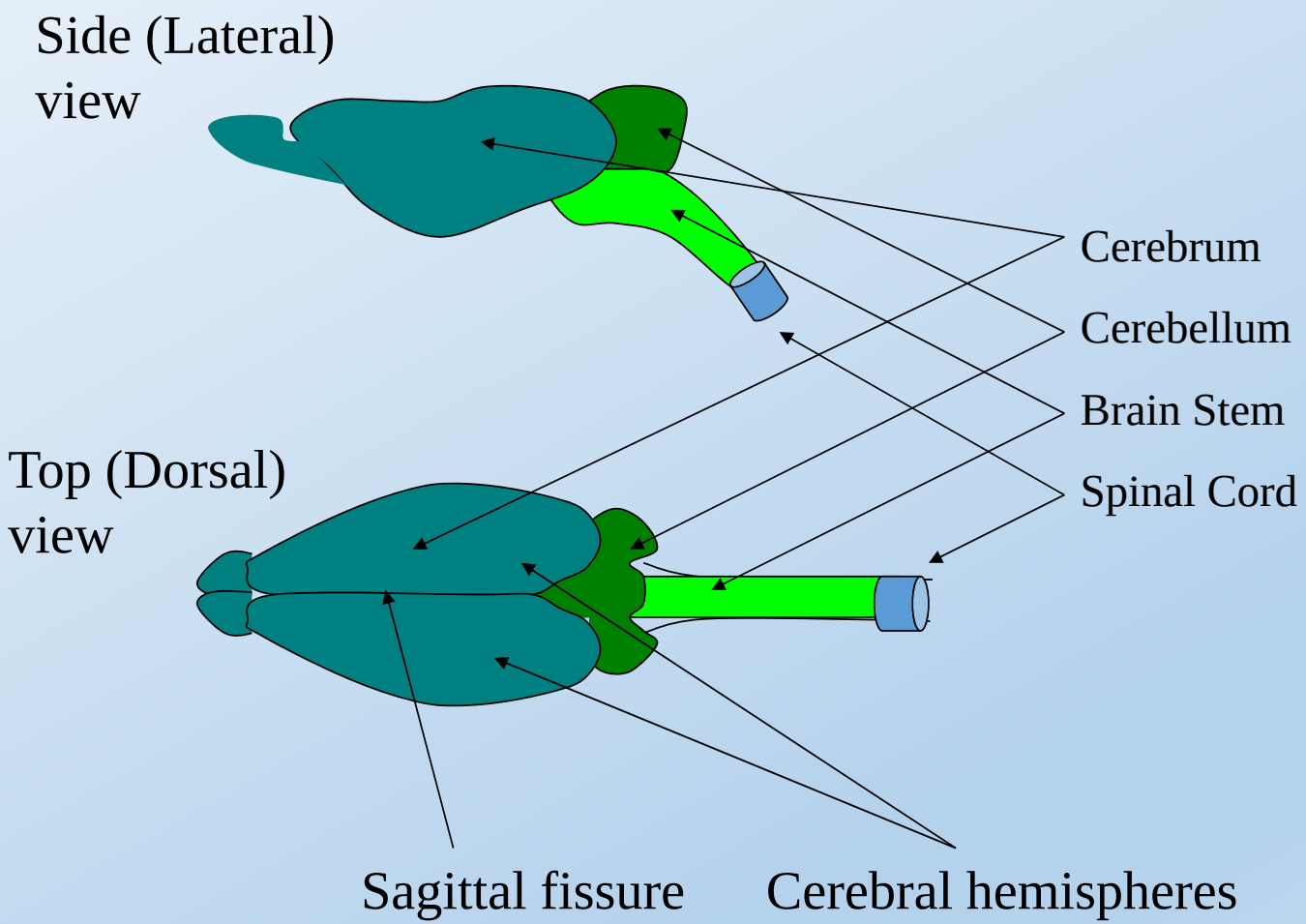
Evolution of brain in Homos



Basic patterns



Mouse brain


Side (Lateral) view
Cerebrum
Cerebellum
Brain Stem
Spinal Cord
Top (Dorsal) view
Sagittal fissure
Cerebral hemispheres

Dura mater (Hard Mother)

Subdural space

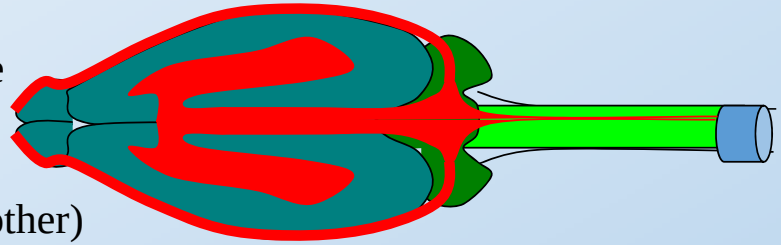
Arachnoid membrane

Subarachnoid space

Pia mater (Gentle Mother)

Artery

Brain



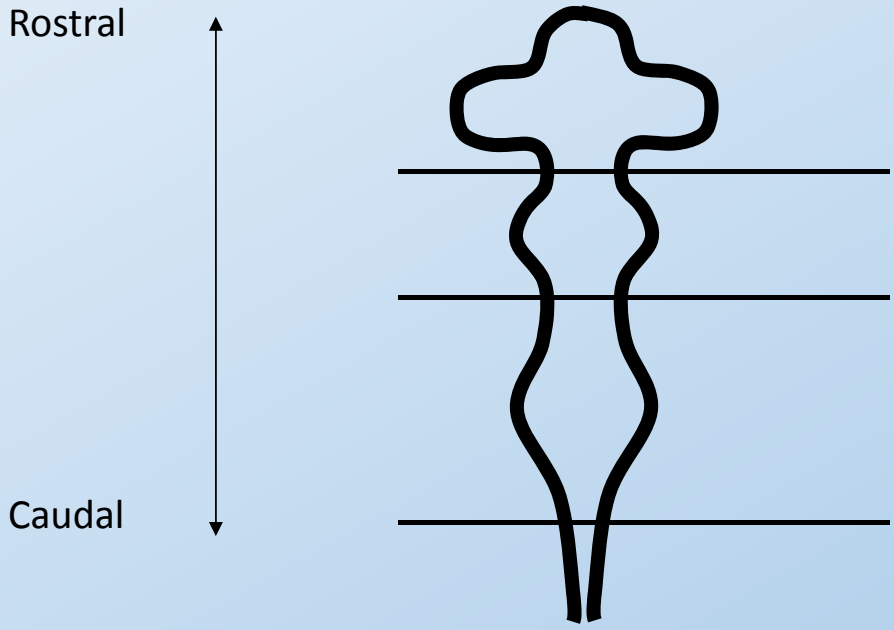
Ventricles

CSF (Cerebro-spinal Fluid)

Early development of nervous system in embryo

Neural Plate → Neural Groove → Neural Tube

Fuse Dorsally



*Pros*encephalon

(forebrain)

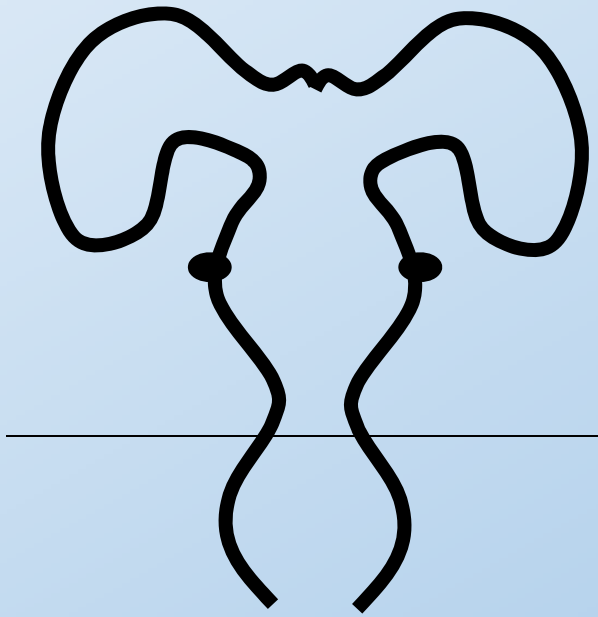
*Mes*encephalon

(midbrain)

*Rhomb*encephalon

(hindbrain)

Development of nervous system in embryo



*Tel*encephalon

(2 cerebral hemespheres)

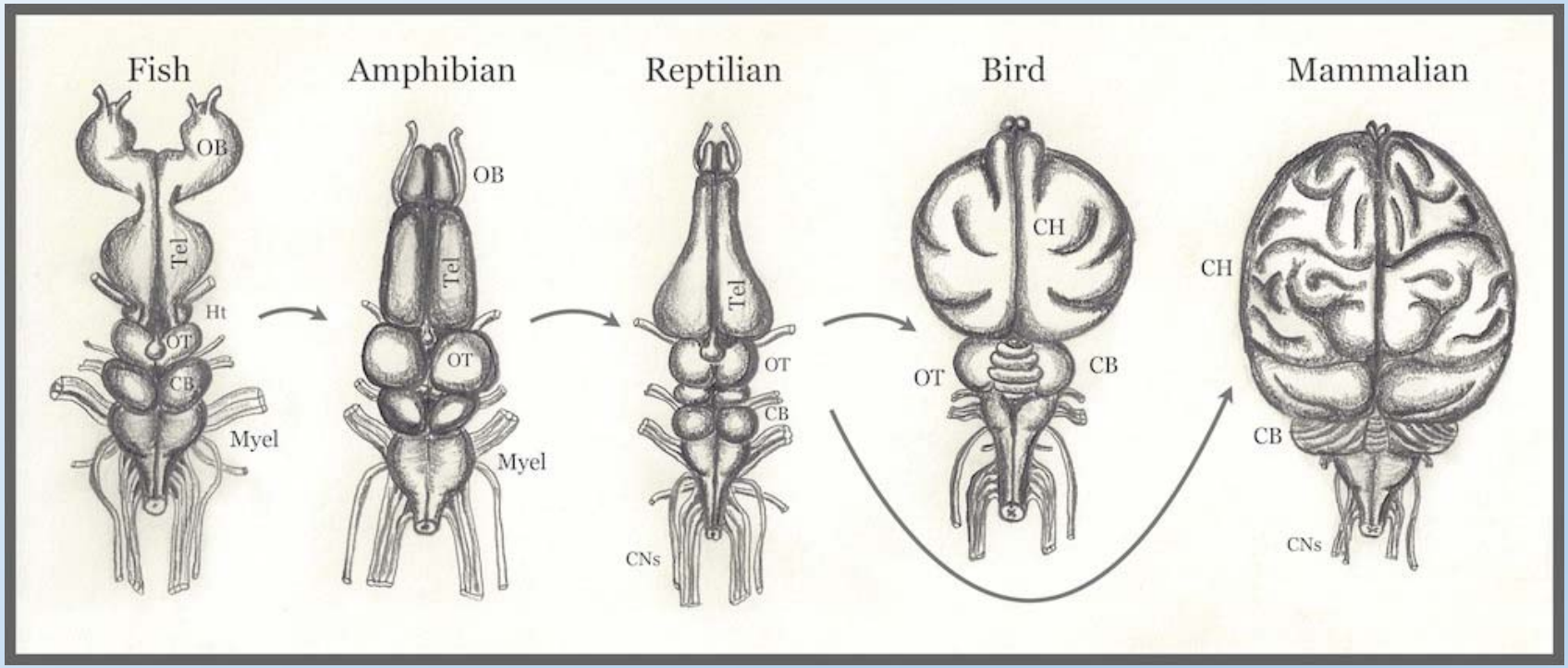
*Di*encephalon

(between brain)

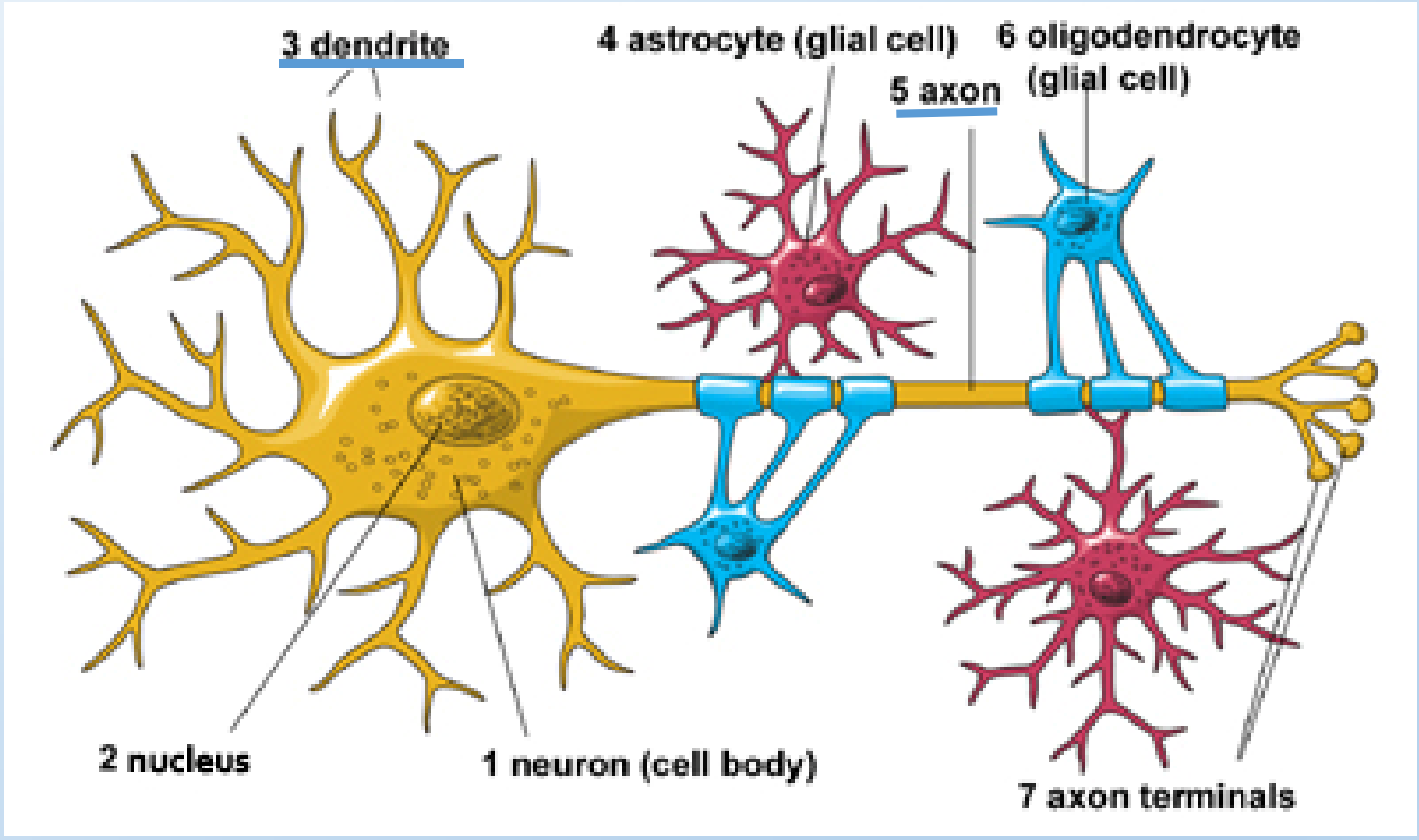
Mesencephalon

(Midbain)

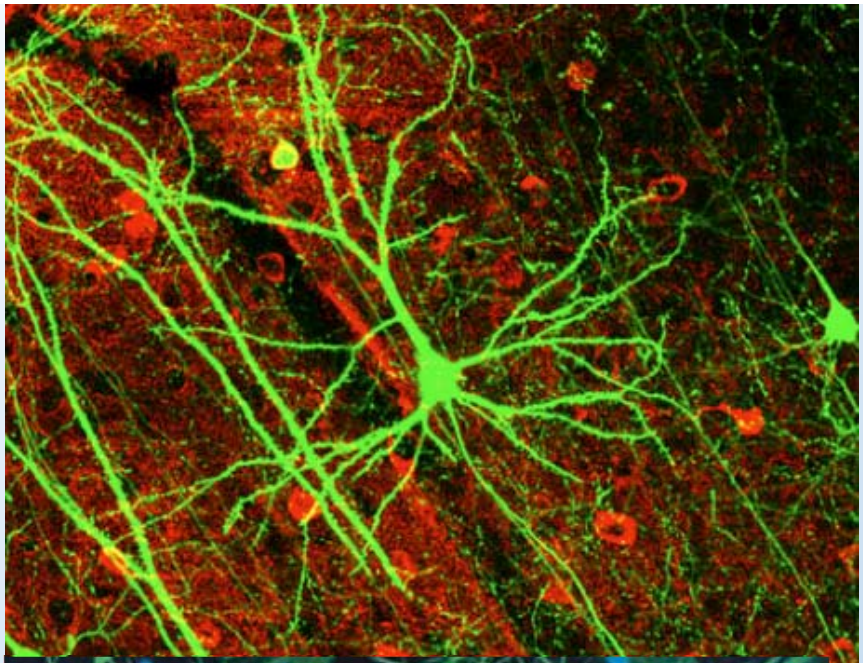
The evolution of brain

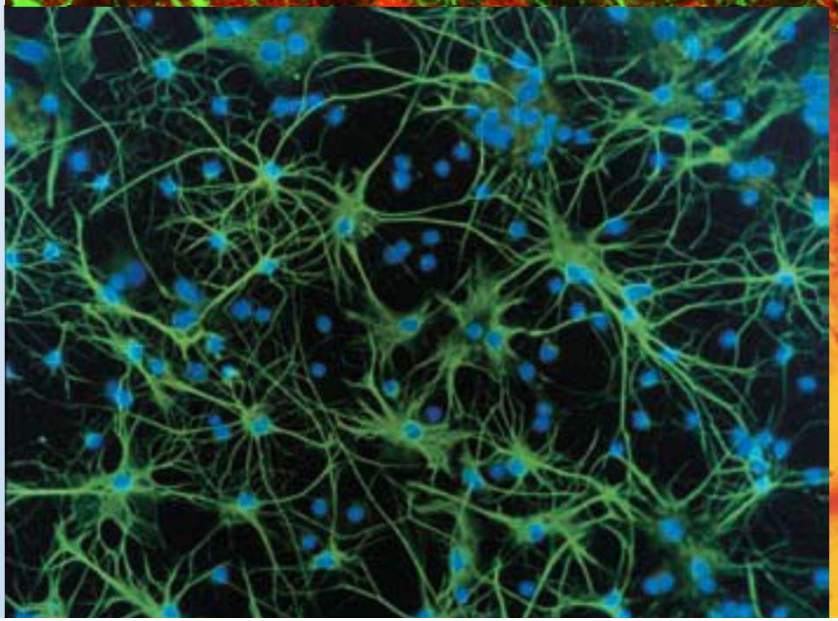


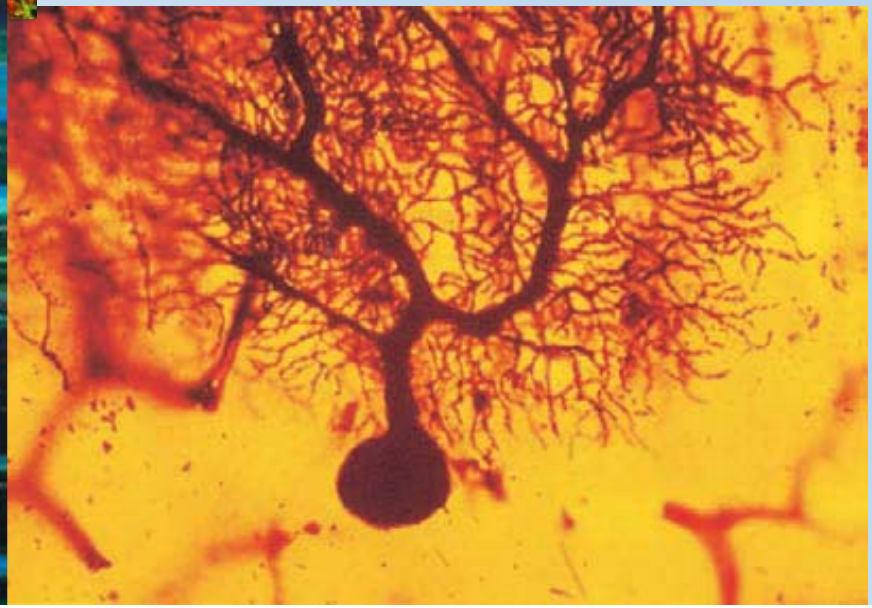
Building blocks of brain



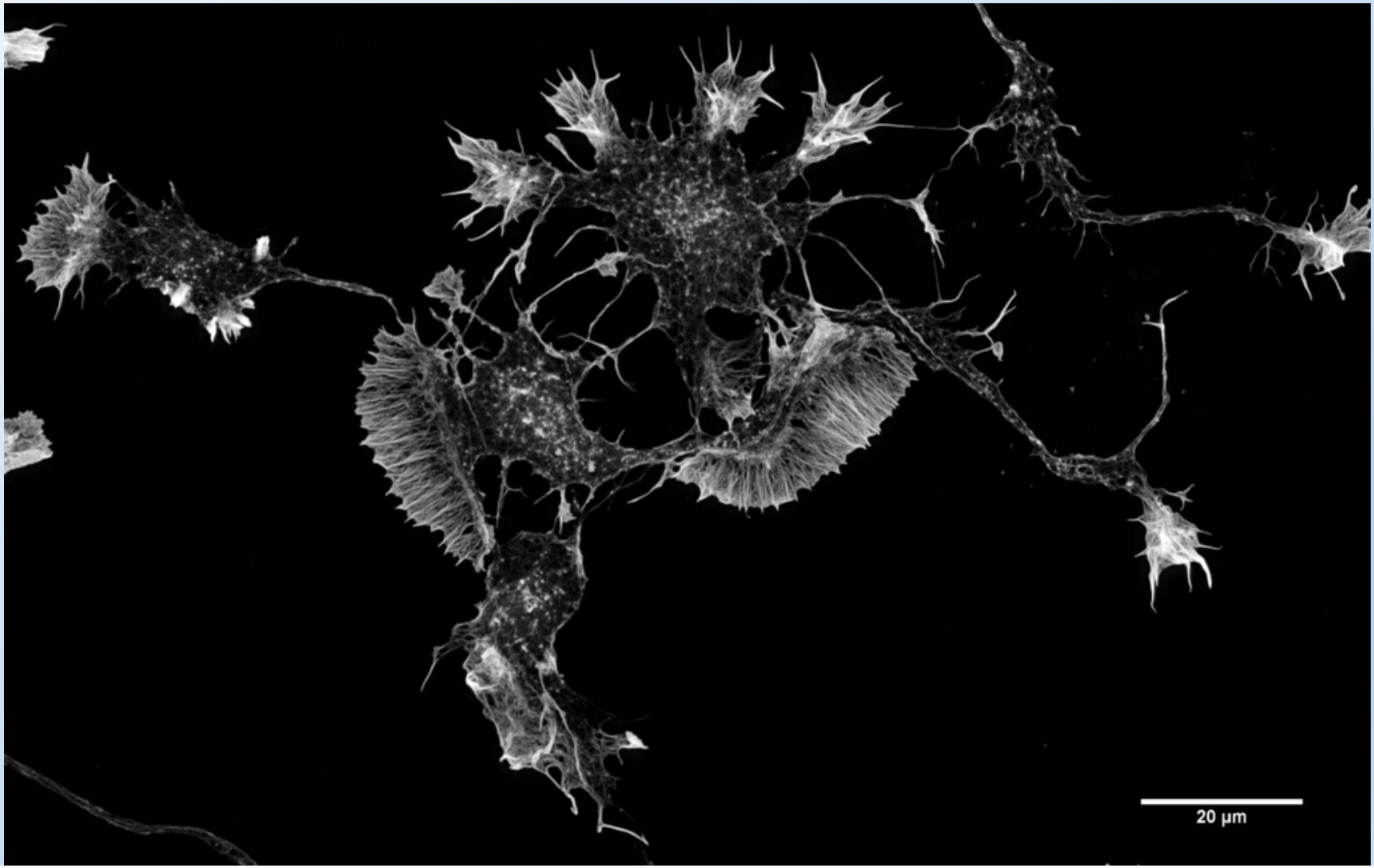
Neurons



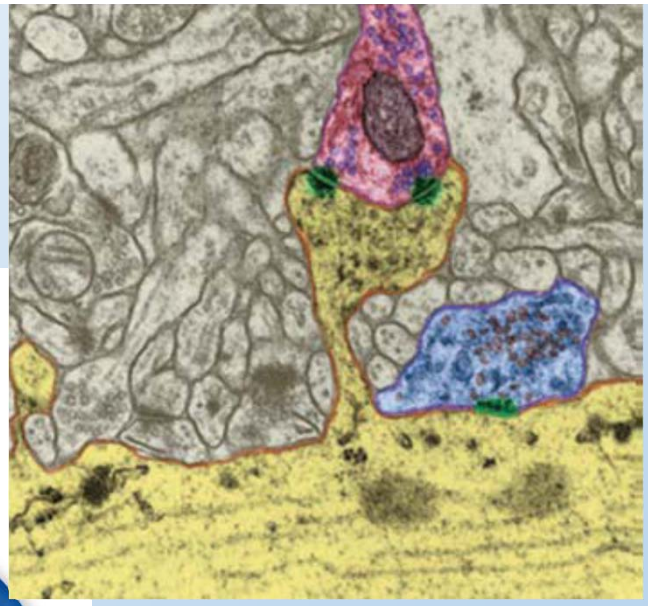


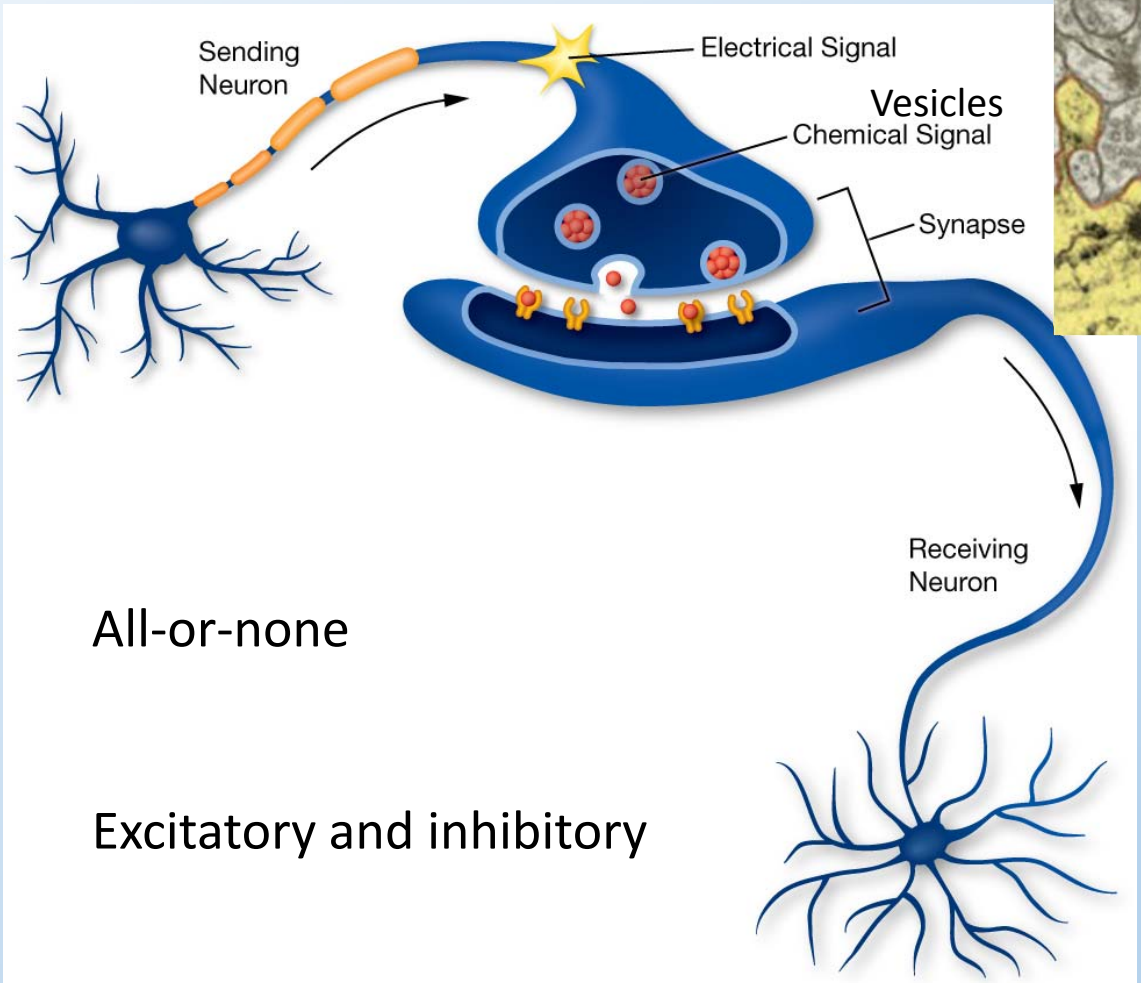


培养基中的神经元



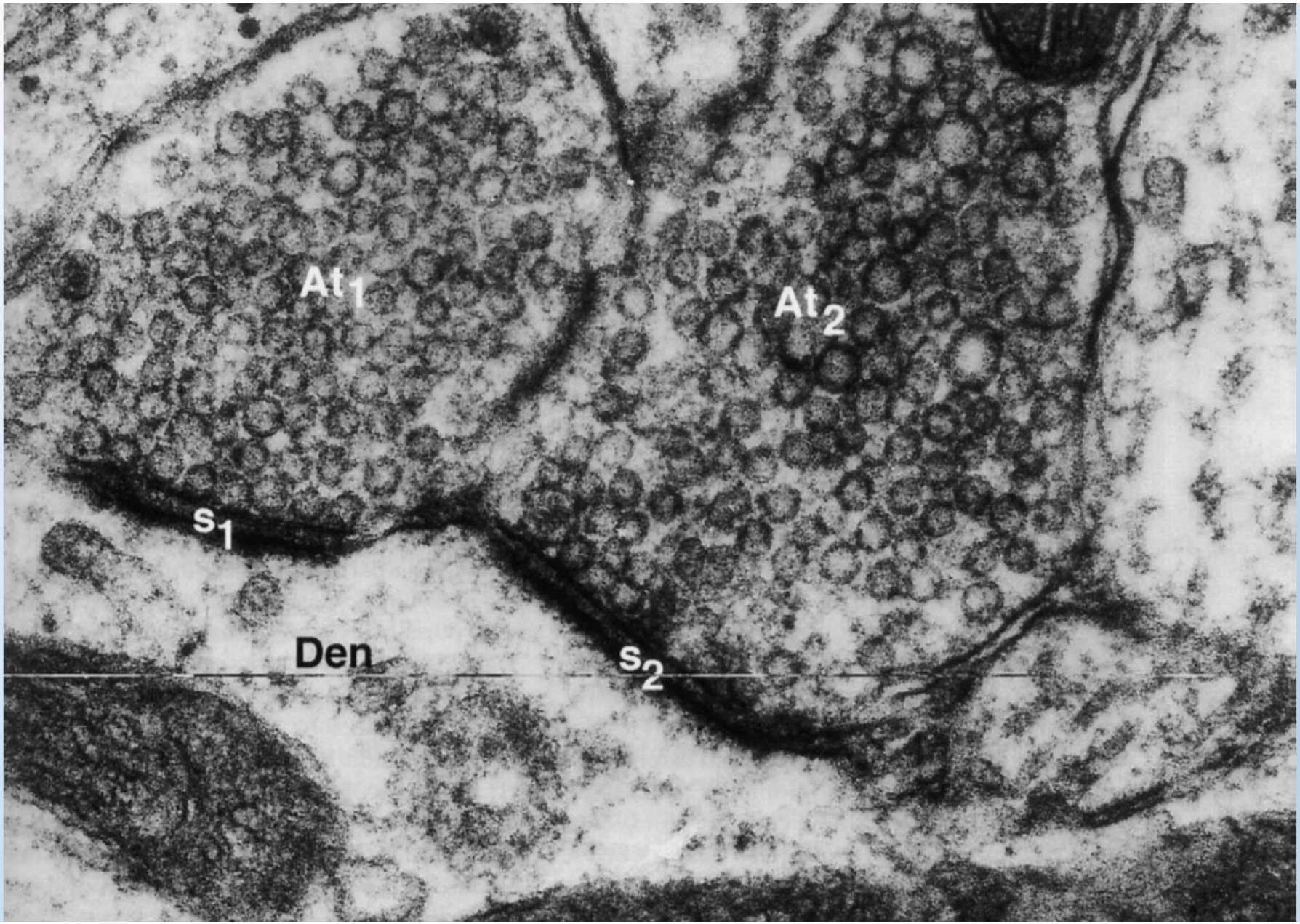
The way neuron works



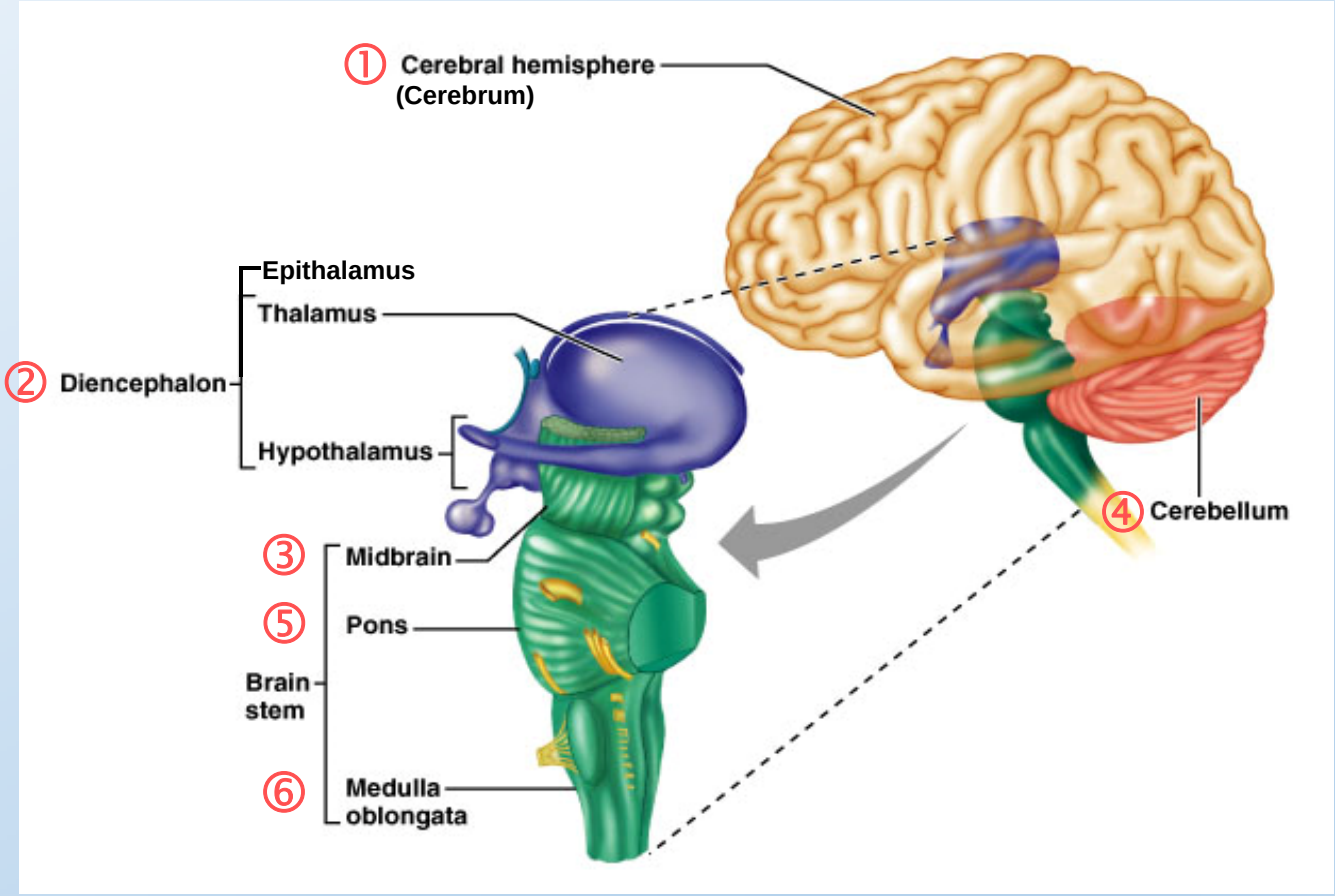


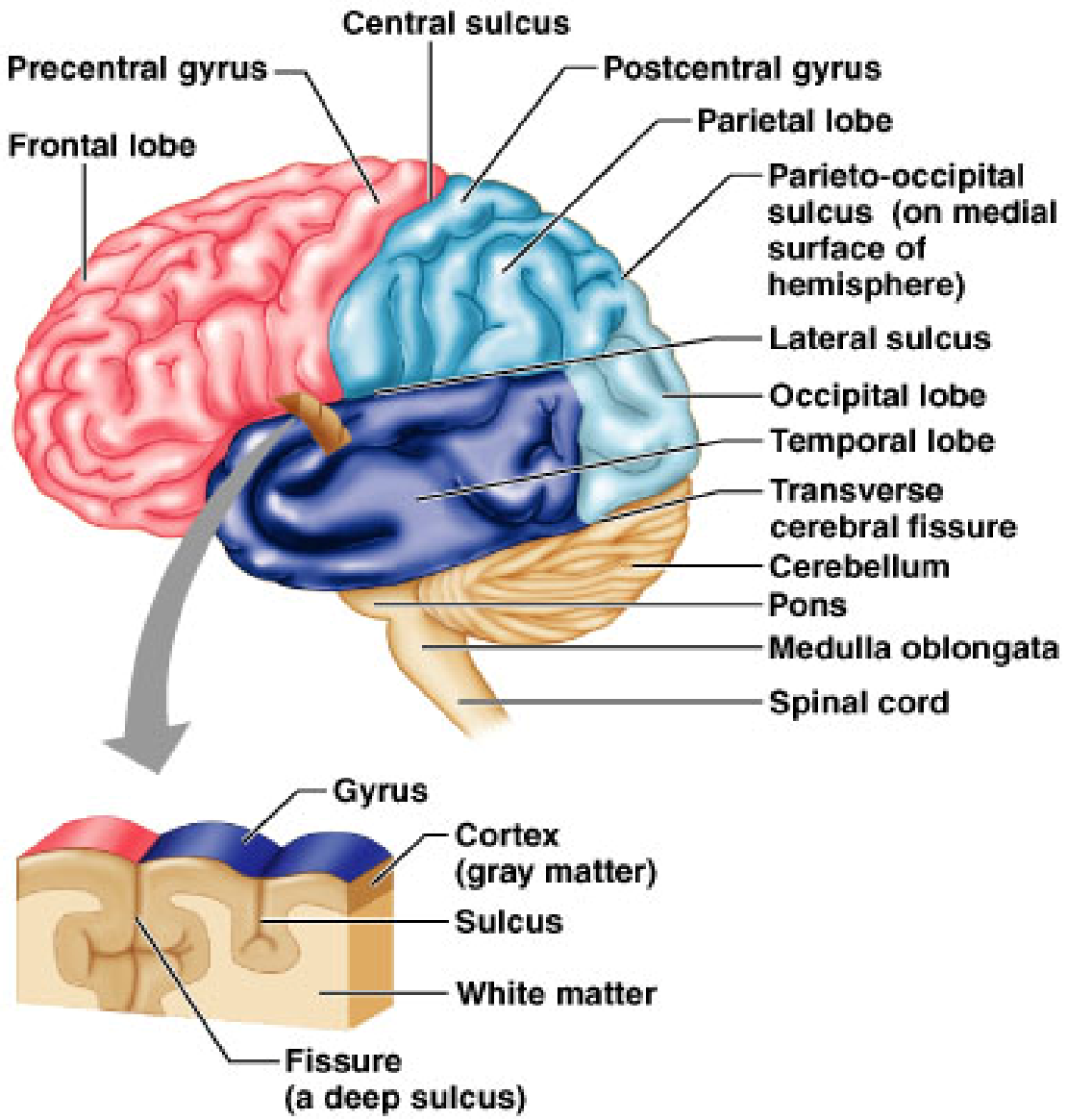
All-or-none

Excitatory and inhibitory


At1
At2
S1
Den
S2

The 6 Divisions of the Brain




Central sulcus
Precentral gyrus
Postcentral gyrus
Frontal lobe
Parietal lobe
Parieto-occipital sulcus (on medial surface of hemisphere)
Lateral sulcus
Occipital lobe
Temporal lobe
Transverse cerebral fissure
Cerebellum
Pons
Medulla oblongata
Spinal cord
Gyrus
Cortex (gray matter)
Sulcus
White matter
Fissure (a deep sulcus)

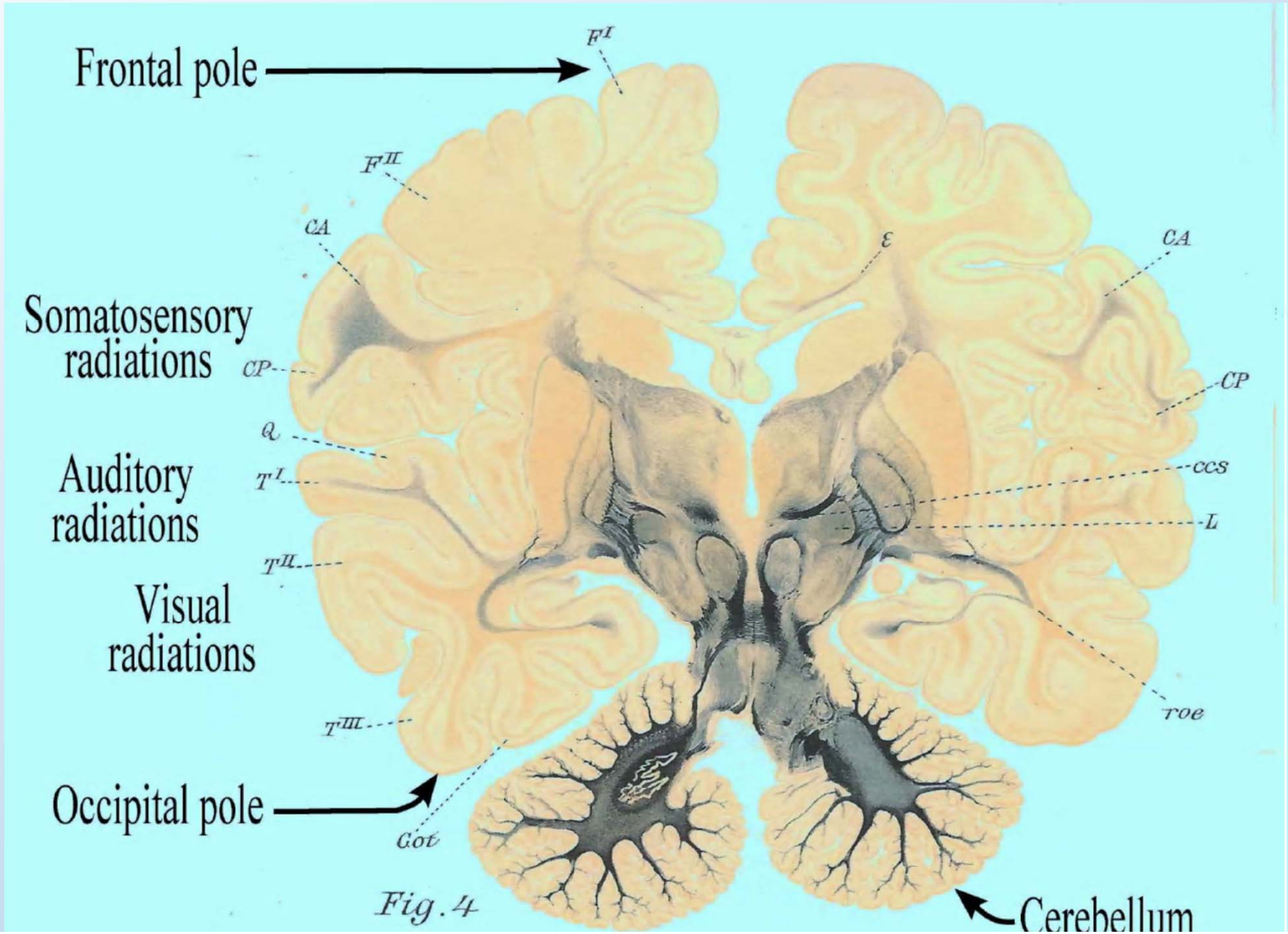
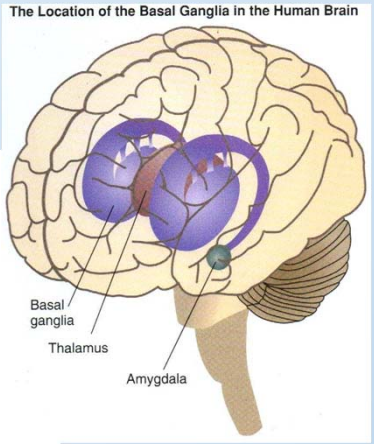
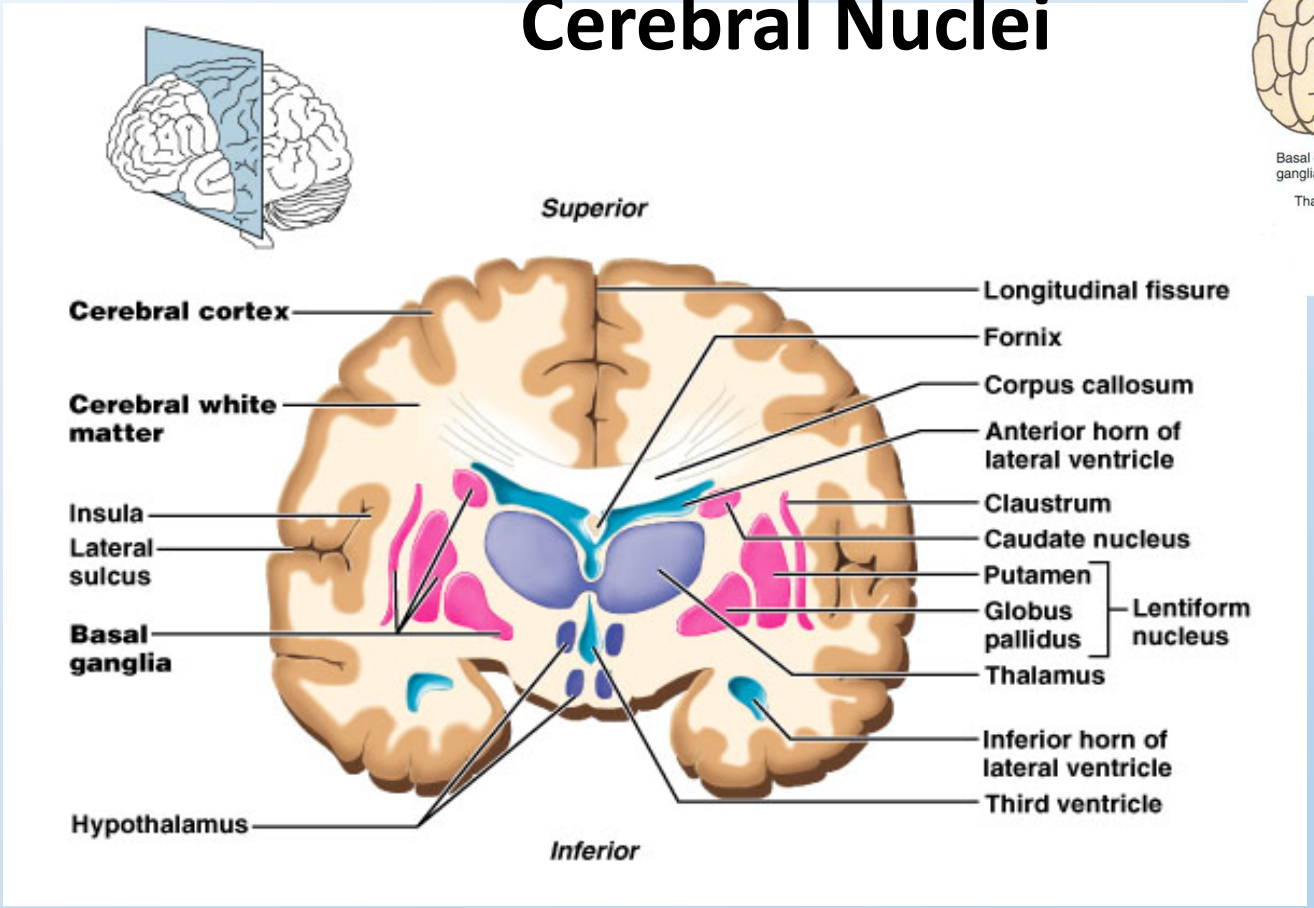

Frontal pole
Somatosensory radiations
Auditory radiations
Visual radiations
Occipital pole
Cerebellum
F^I
F^{II}
CA
CP
Q
T^I
T^{II}
T^{III}
Cot
ε
CA
CP
CCS
L
roe

Fig. 4

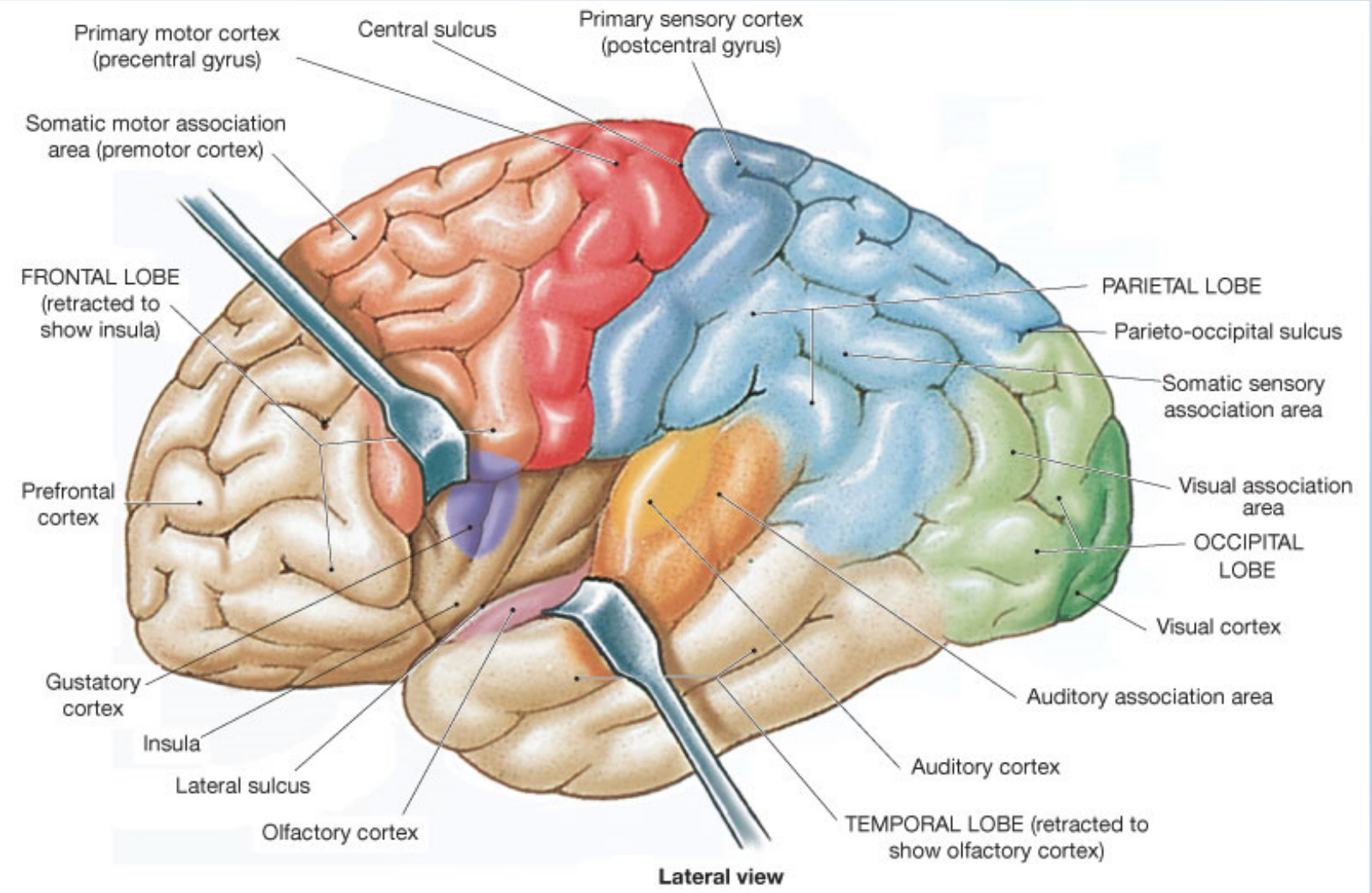
Cerebral Nuclei



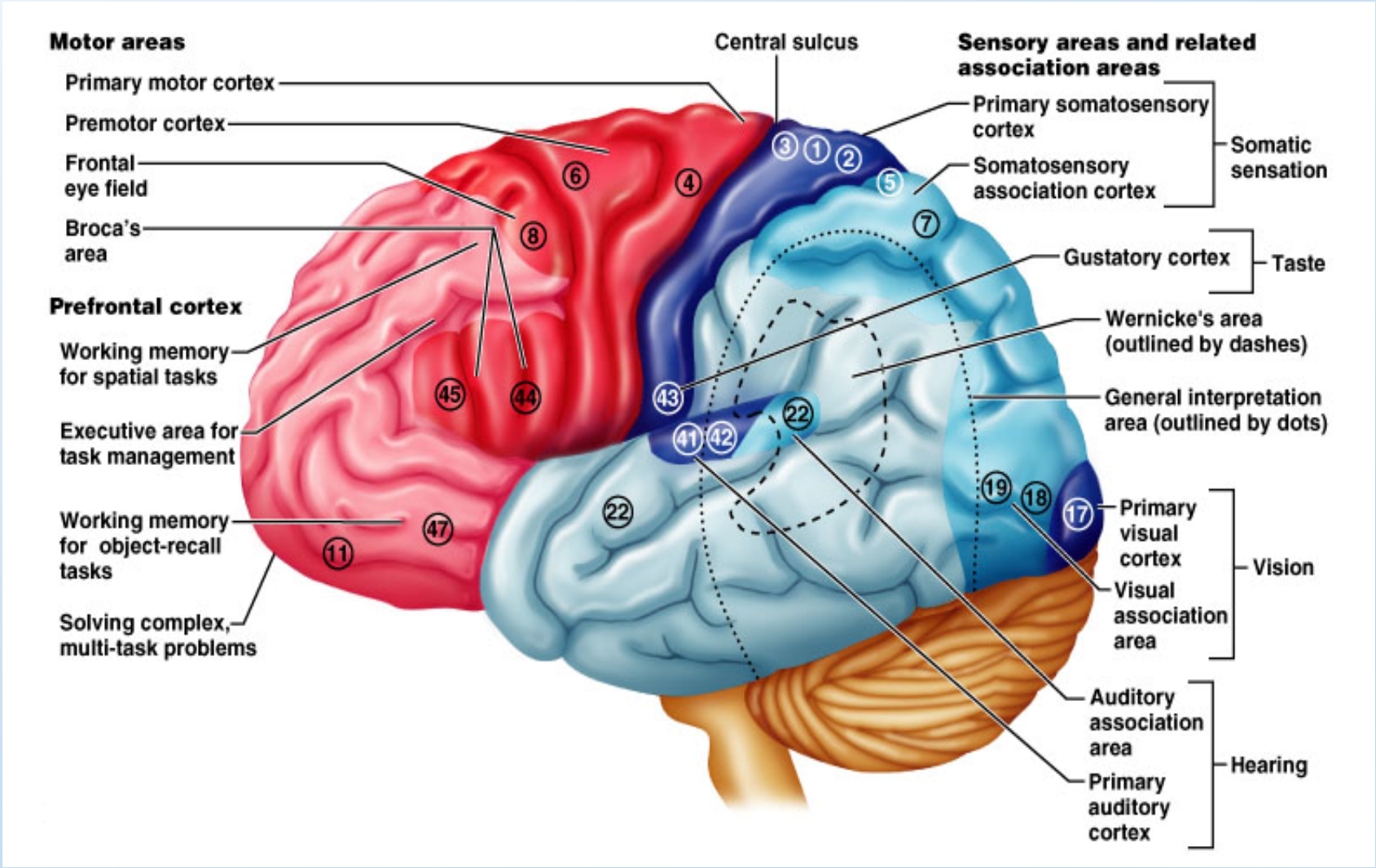


Frontal Section

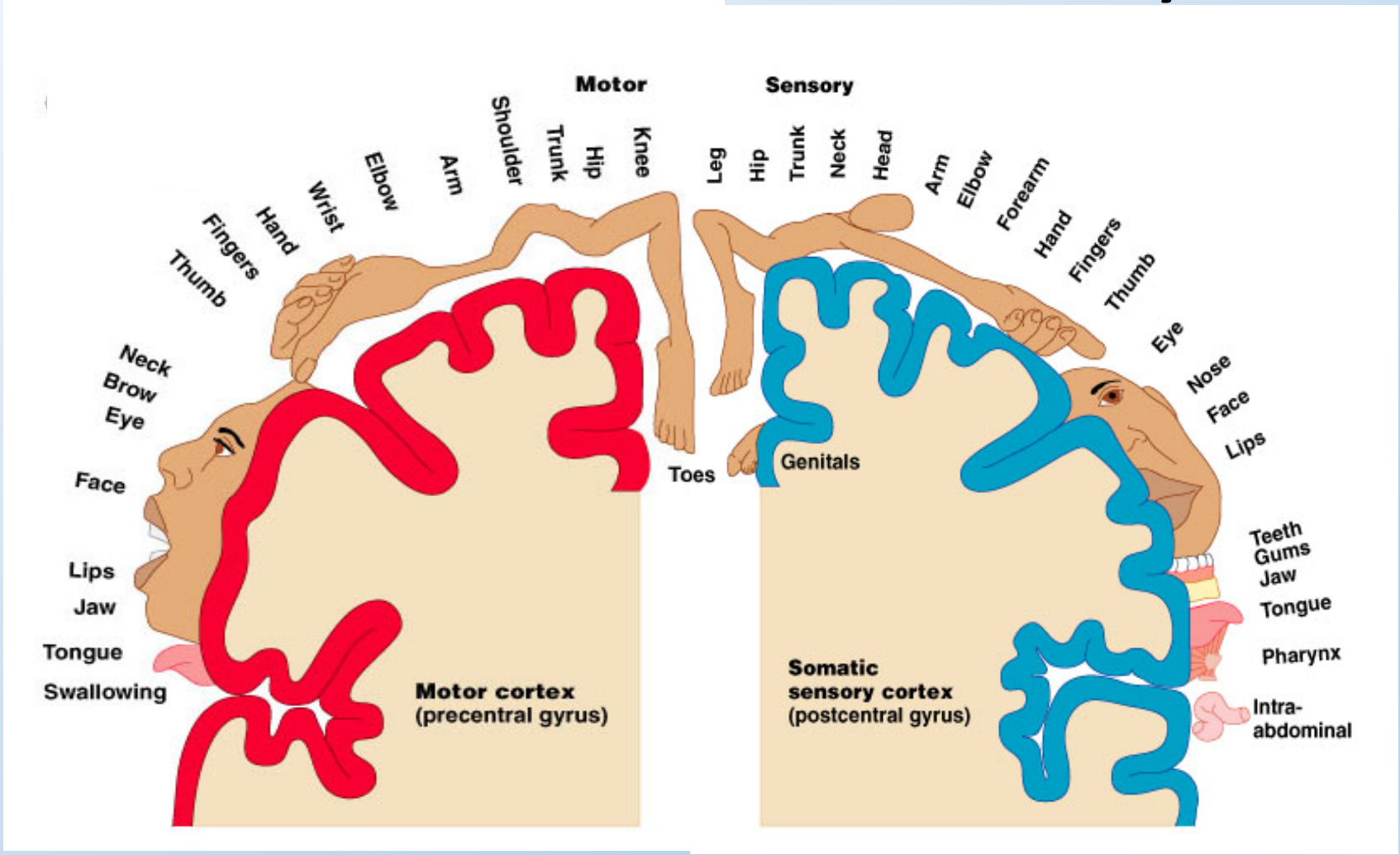
Cerebral Lobes

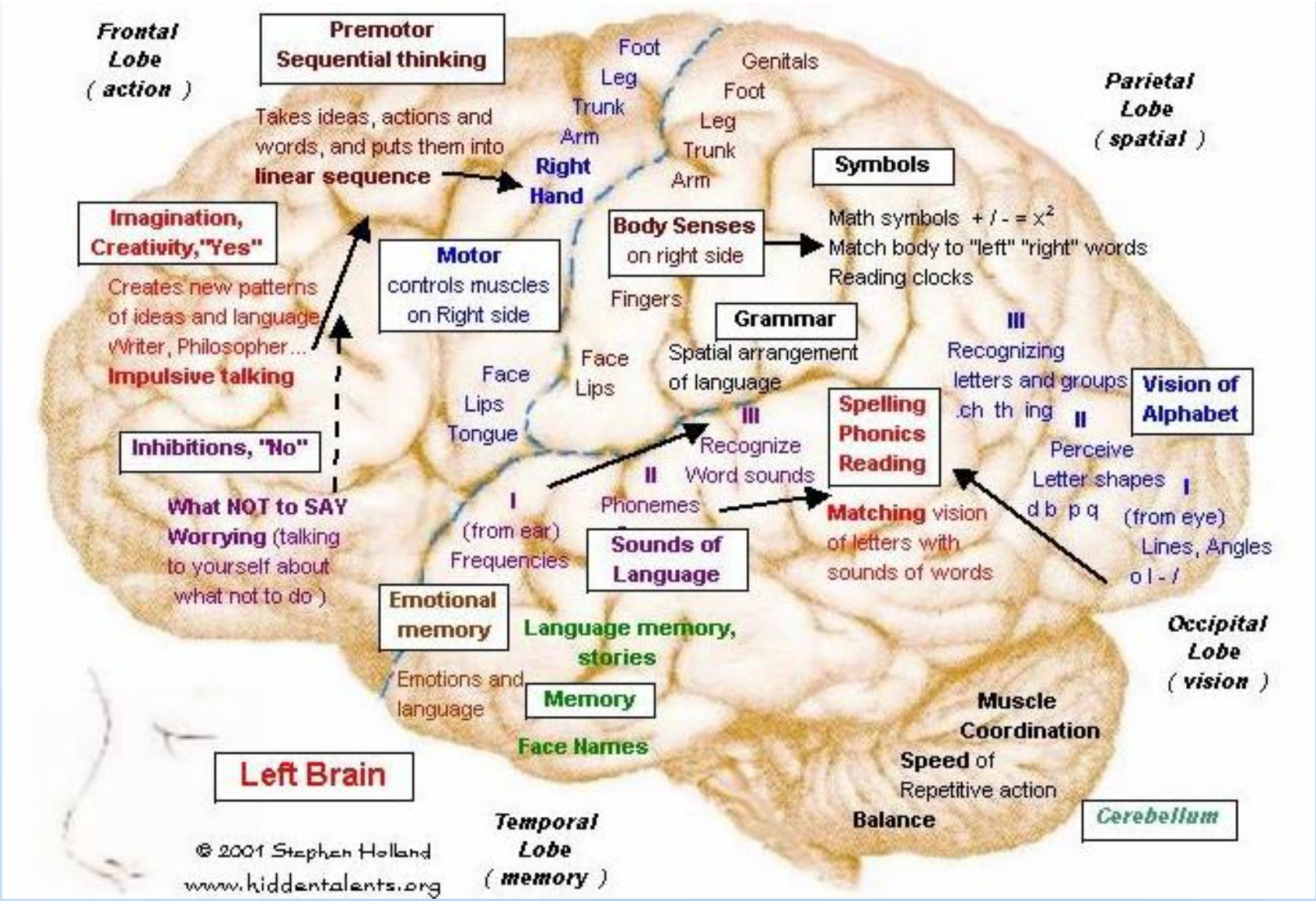


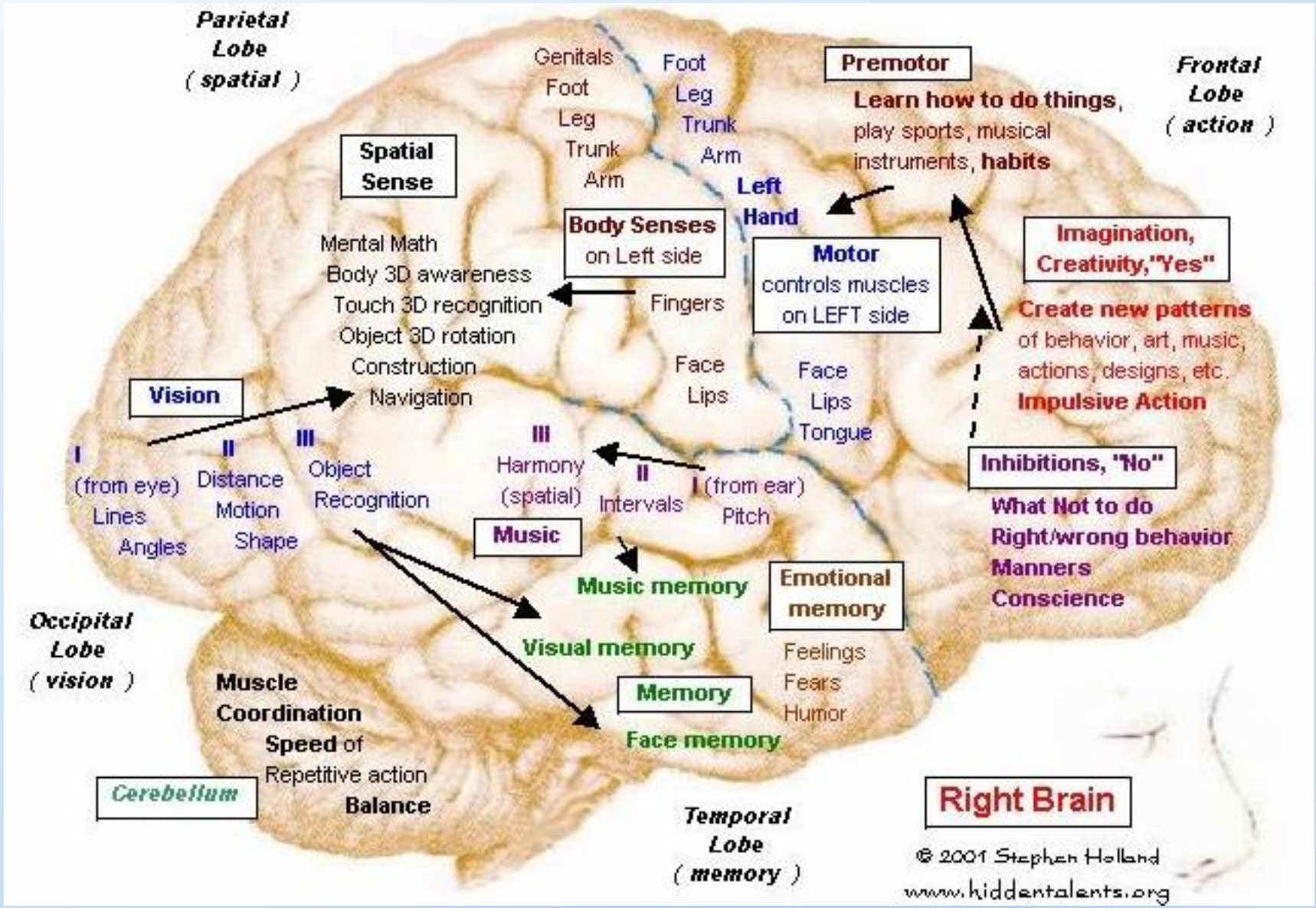
Functional Regions of the Brain



Homunculus - Motor and Sensory




Frontal Lobe (action)
Premotor Sequential thinking
Takes ideas, actions and words, and puts them into linear sequence
Imagination, Creativity,"Yes"
Creates new patterns of ideas and language
Writer, Philosopher...
Impulsive talking
Inhibitions, "No"
What NOT to SAY
Worrying (talking to yourself about what not to do)
Motor controls muscles on Right side
Foot
Leg
Trunk
Arm
Right Hand
Genitals
Foot
Leg
Trunk
Arm
Fingers
Face
Lips
Tongue
Face
Lips
Parietal Lobe (spatial)
Symbols
Body Senses on right side
Math symbols + / - = x²
Match body to "left" "right" words
Reading clocks
Grammar
Spatial arrangement of language
III
Recognizing letters and groups
.ch th ing
Vision of Alphabet
II
Perceive Letter shapes
d b p q
I
(from eye)
Lines, Angles
o l - /
Spelling Phonics Reading
III
Recognize Word sounds
II
Phonemes
I
(from ear)
Frequencies
Sounds of Language
Matching vision of letters with sounds of words
Emotional memory
Language memory, stories
Emotions and language
Memory
Face Names
Occipital Lobe (vision)
Muscle Coordination
Speed of Repetitive action
Balance
Cerebellum
Left Brain
Temporal Lobe (memory)
© 2001 Stephen Holland
www.hiddentalents.org


Parietal Lobe (spatial)
Genitals
Foot
Leg
Trunk
Arm
Foot
Leg
Trunk
Arm
Premotor
Learn how to do things, play sports, musical instruments, habits
Frontal Lobe (action)
Spatial Sense
Left Hand
Body Senses on Left side
Mental Math
Body 3D awareness
Touch 3D recognition
Object 3D rotation
Construction
Navigation
Fingers
Motor controls muscles on LEFT side
Imagination, Creativity, "Yes"
Create new patterns of behavior, art, music, actions, designs, etc.
Impulsive Action
Face
Lips
Face
Lips
Tongue
Vision
I (from eye) Lines Angles
II Distance Motion Shape
III Object Recognition
III Harmony (spatial)
II Intervals
I (from ear) Pitch
Inhibitions, "No"
What Not to do
Right/wrong behavior
Manners
Conscience
Music
Music memory
Emotional memory
Feelings
Fears
Humor
Occipital Lobe (vision)
Visual memory
Memory
Face memory
Muscle Coordination
Speed of Repetitive action
Balance
Cerebellum
Temporal Lobe (memory)
Right Brain
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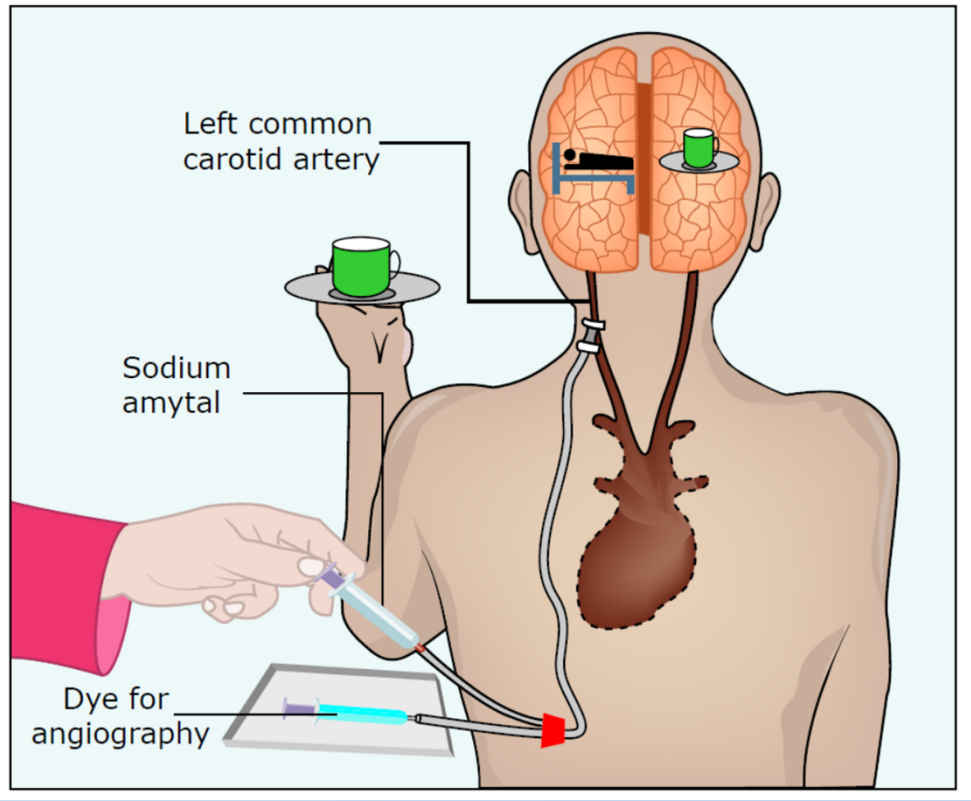
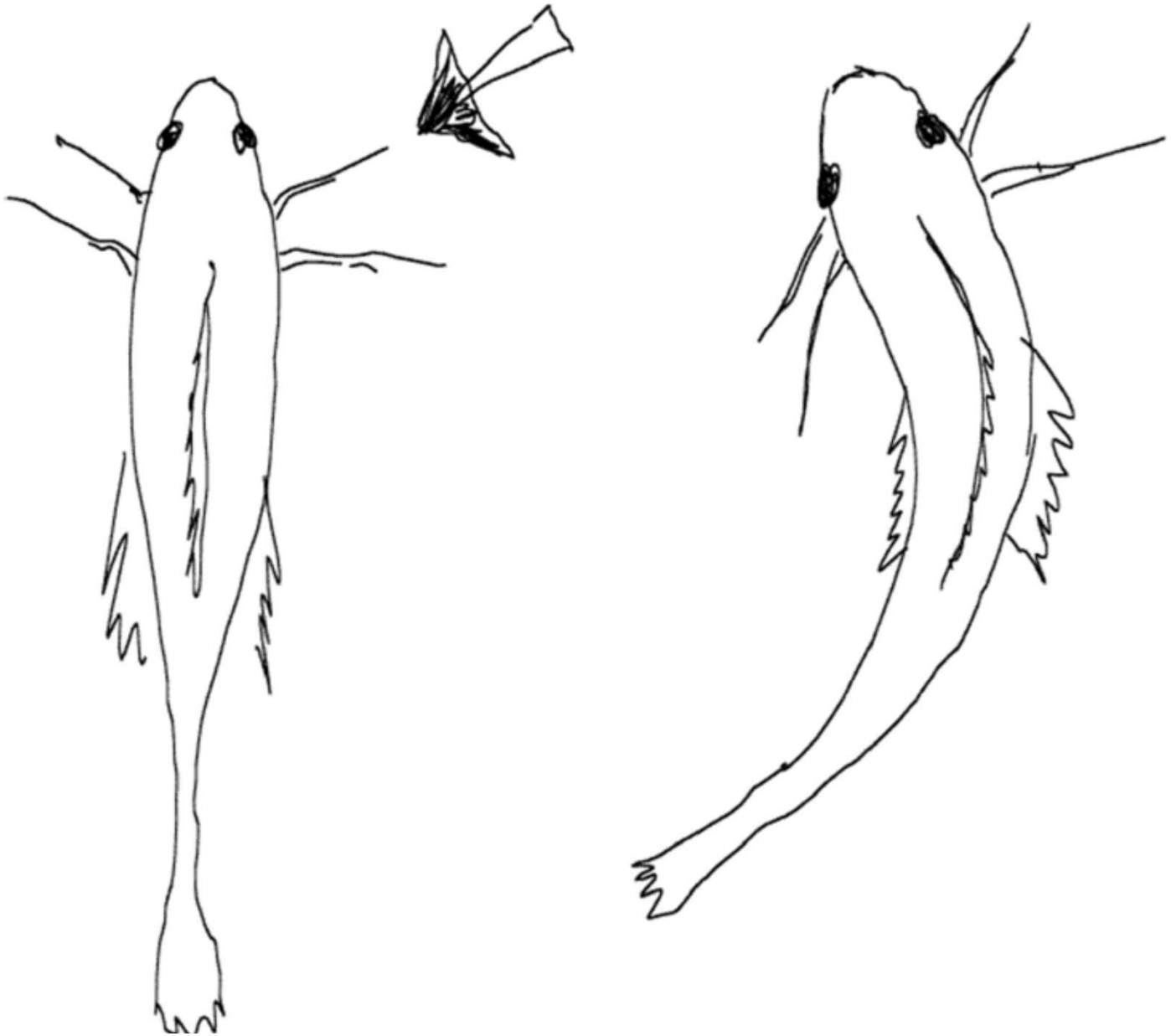
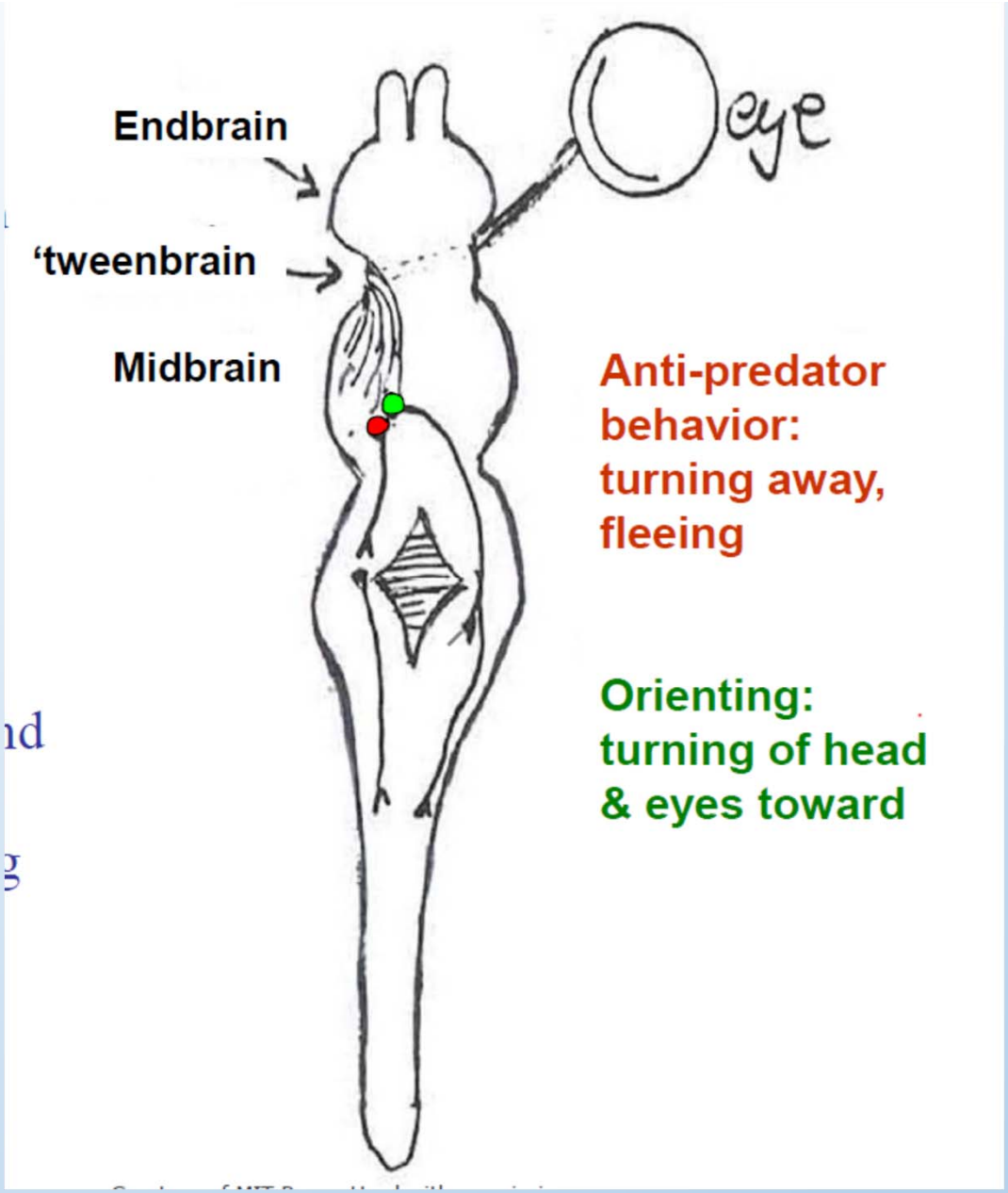
Wada Test


Left common carotid artery
Sodium amytal
Dye for angiography



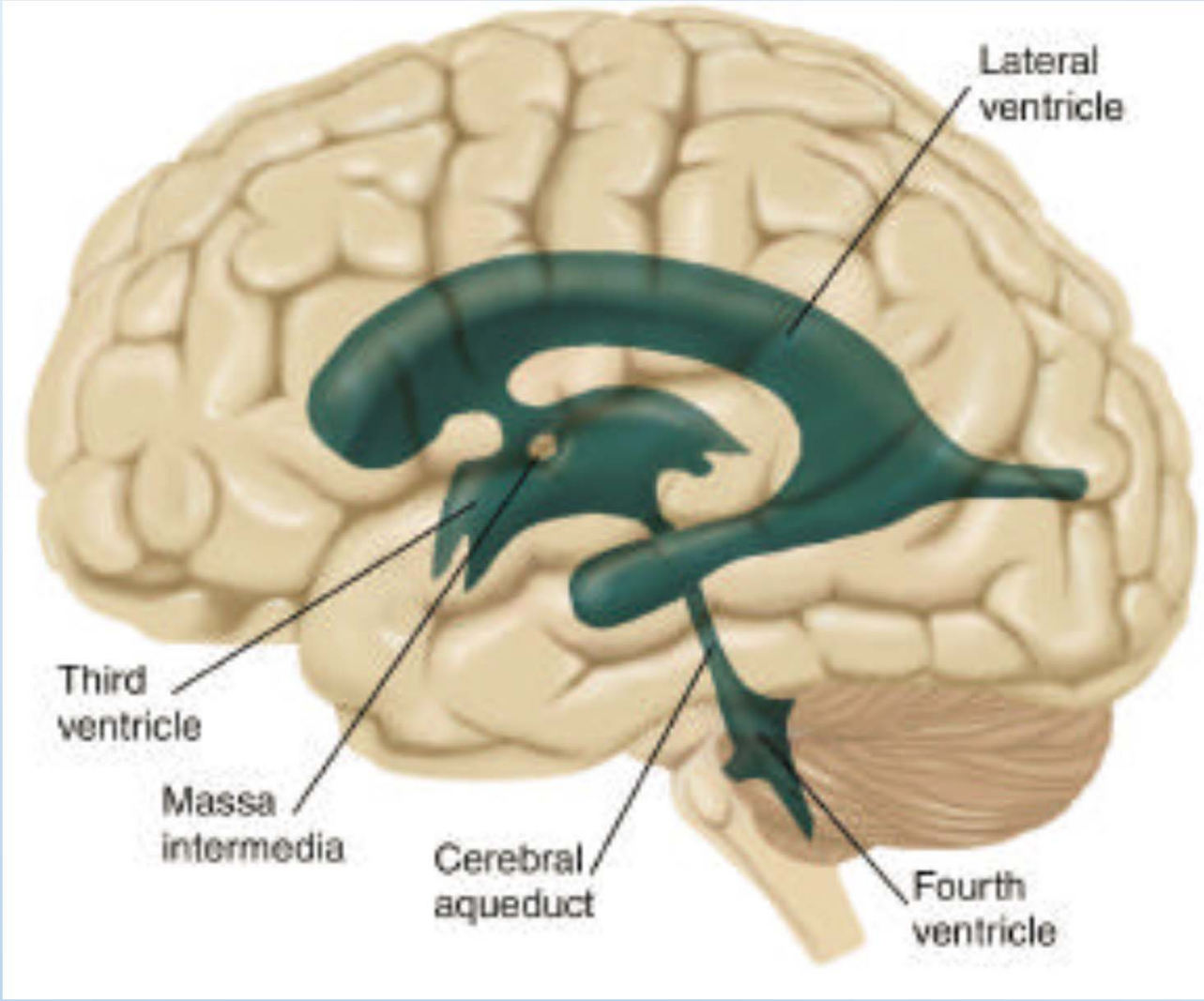


Anti-predator behavior: turning away, fleeing

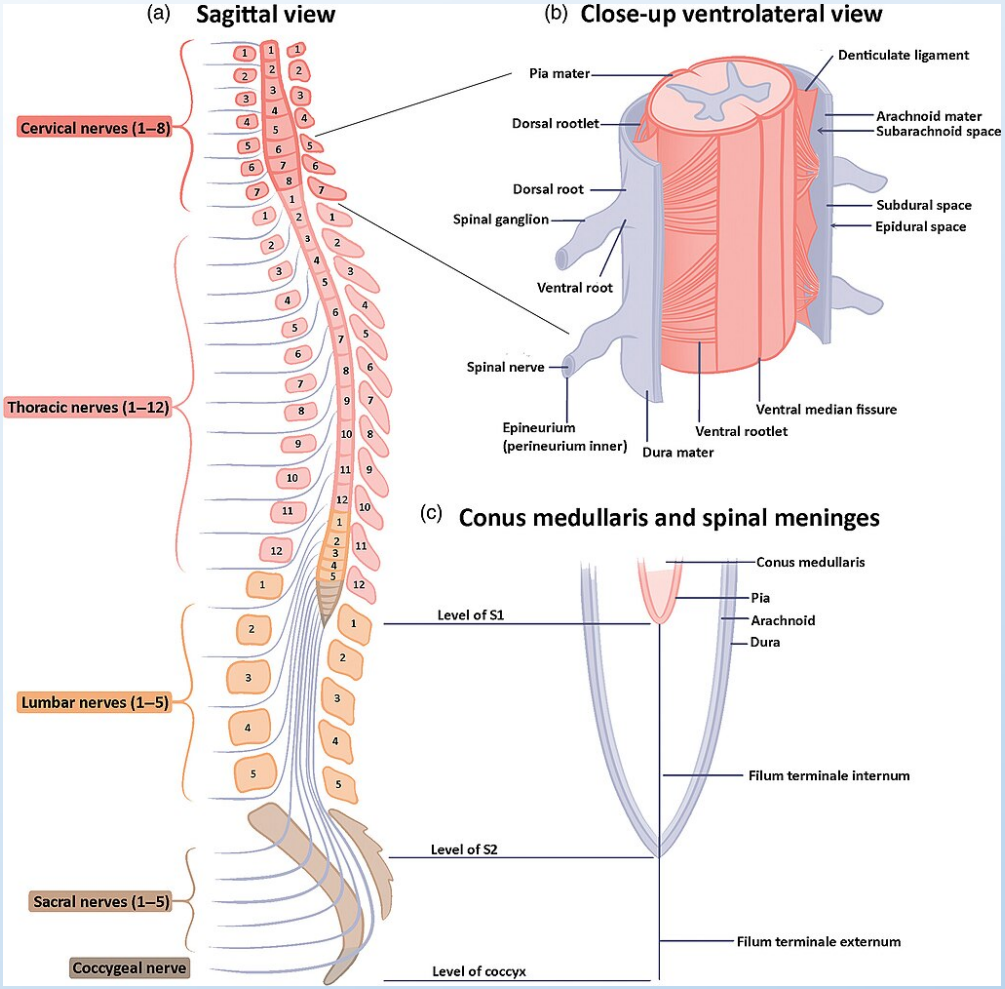
Orienting: turning of head & eyes toward

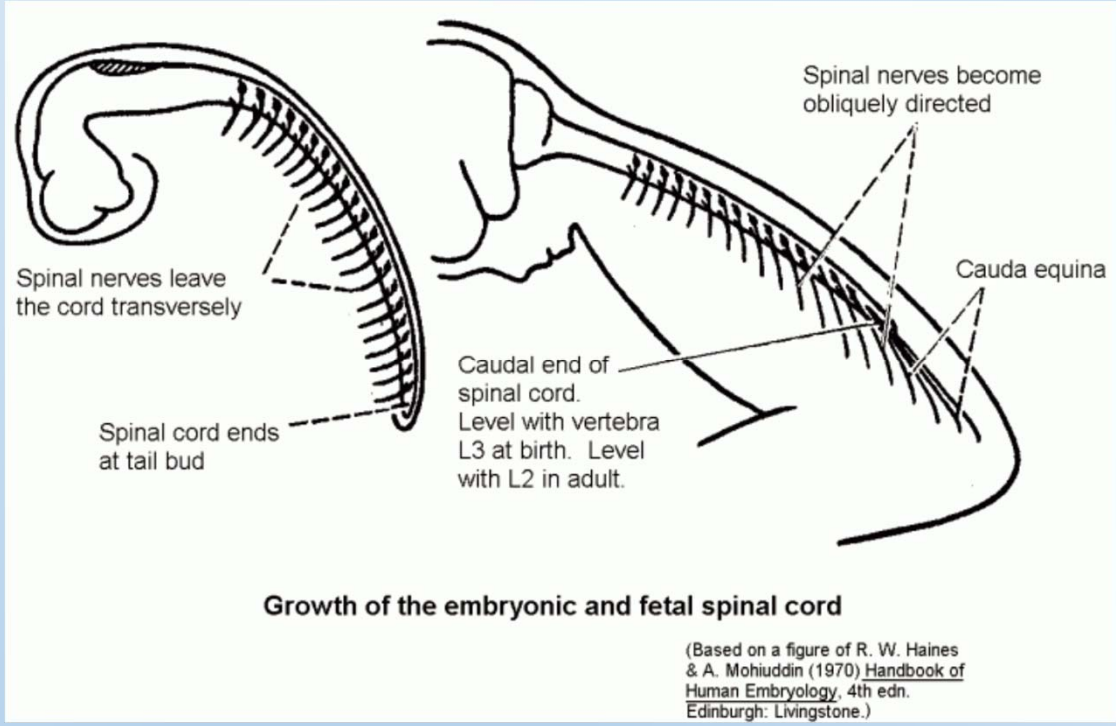
Cerebrospinal Fluid

The brain floats in a pool of cerebrospinal fluid (CSF)which reduces its net weight from 1400 g --> 80 g



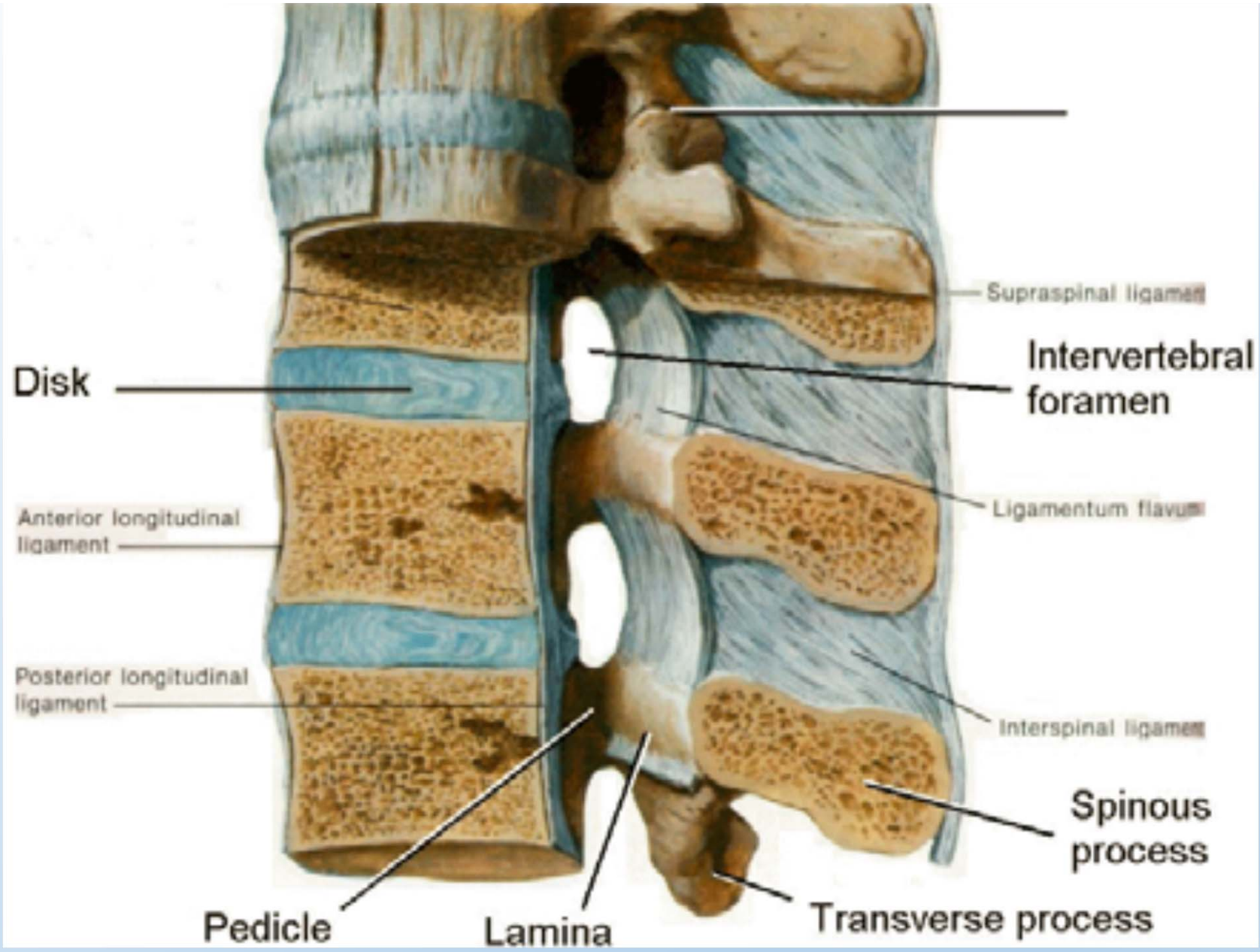
The spinal code



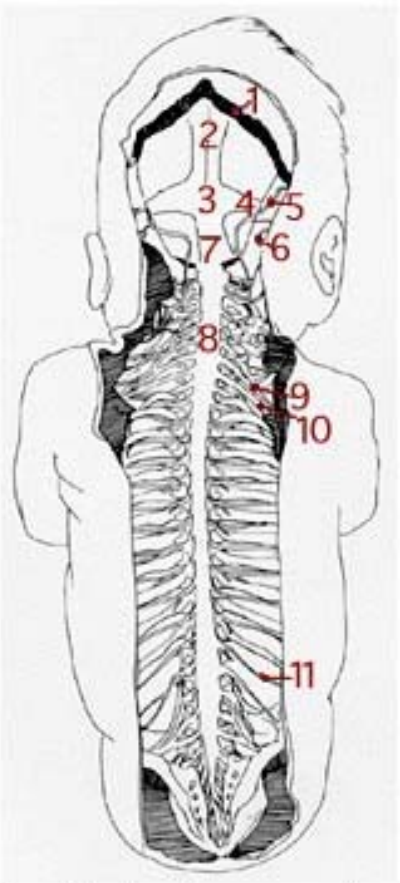


Growth of the embryonic and fetal spinal cord

(Based on a figure of R. W. Haines & A. Mohiuddin (1970) Handbook of Human Embryology, 4th edn. Edinburgh: Livingstone.)


Supraspinal ligament
Intervertebral foramen
Disk
Ligamentum flavum
Anterior longitudinal ligament
Posterior longitudinal ligament
Interspinal ligament
Spinous process
Pedicle
Lamina
Transverse process

Spinal Chord



1. Posterior margin of parietal bone
2. Superior sagittal sinus
3. Confluence of sinuses
4. Transverse sinus
5. Greater occipital nerve
6. Lesser occipital nerve
7. Occipital sinus
8. Spinal dura mater
9. Superior trunk of brachial plexus*

Spinal Plexus:

(in the Nervous System)

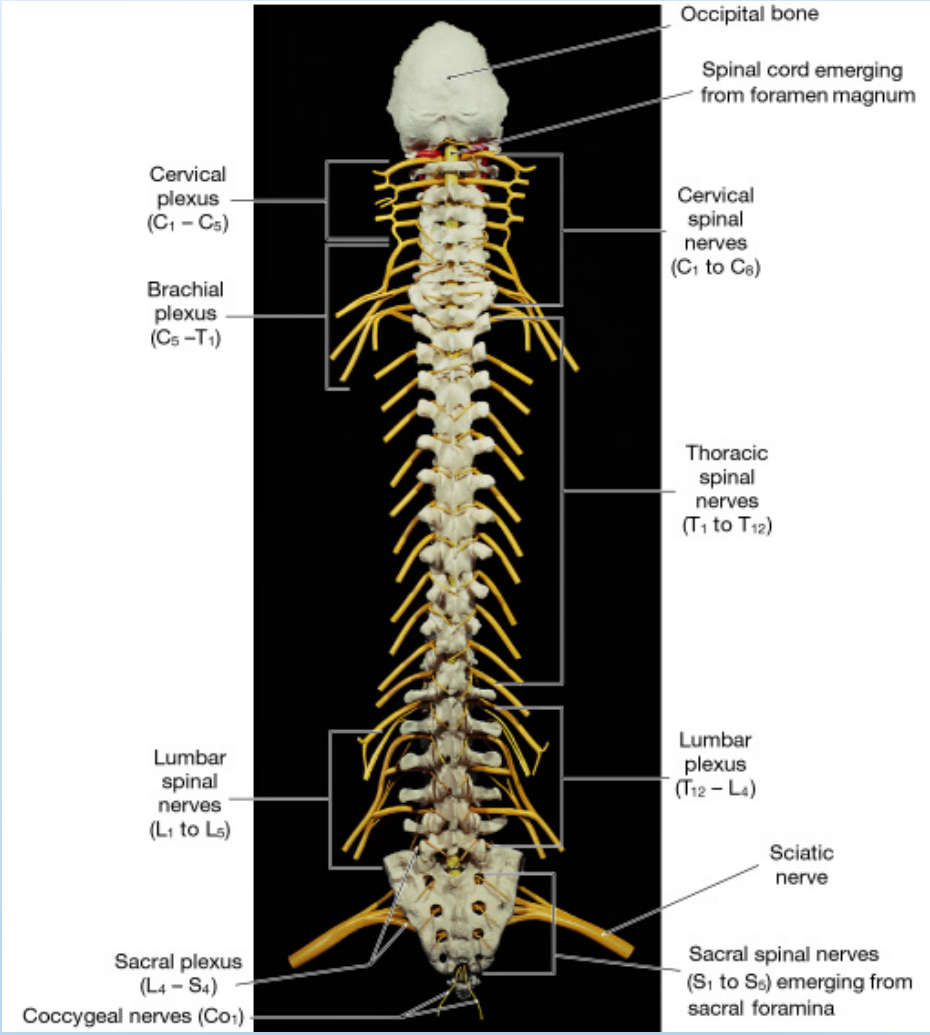
is a re-arrangement of spinal nerves into functional groups.

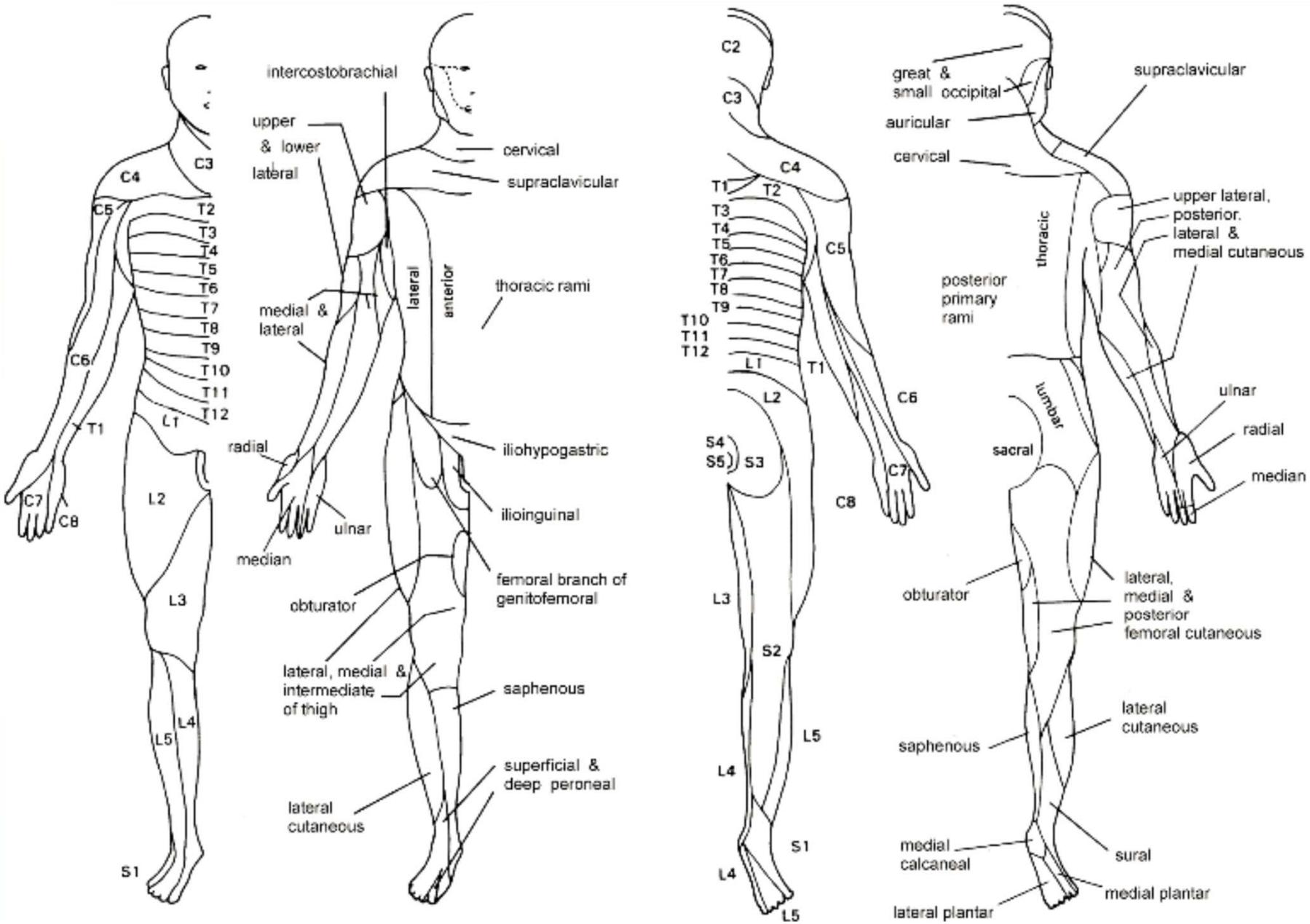
Cervical (C_1-C_5)

Brachial (C_5-T_1)

Lumbar (T_{12}-L_4)

Sacral (L_4-S_4)




C4
C3
C5
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
C6
L1
T1
C7
C8
L2
L3
L4
L5
S1
intercostobrachial
upper
& lower
lateral
cervical
supraclavicular
medial &
lateral
lateral
anterior
thoracic rami
radial
iliohypogastric
ulnar
ilioinguinal
median
femoral branch of
genitofemoral
obturator
lateral, medial &
intermediate
of thigh
saphenous
superficial &
deep peroneal
lateral
cutaneous
C2
C3
C4
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2
S4
S5
S3
C5
T1
C6
C7
C8
L3
S2
L5
L4
S1
L4
L5
great &
small occipital
auricular
cervical
supraclavicular
upper lateral,
posterior,
lateral &
medial cutaneous
thoracic
posterior
primary
rami
lumbar
sacral
ulnar
radial
median
obturator
lateral,
medial &
posterior
femoral cutaneous
lateral
cutaneous
saphenous
medial
calcaneal
sural
medial plantar
lateral plantar

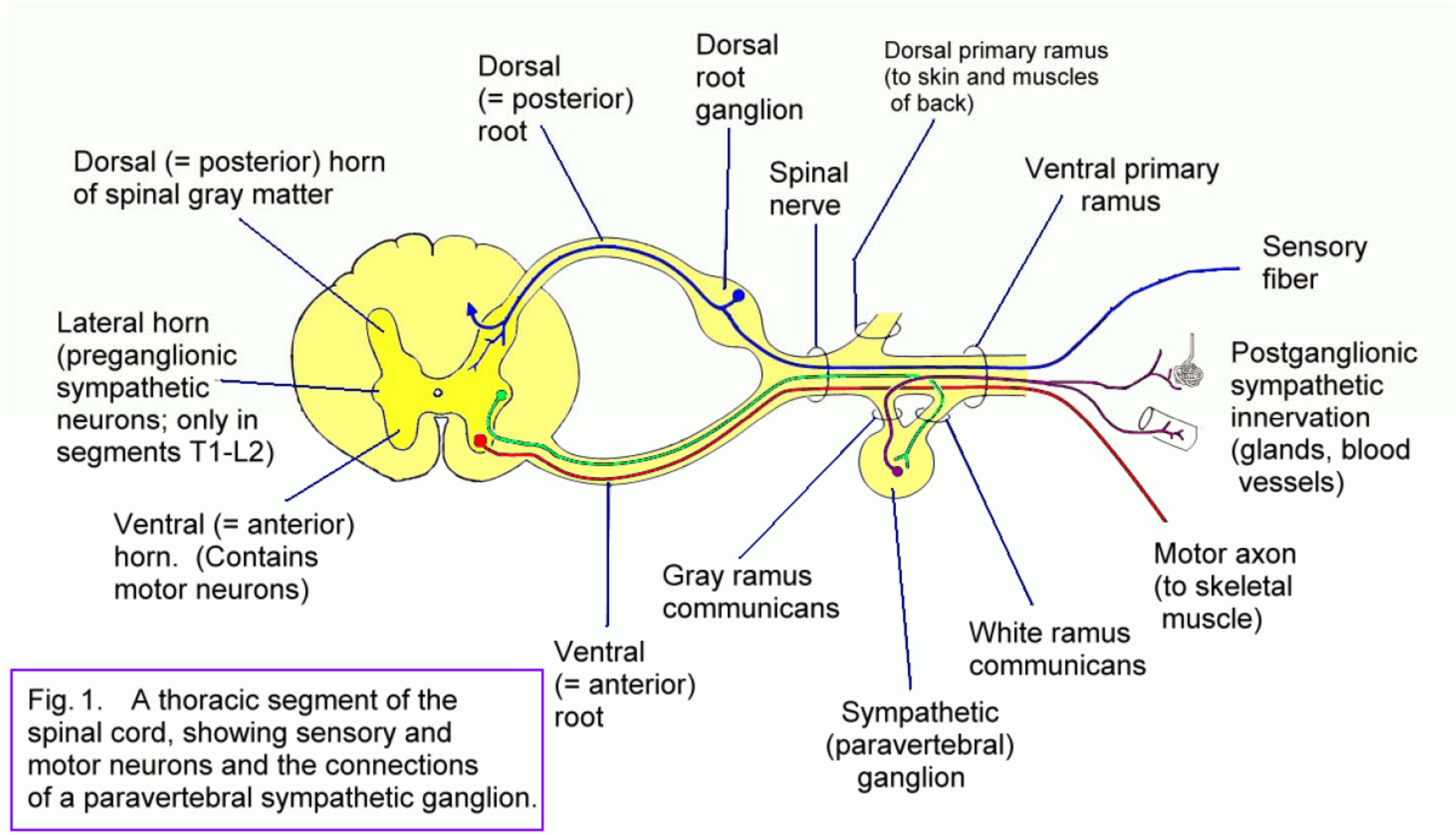
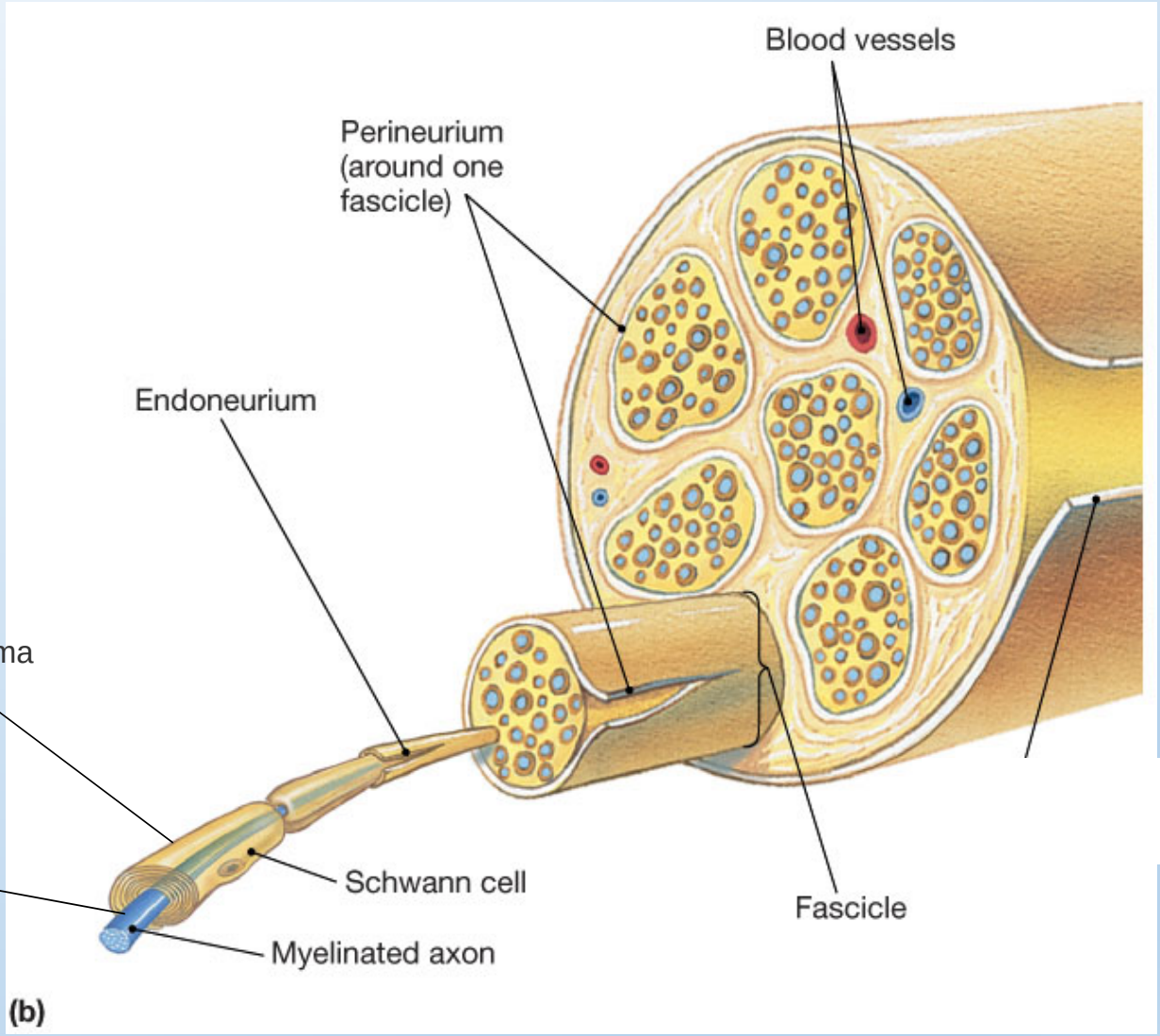
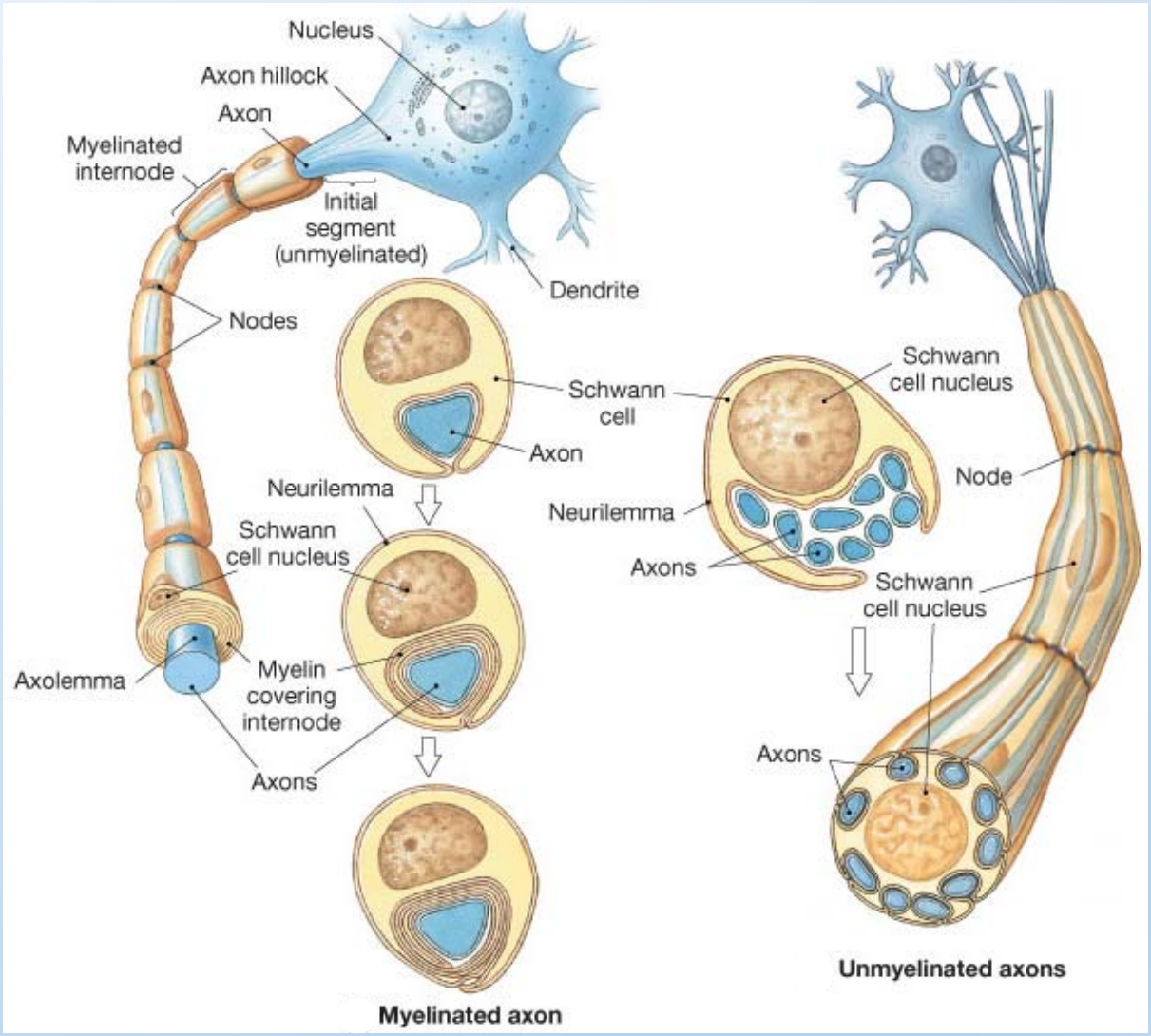


Fig. 1. A thoracic segment of the spinal cord, showing sensory and motor neurons and the connections of a paravertebral sympathetic ganglion.

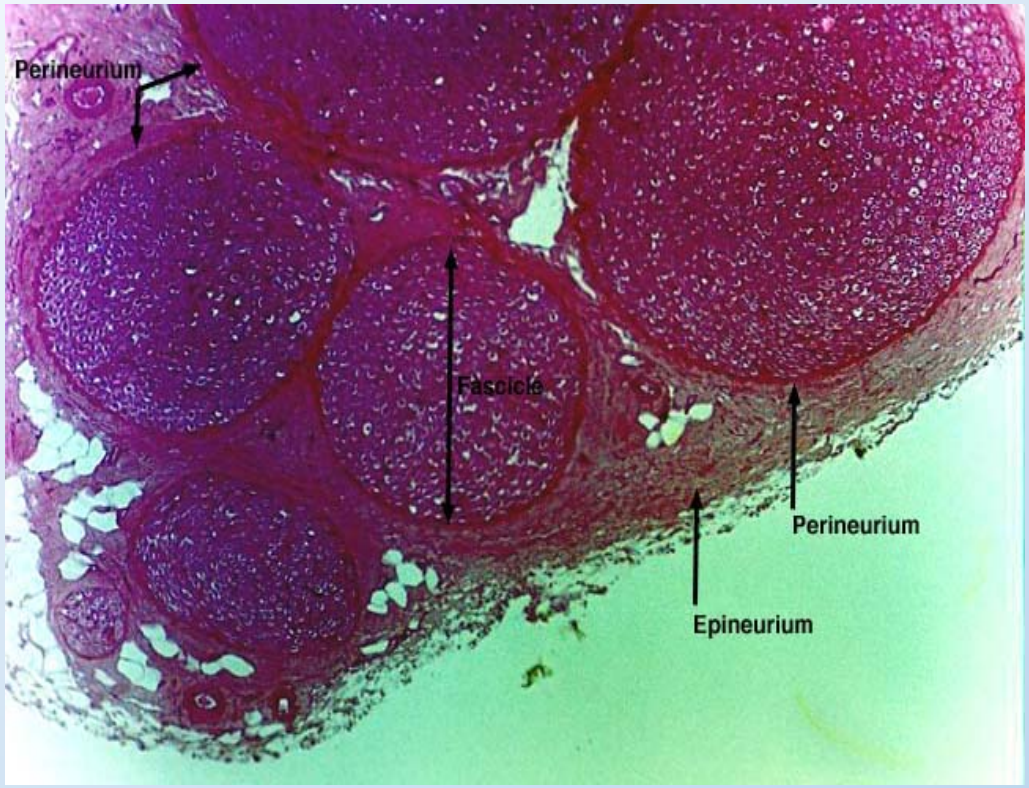
Anatomy of a Nerve

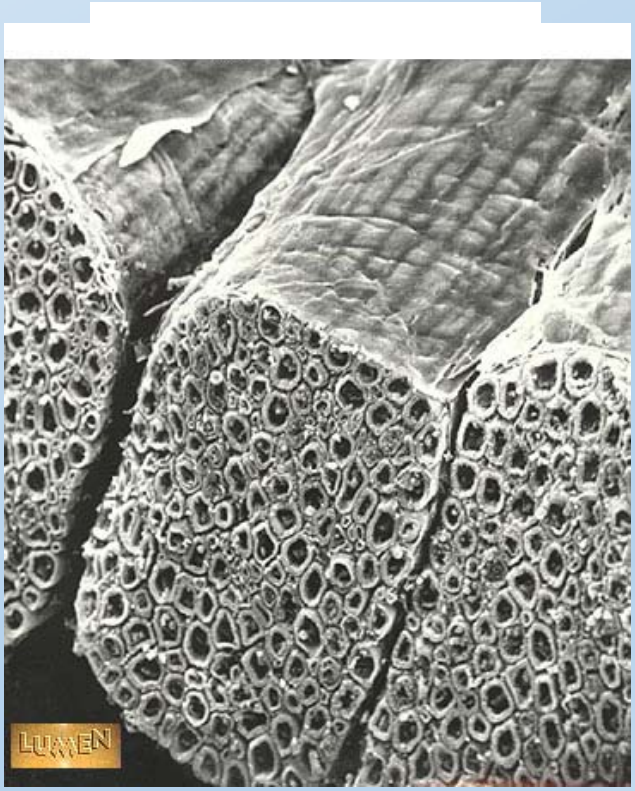


Axon Myelination

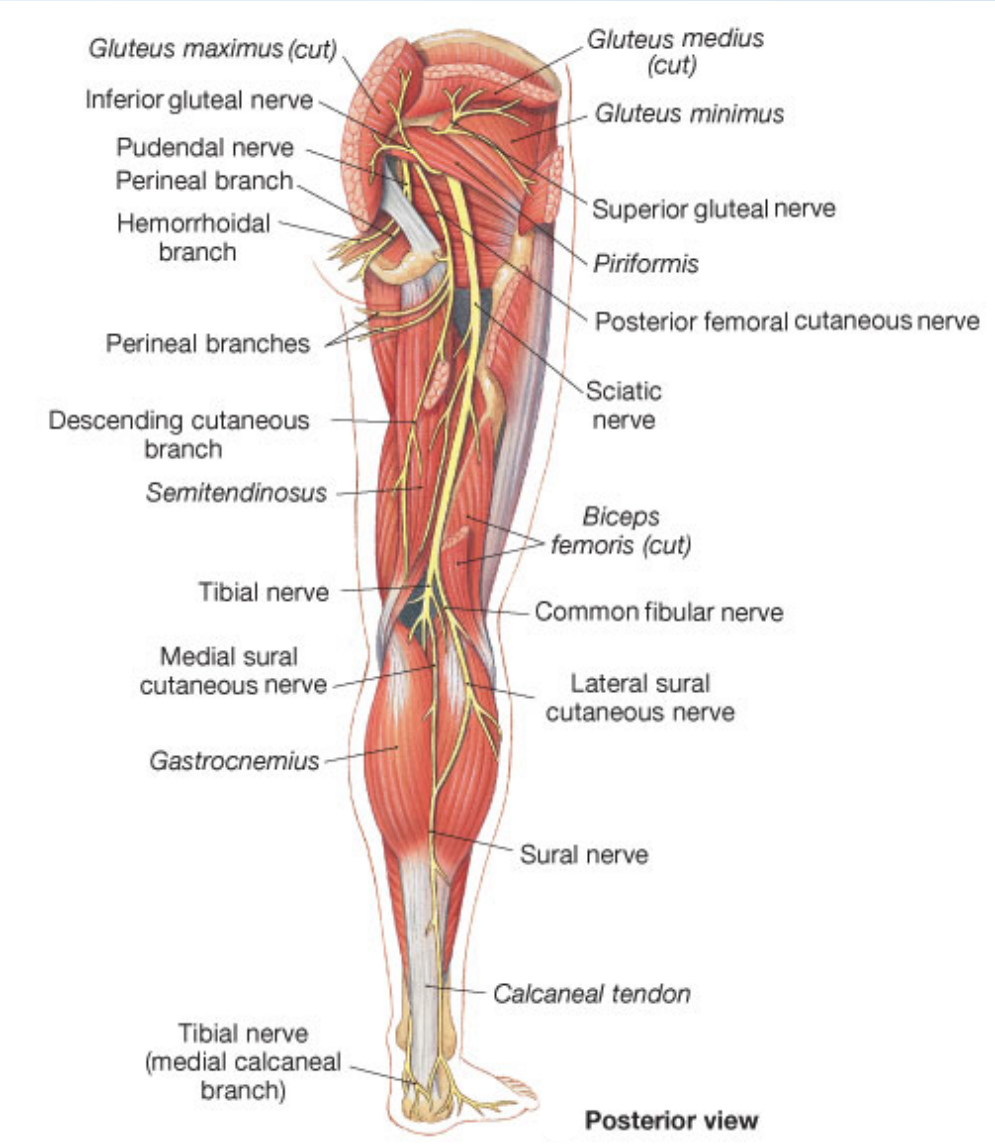


Histology of Nerves

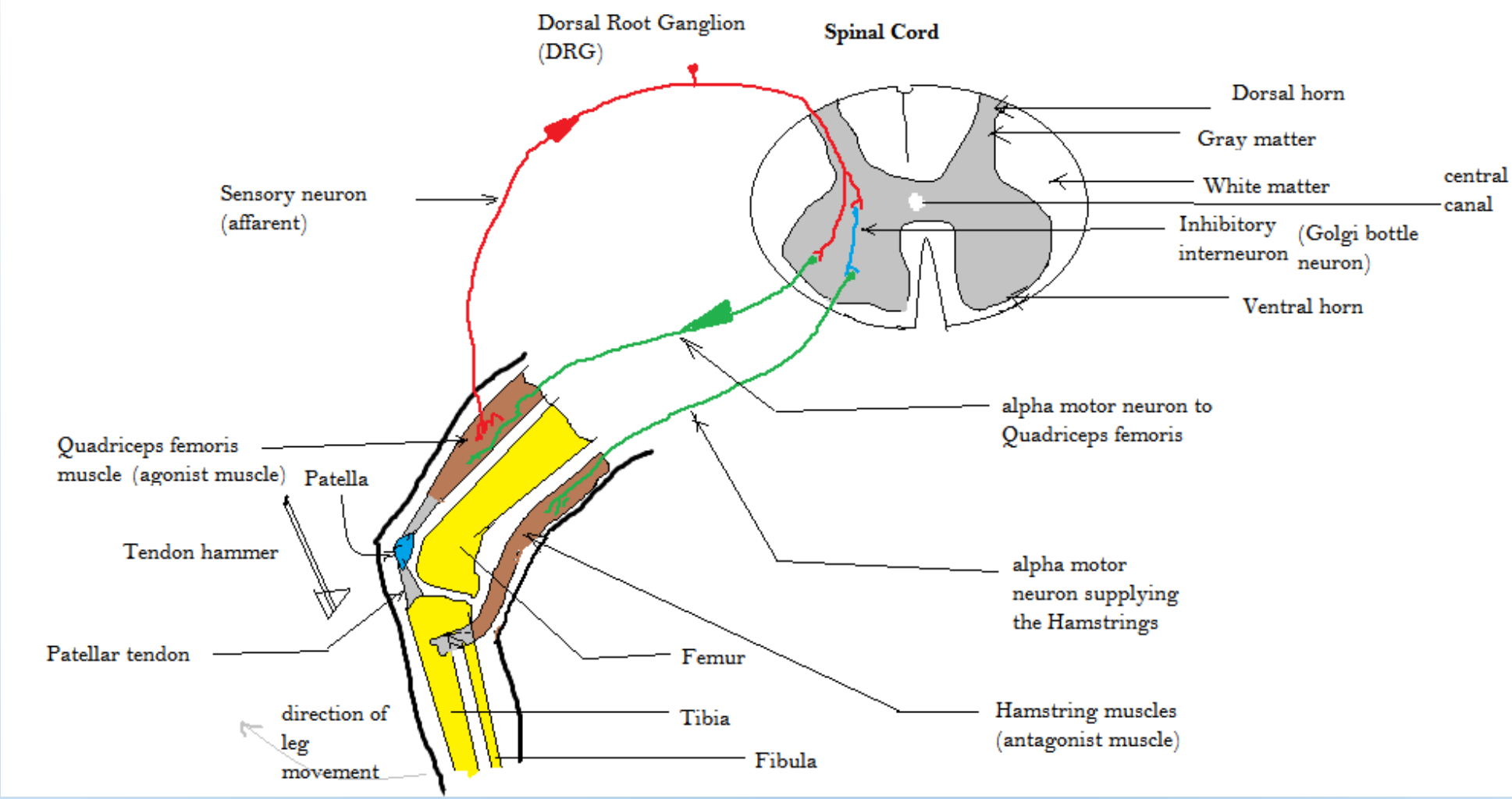


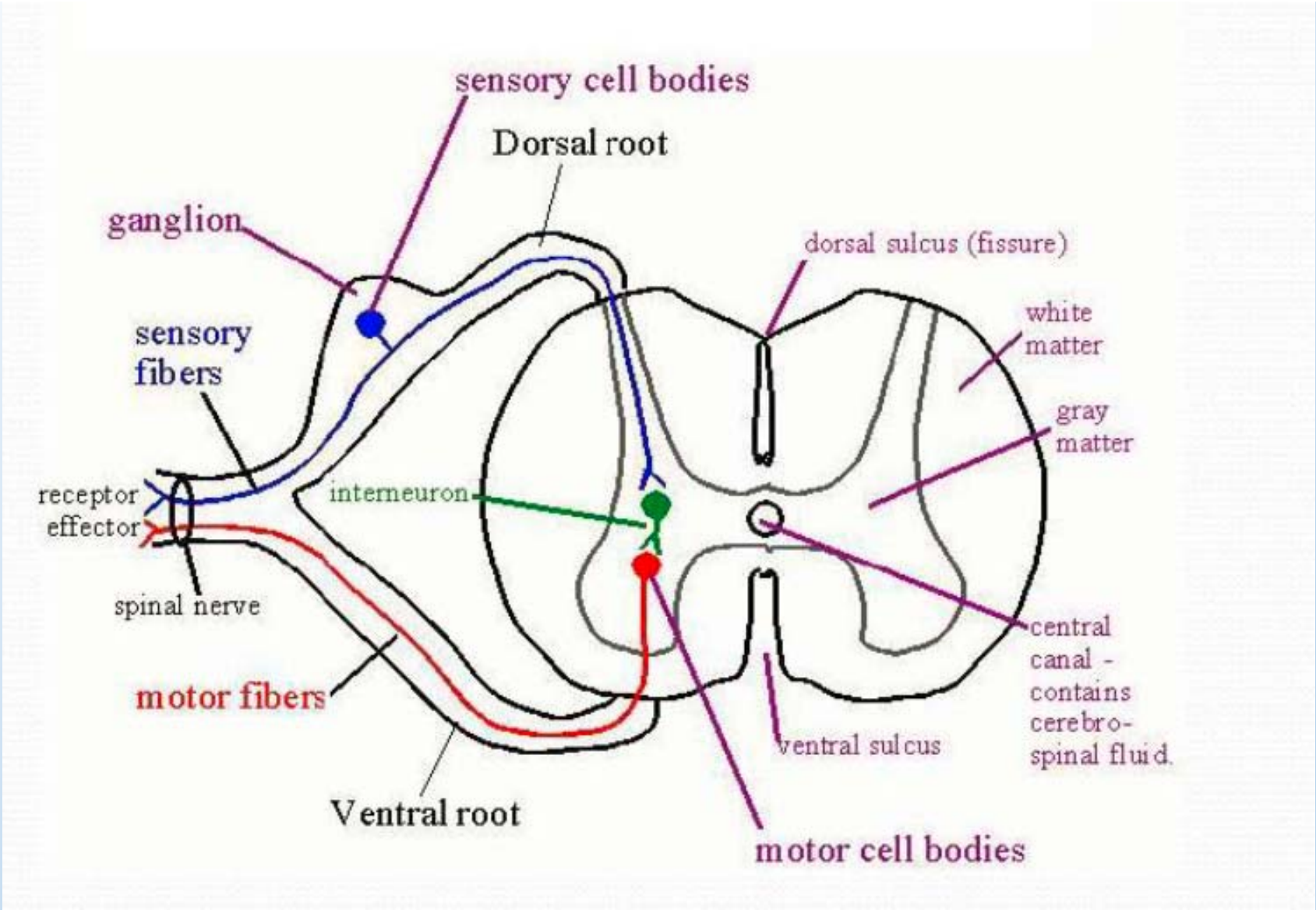


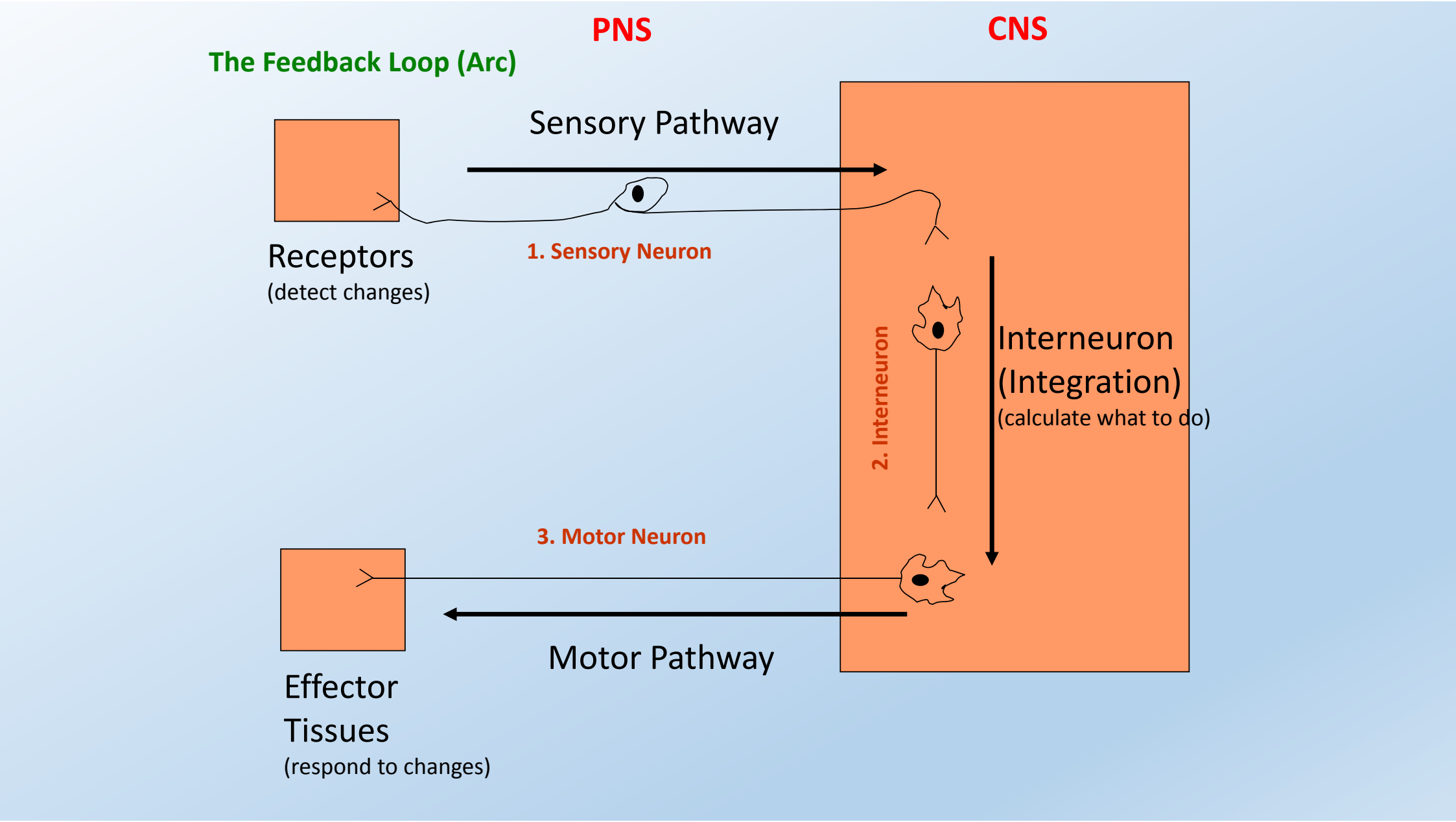
What Nerves look like on models



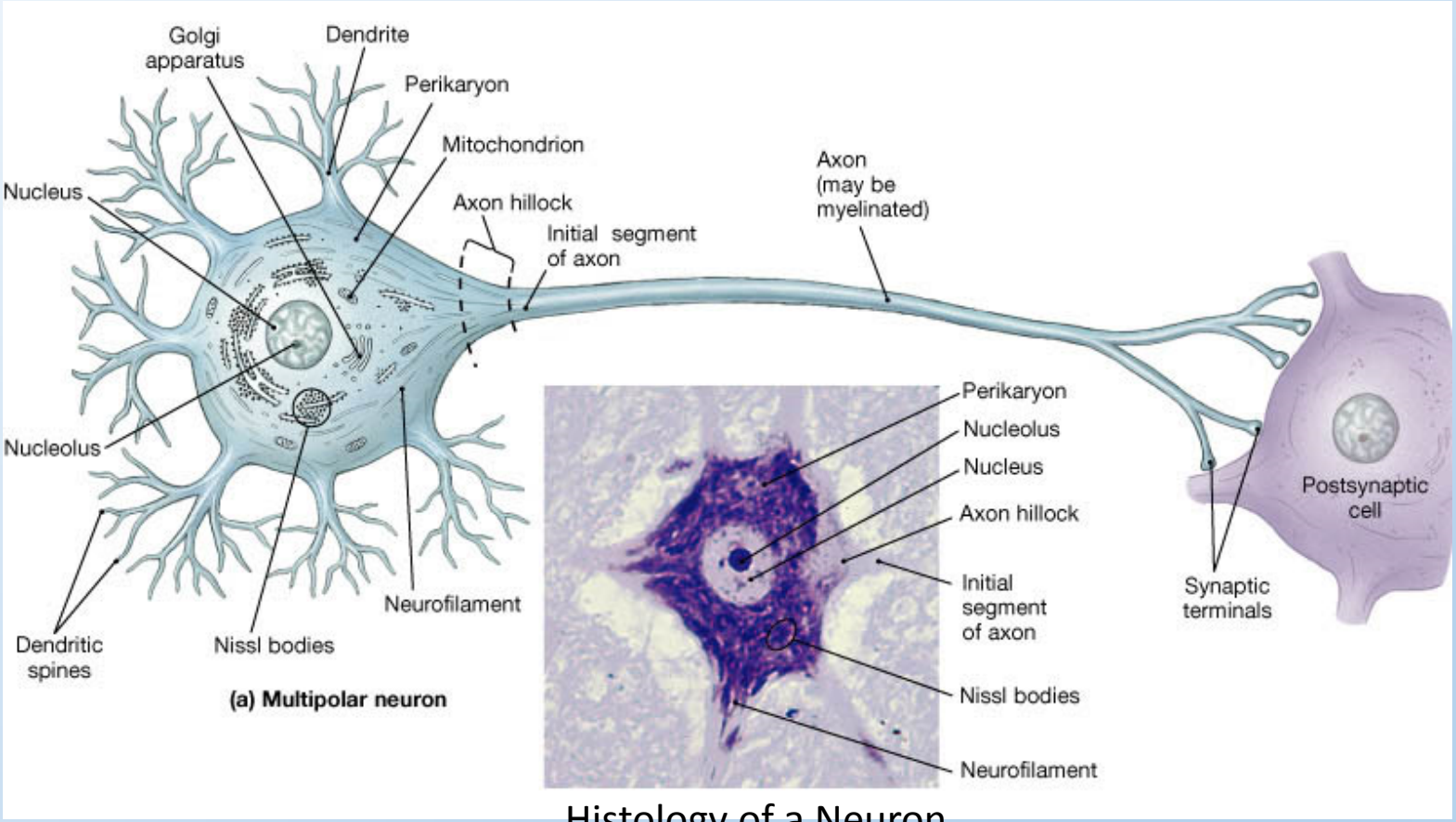
Patellar reflex




sensory cell bodies
Dorsal root
ganglion
dorsal sulcus (fissure)
white matter
sensory fibers
gray matter
receptor
effector
interneuron
spinal nerve
central canal - contains cerebro-spinal fluid.
motor fibers
ventral sulcus
Ventral root
motor cell bodies

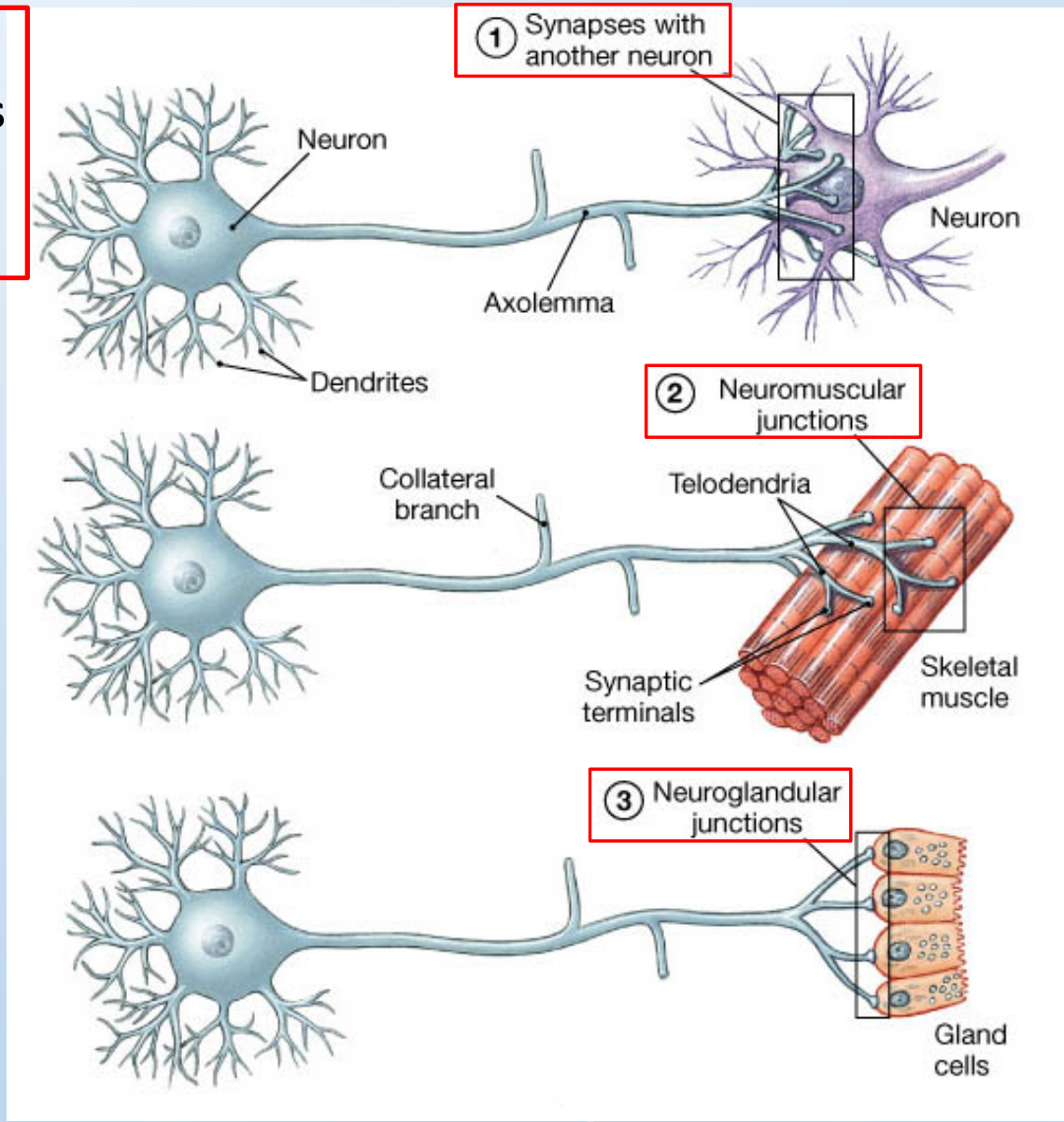

PNS
CNS
The Feedback Loop (Arc)
Sensory Pathway
Receptors
(detect changes)
1. Sensory Neuron
2. Interneuron
Interneuron
(Integration)
(calculate what to do)
3. Motor Neuron
Motor Pathway
Effector
Tissues
(respond to changes)

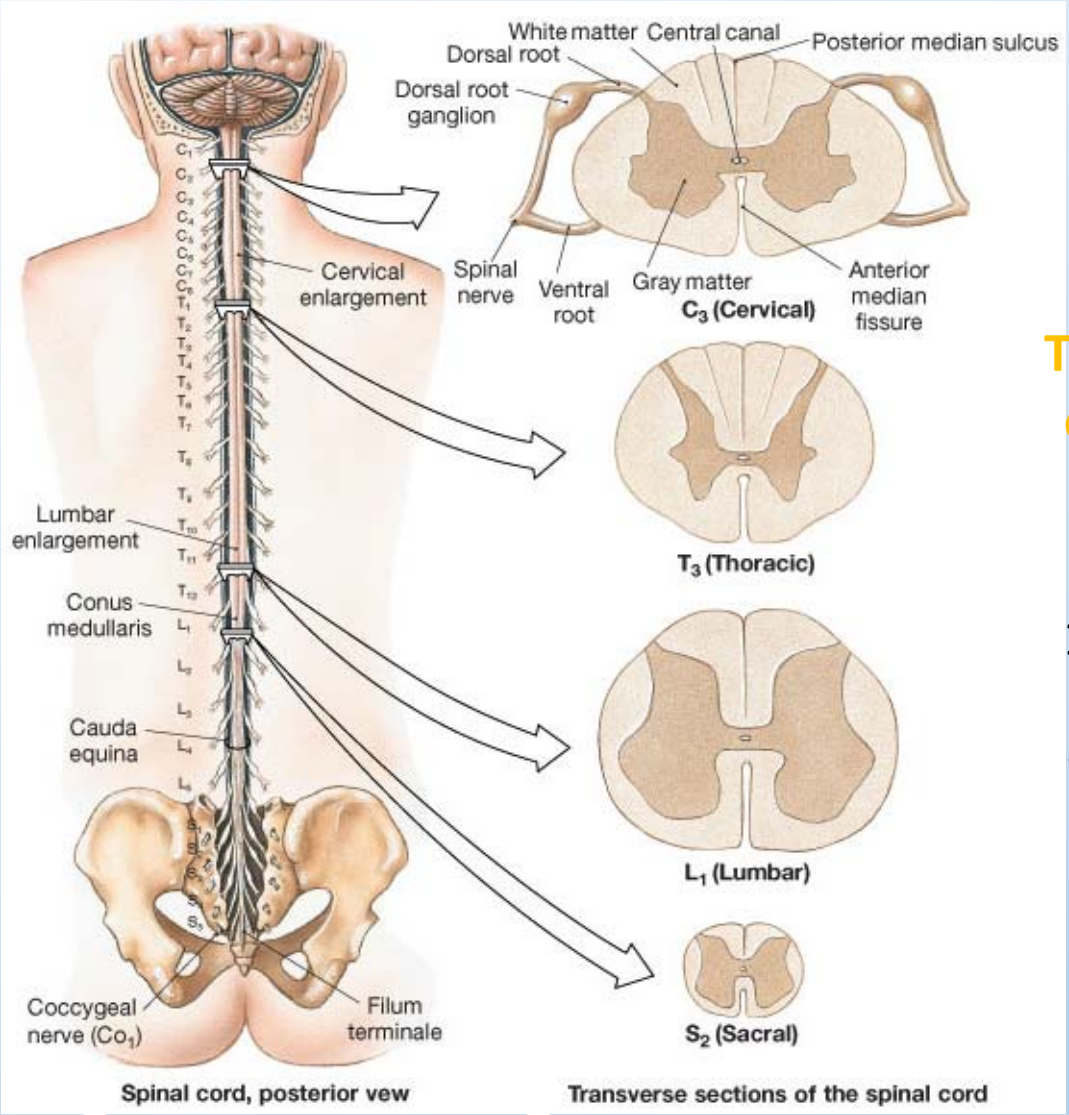
The Motor/Multipolar Neuron



Histology of a Neuron

The **3** major types of **Communications Junctions** coming from Neurons





In the Spinal cord:
White matter = columns
Gray matter = horns

There are 31 pairs of Spinal Nerves

8 Cervical (C_1-C_8)

12 Thoracic (T_1-T_{12})

5 Lumbar (L_1-L_5)

5 Sacral (S_1-S_5)

1 Coccygeal (Co_1)

Spinal Meninges

- Dura Mater

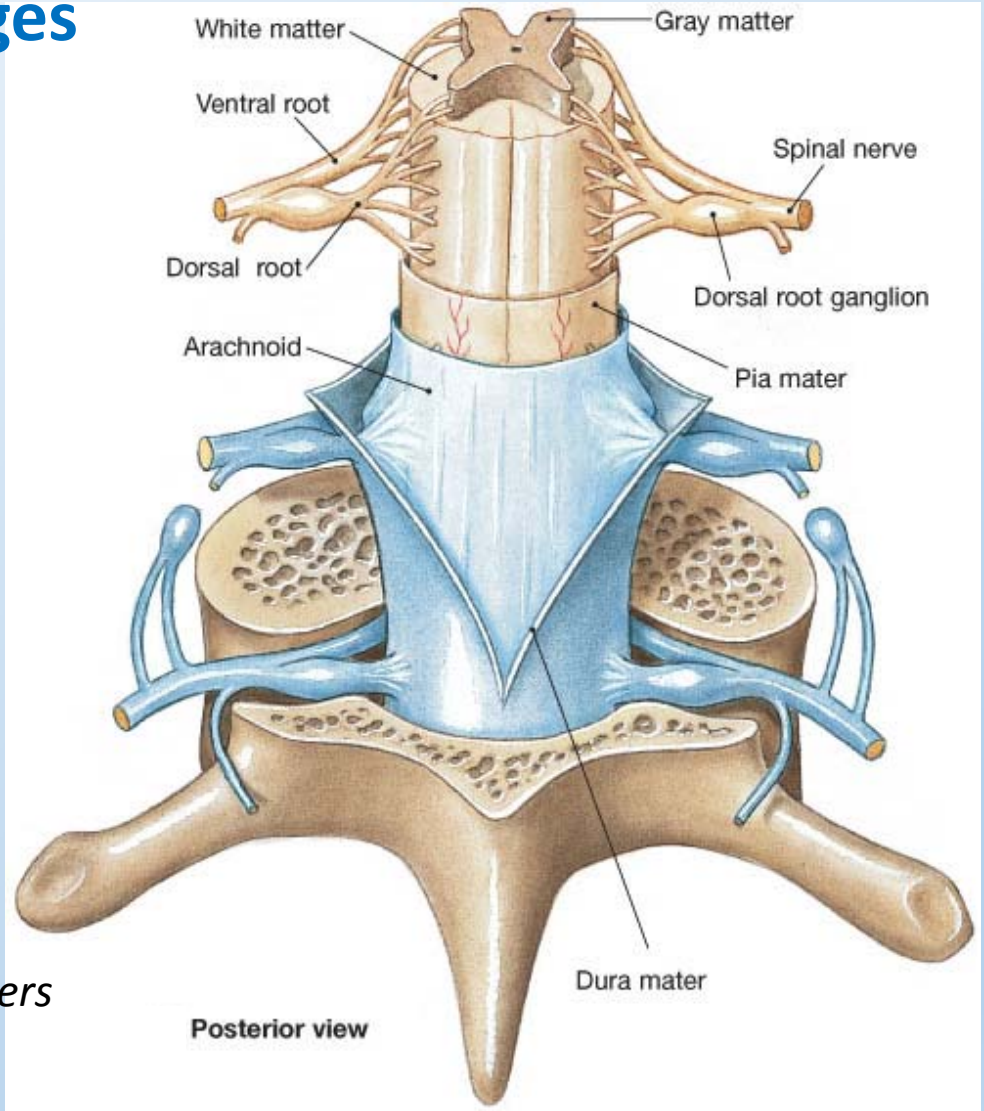
Dense irregular CT + Simple squamous epithelium

- Arachnoid

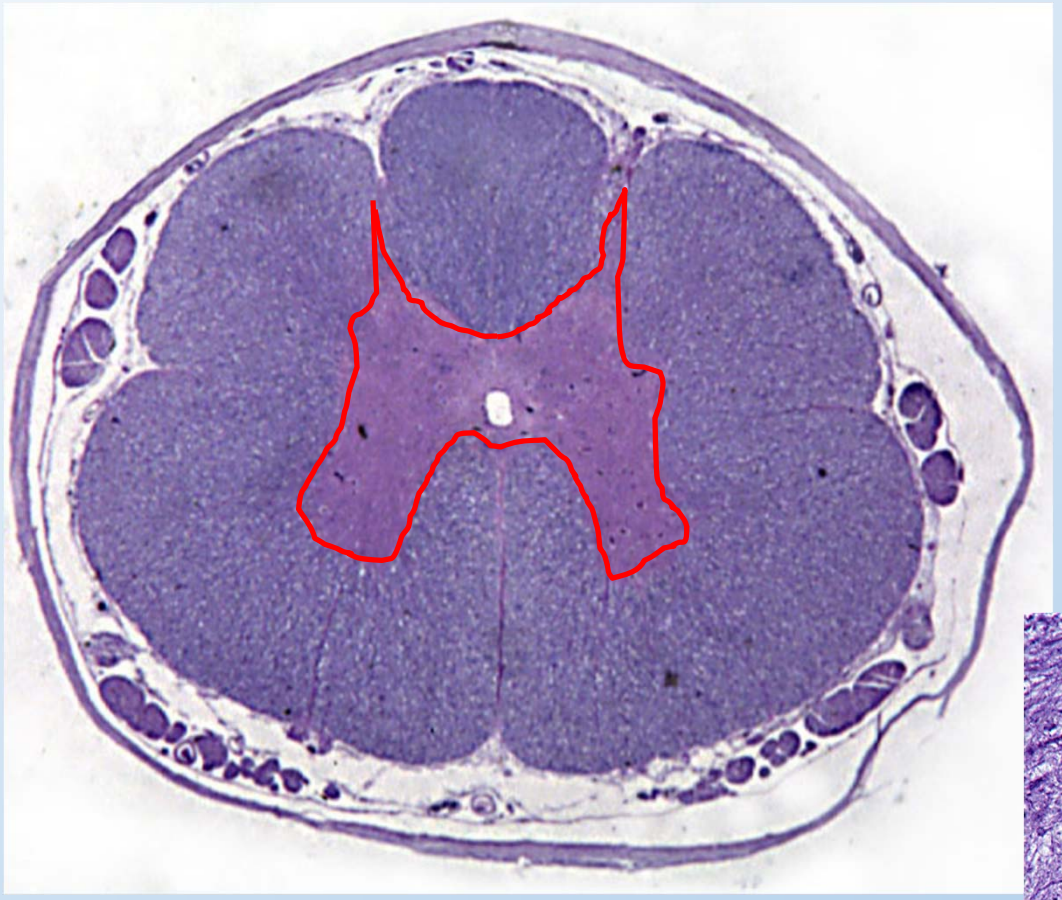
Simple squamous epithelium

- Pia Mater

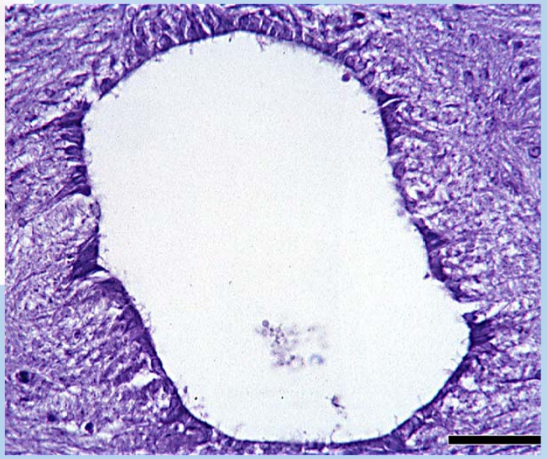
Collagen and elastic fibers



Cross Section of Spinal Cord Histology

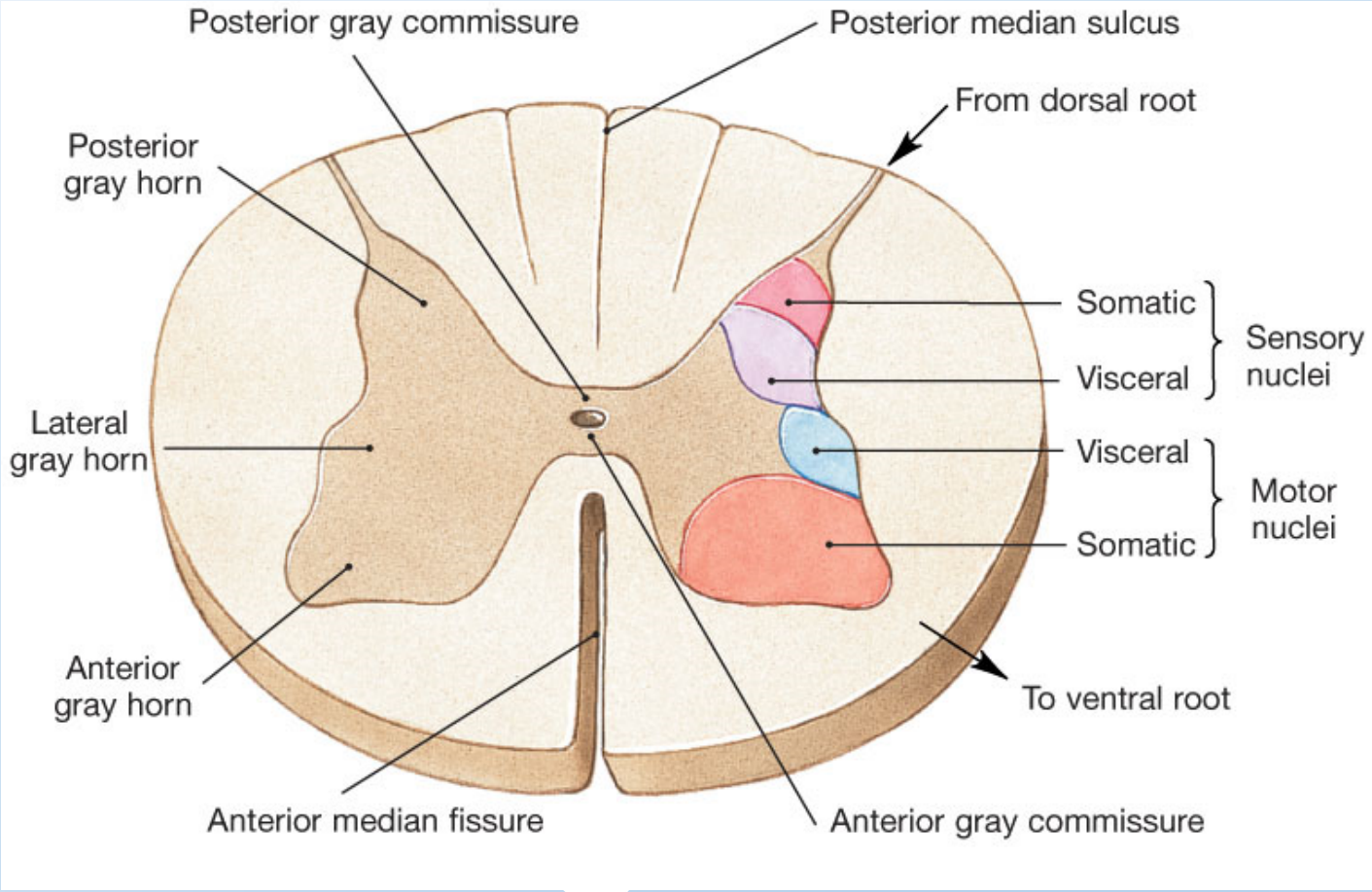


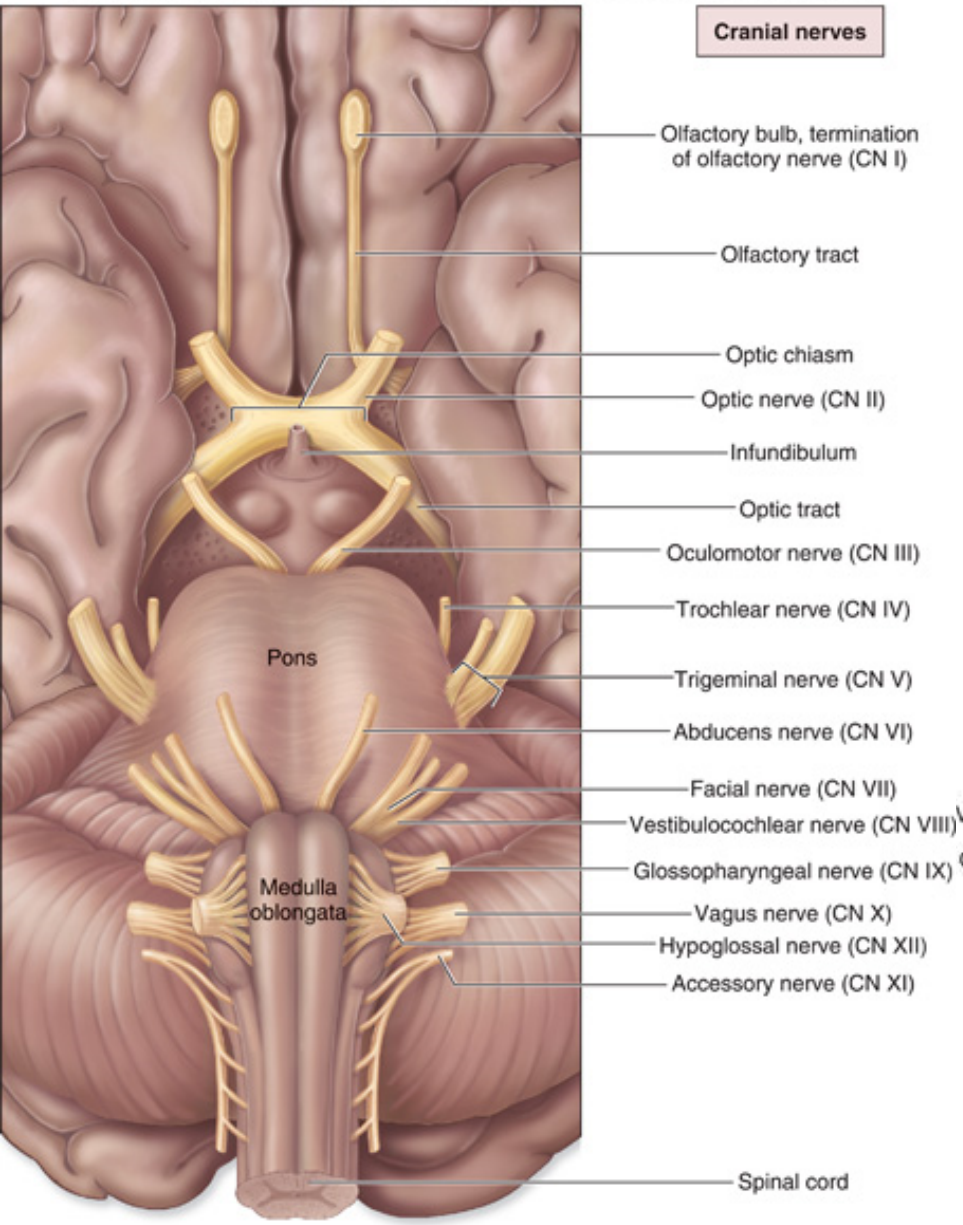
Central Canal
filled with CSF lined
with ependymal cells



Now draw the x.s. of spinal cord!

The Spinal Cord Nuclei





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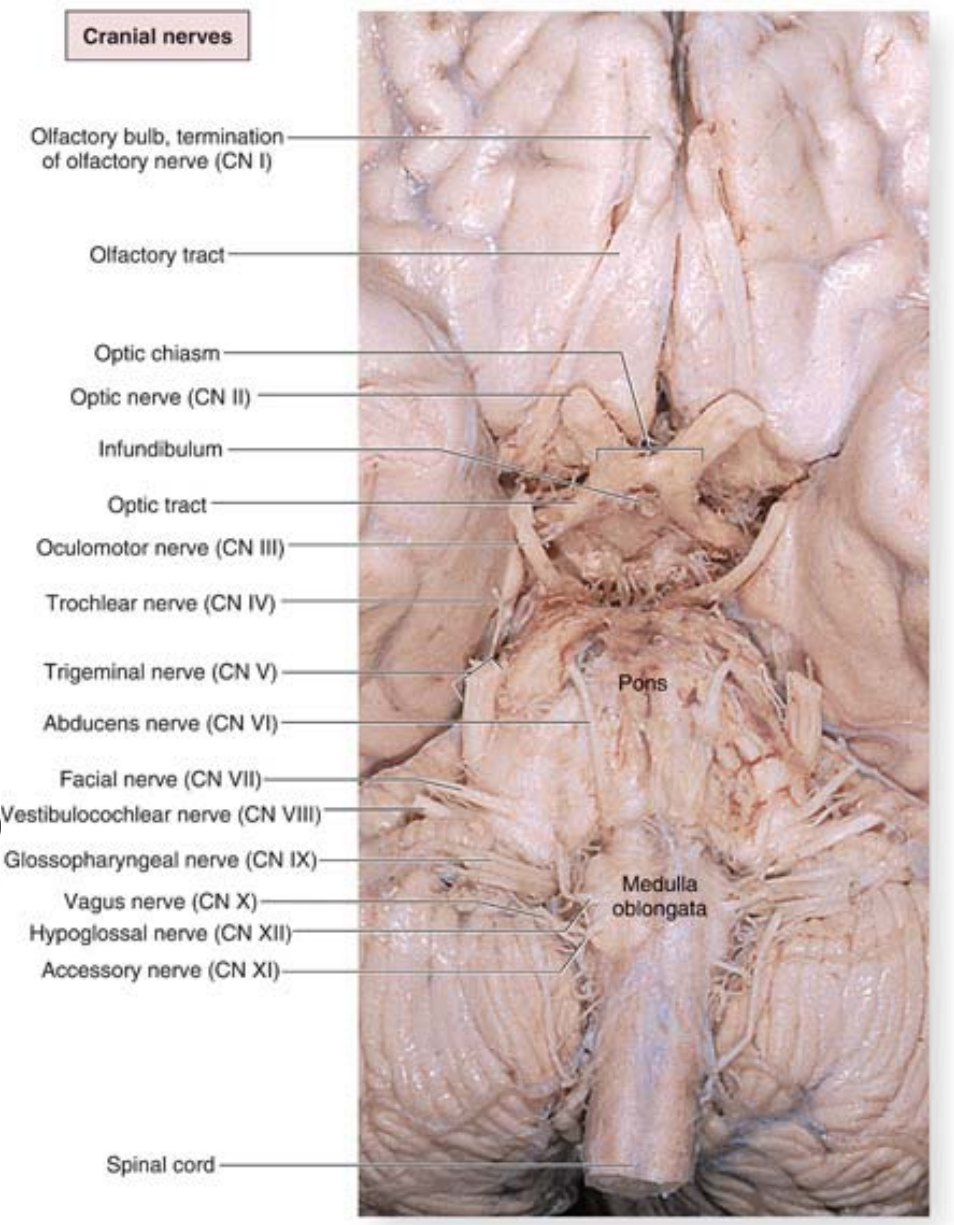
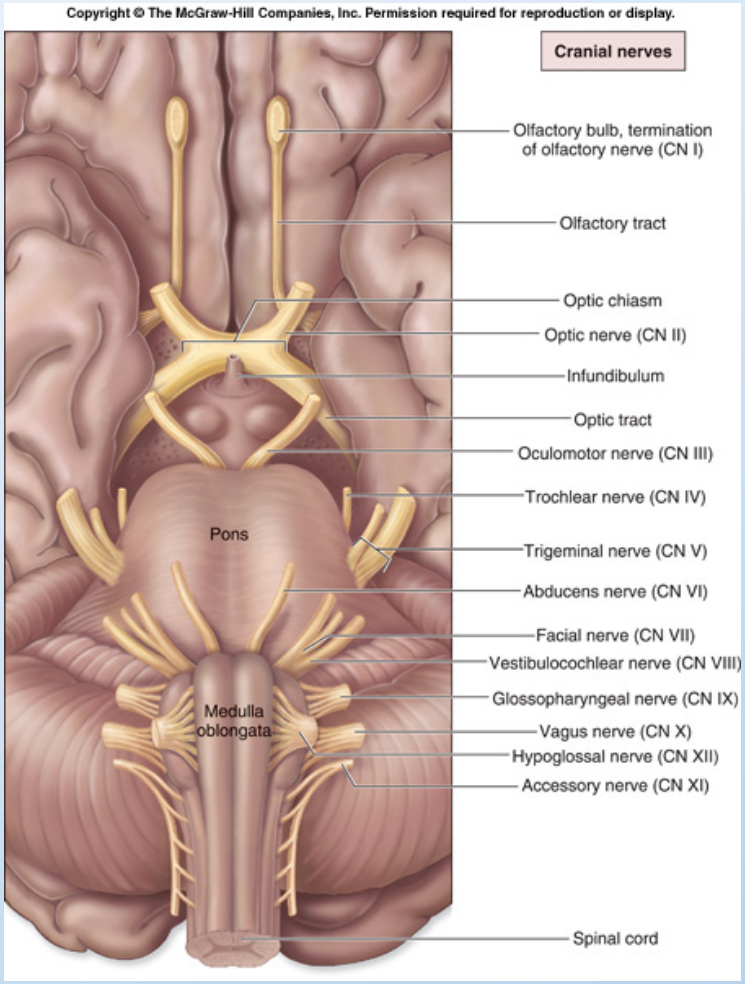


Nervous System : Cranial Nerves

Cranial Nerves

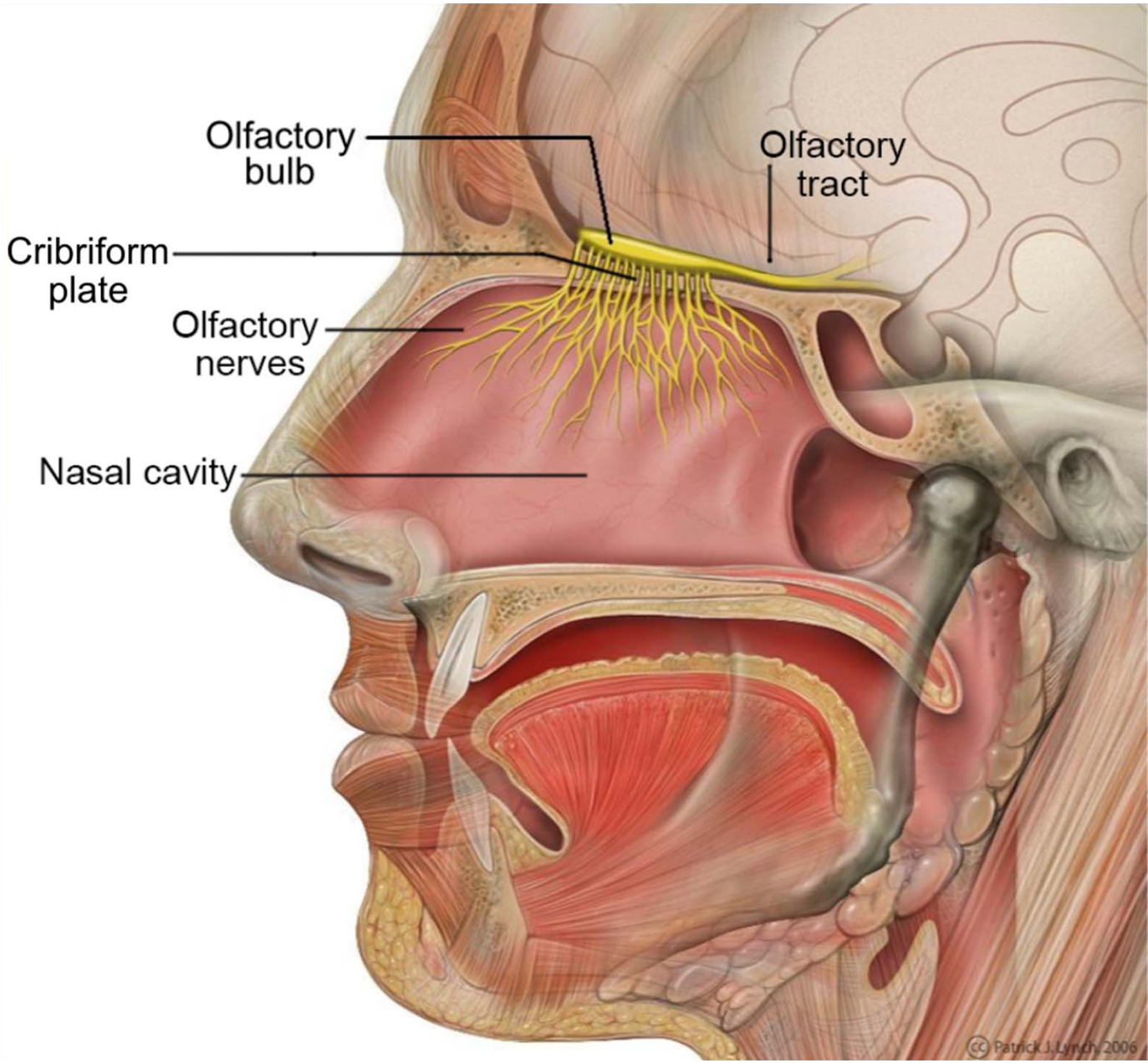


- Indicated by Roman numerals I-XII from anterior to posterior
- May have one or more of 3 functions
  - Sensory (special or general)
  - Somatic motor (skeletal muscles)
  - Parasympathetic (regulation of glands, smooth muscles, cardiac muscle)
- Proprioception
  - Positional information of body parts

Cranial Nerves

- Olfactory (I)
  - Sensory (smell)
- Optic (II)
  - Sensory (sight)
- Oculomotor (III)
  - Motor (4 of 6 eye muscles)
  - Parasympathetic (constriction of pupil, movement of lens)

Olfactory

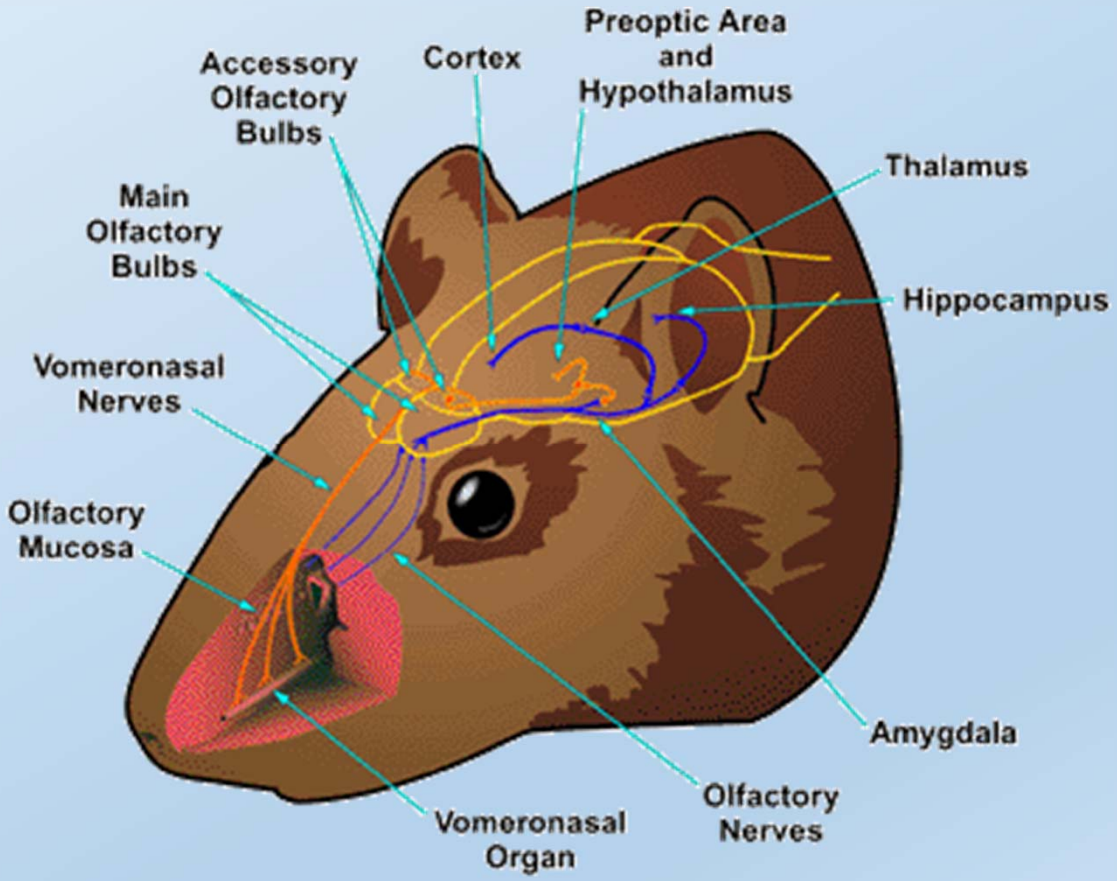

Olfactory bulb
Olfactory tract
Cribriform plate
Olfactory nerves
Nasal cavity
© Patrick J. Lynch, 2006

Animal Sense of Smell

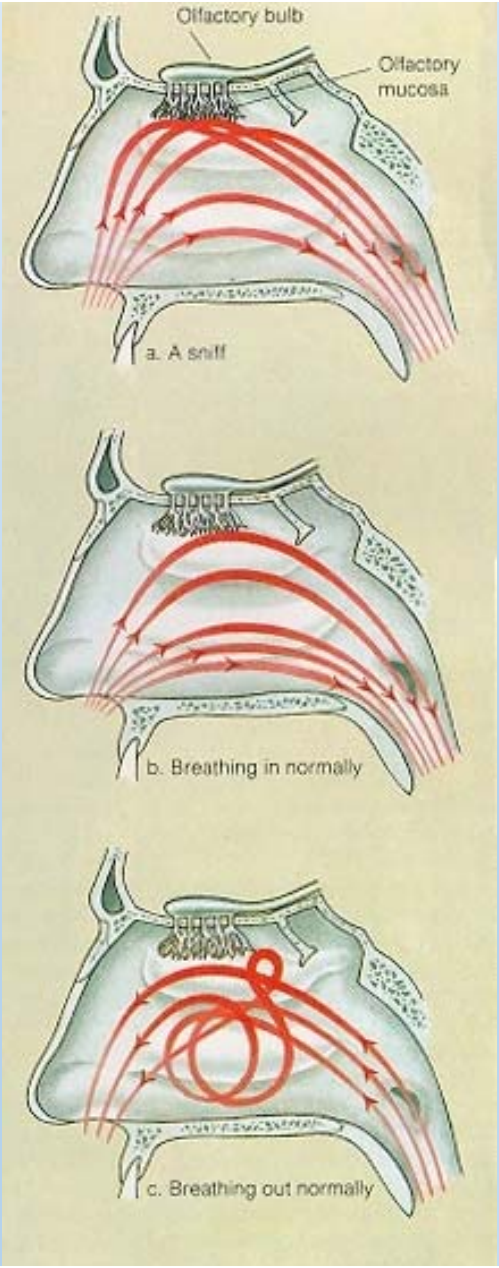
Vomeronasal Organ

Olfactory Organ

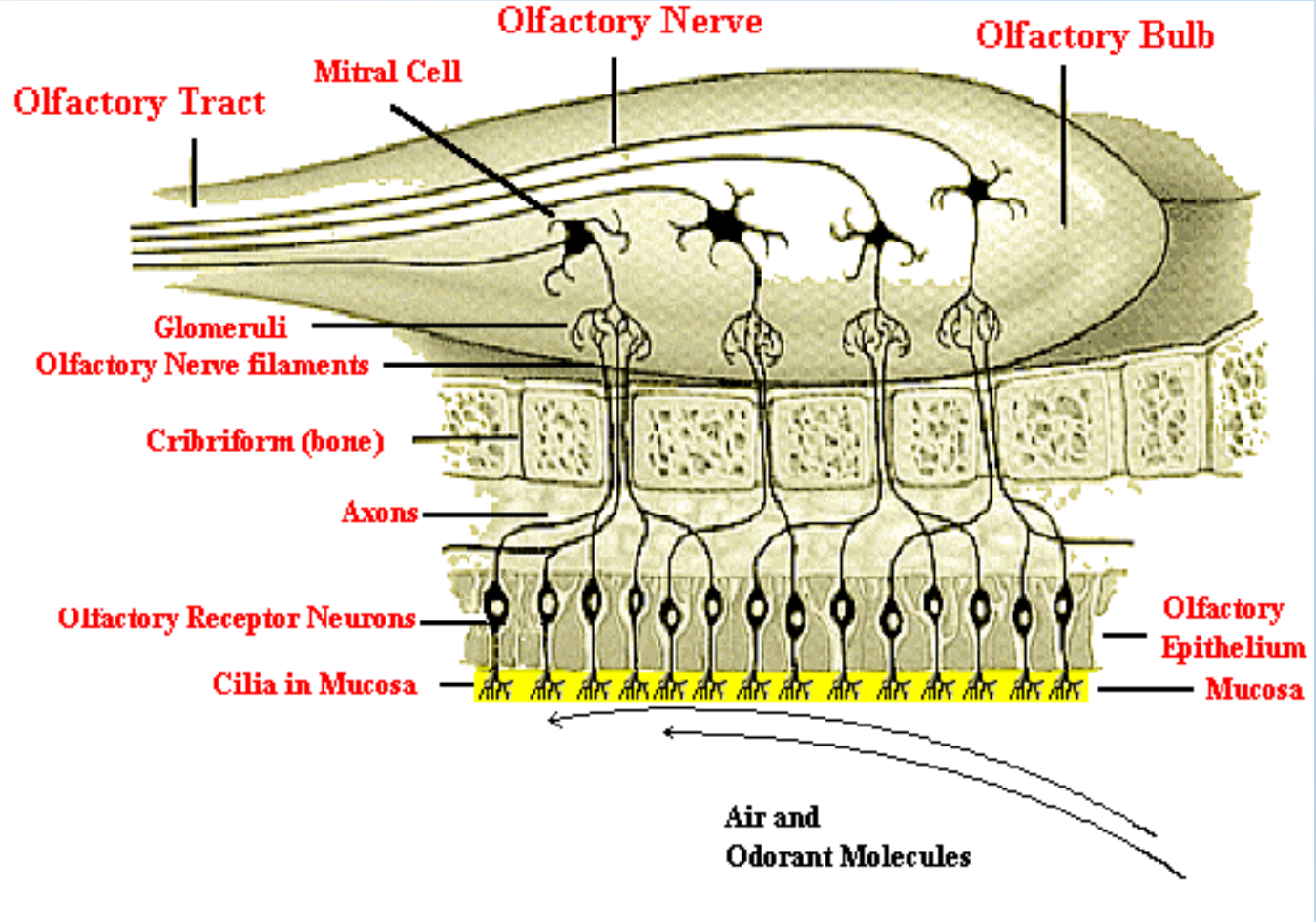
Trigeminal Nerve



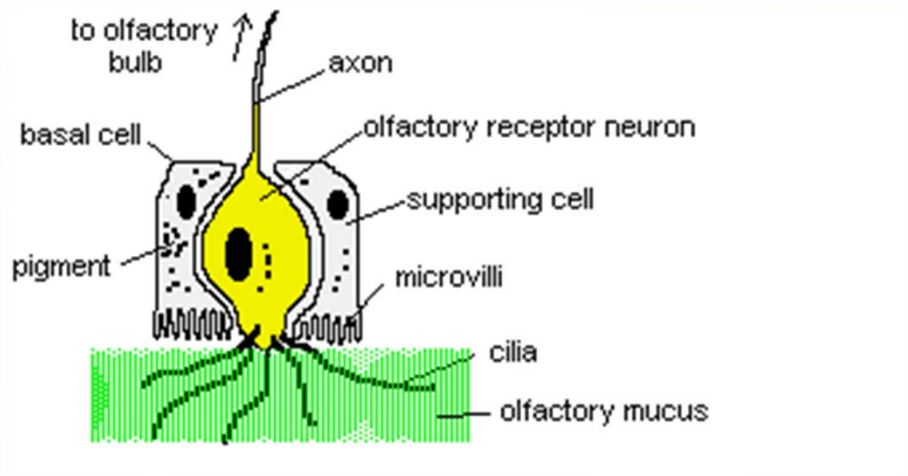
Normal Breath

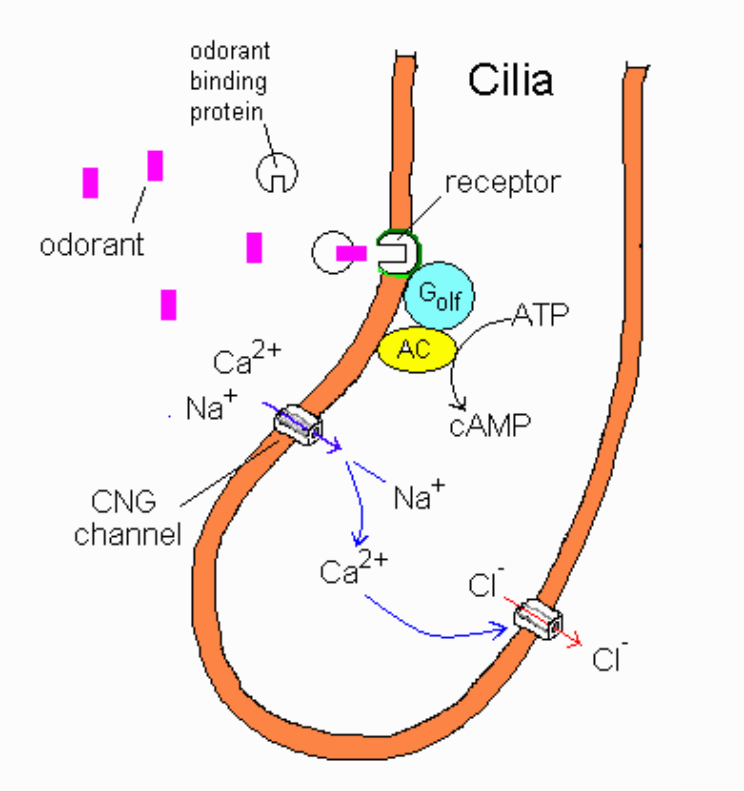


Olfactory Bulb



Olfactory Receptors

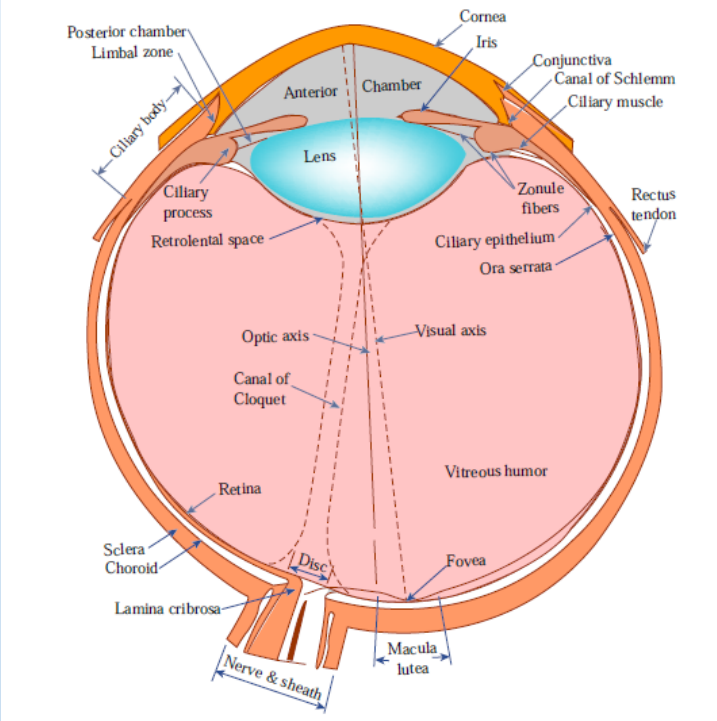


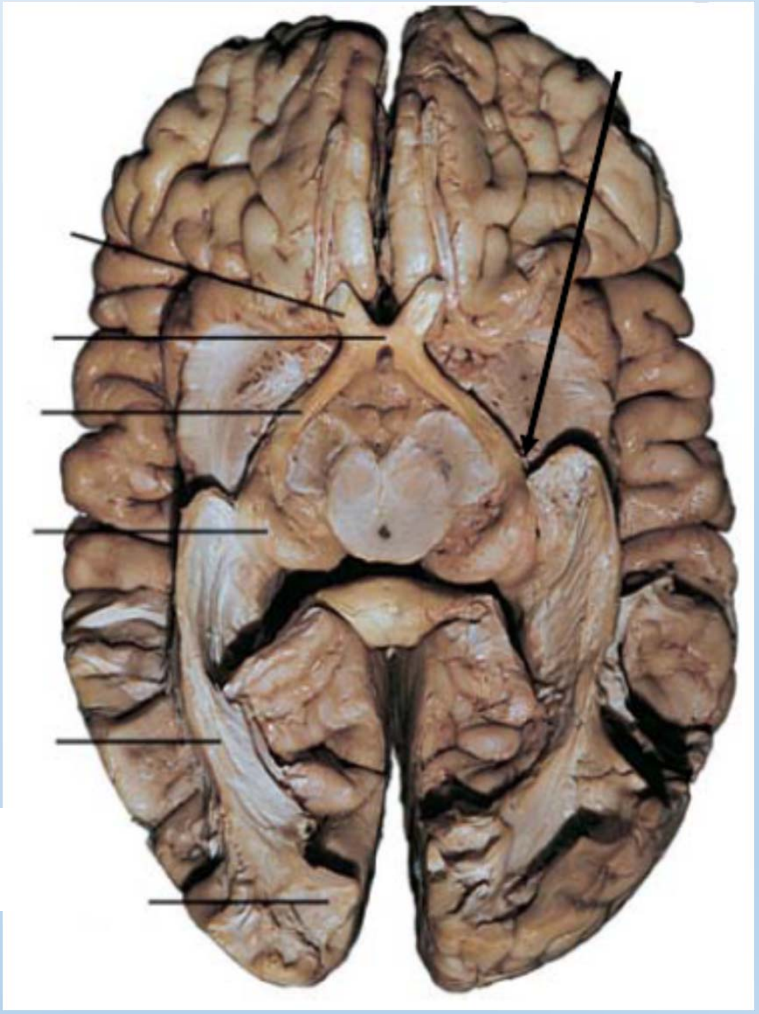


Odor Fatigue

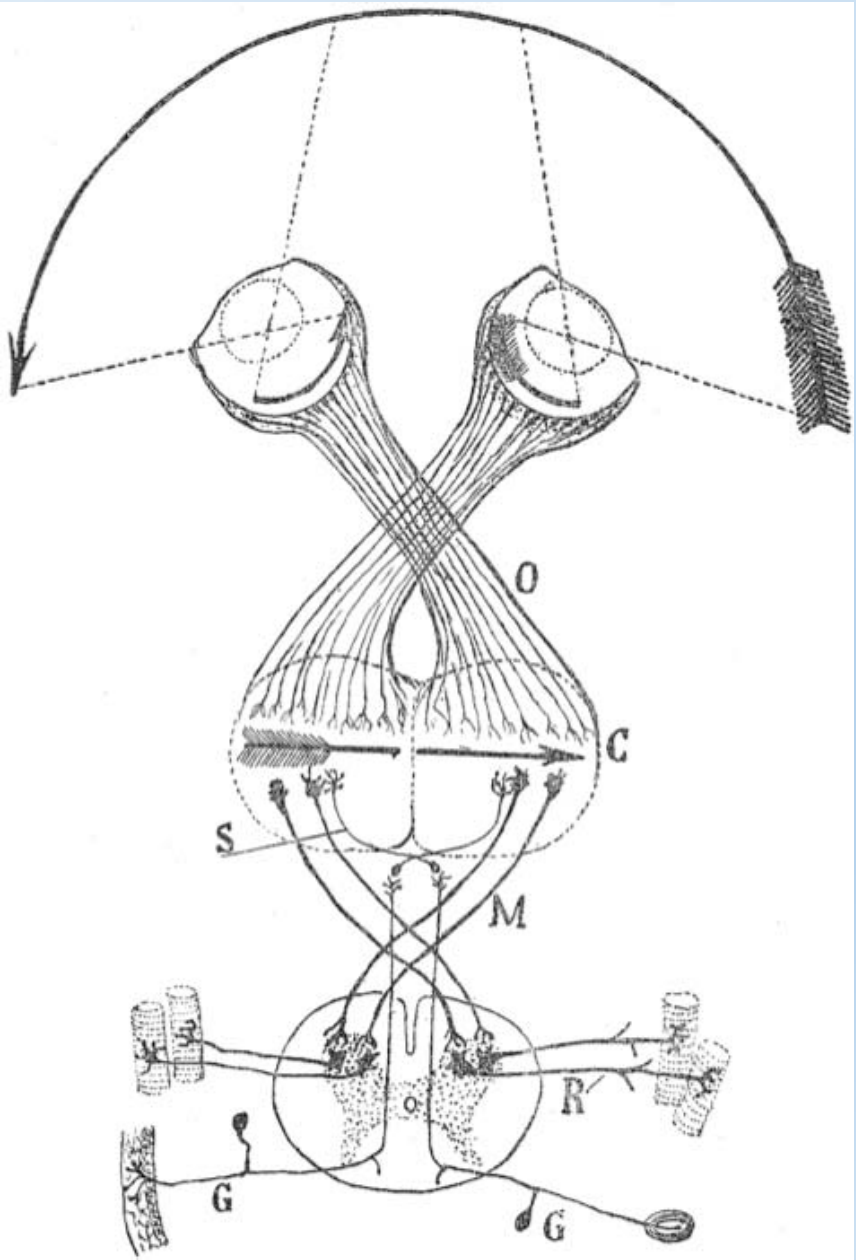
The longer you smell an odor,
the weaker the odor becomes.

The visual system

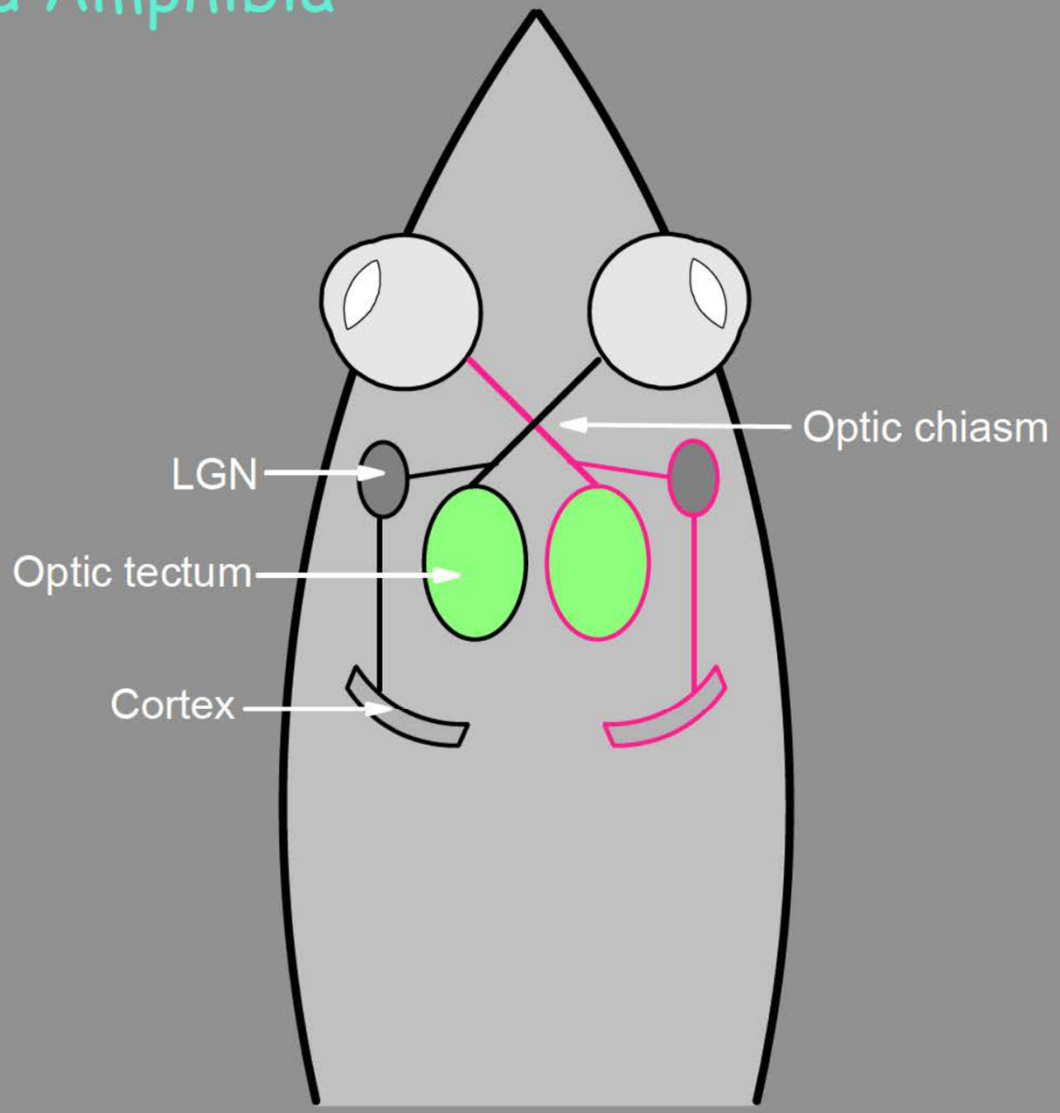




Hardware of vision



Fish and Amphibia



双眼视觉

- 为什么需要两只交叉视野的眼睛

- 作业：
  - 制作一个错觉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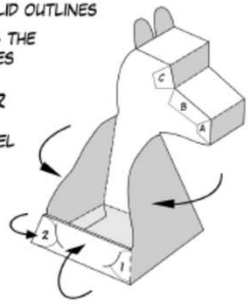
www.eChalk.co.uk
www.eChalk.co.uk

3D HORSE ILLUSION

CUT OUT, FOLD AND ASSEMBLE (SEE DIAGRAM)

- CUT ALONG THE SOLID OUTLINES
- FOLD ALONG THE DOTTED LINES
- INSERT TABS 1 & 2 INTO THE SLOTS ON THE BACK PANEL



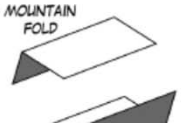
STAND APPROX 1 METRE AWAY, CLOSE ONE EYE AND LOOK AT THE CREATURE'S EYES. MOVE AROUND TO SEE THE ILLUSION...

e·chalk

...learning for the fun of it

www.eChalk.co.uk

Visit our website to download a variety of 3D creatures!



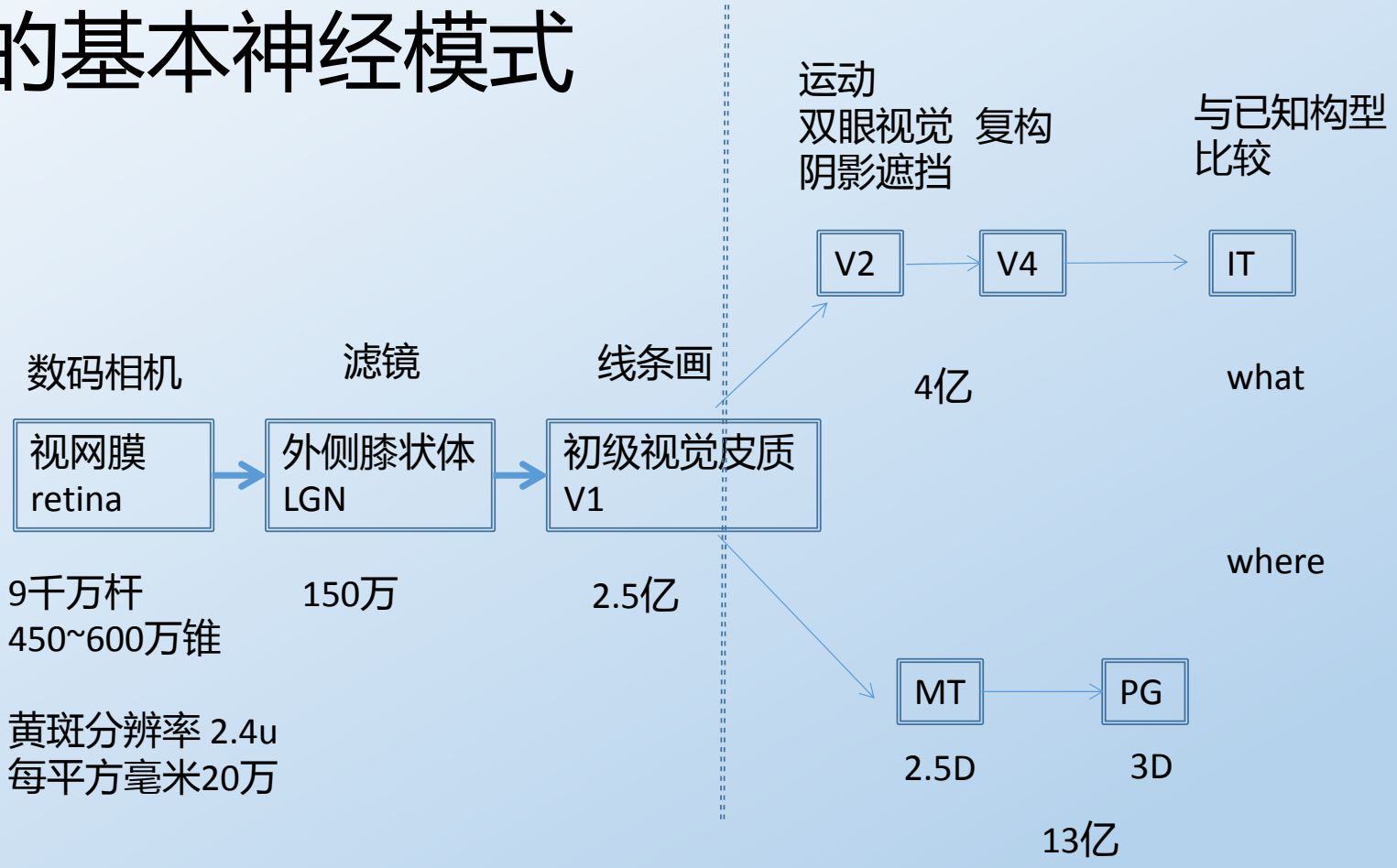
作业：

必做：任择其一， 制作一个

选作： 围绕为什么两只眼睛看就看不到这种错觉，写写你的看法。

下次课（周一）交给我。

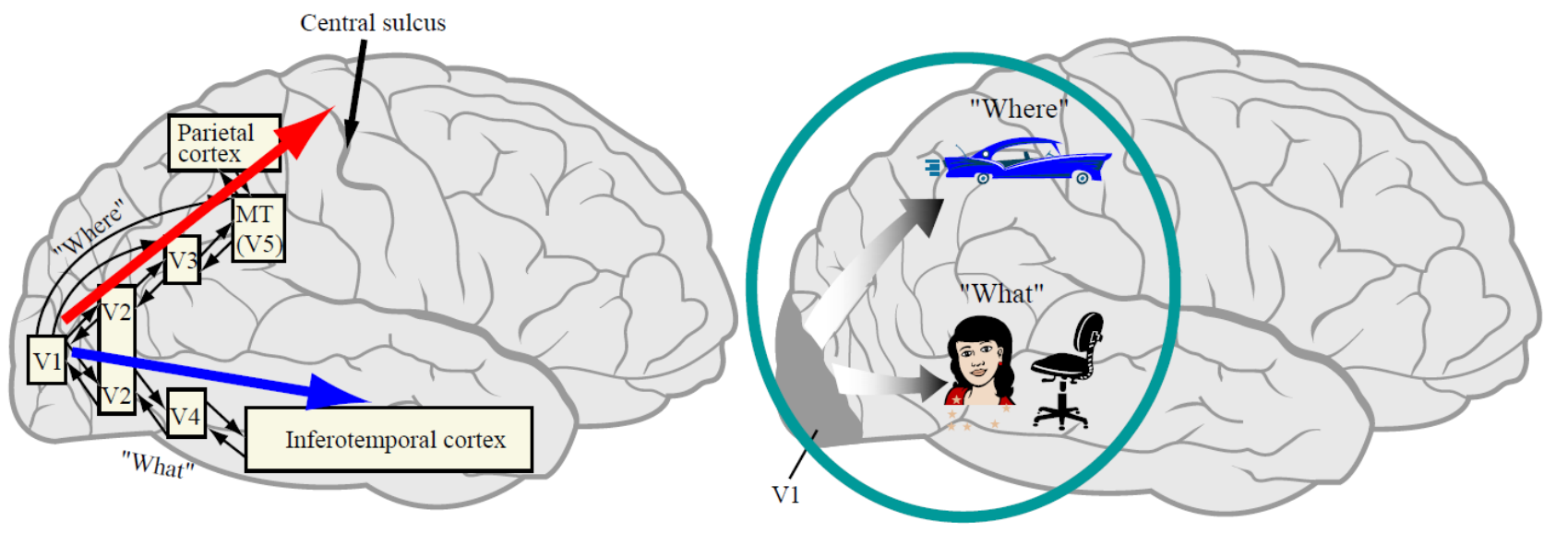
视觉的基本神经模式



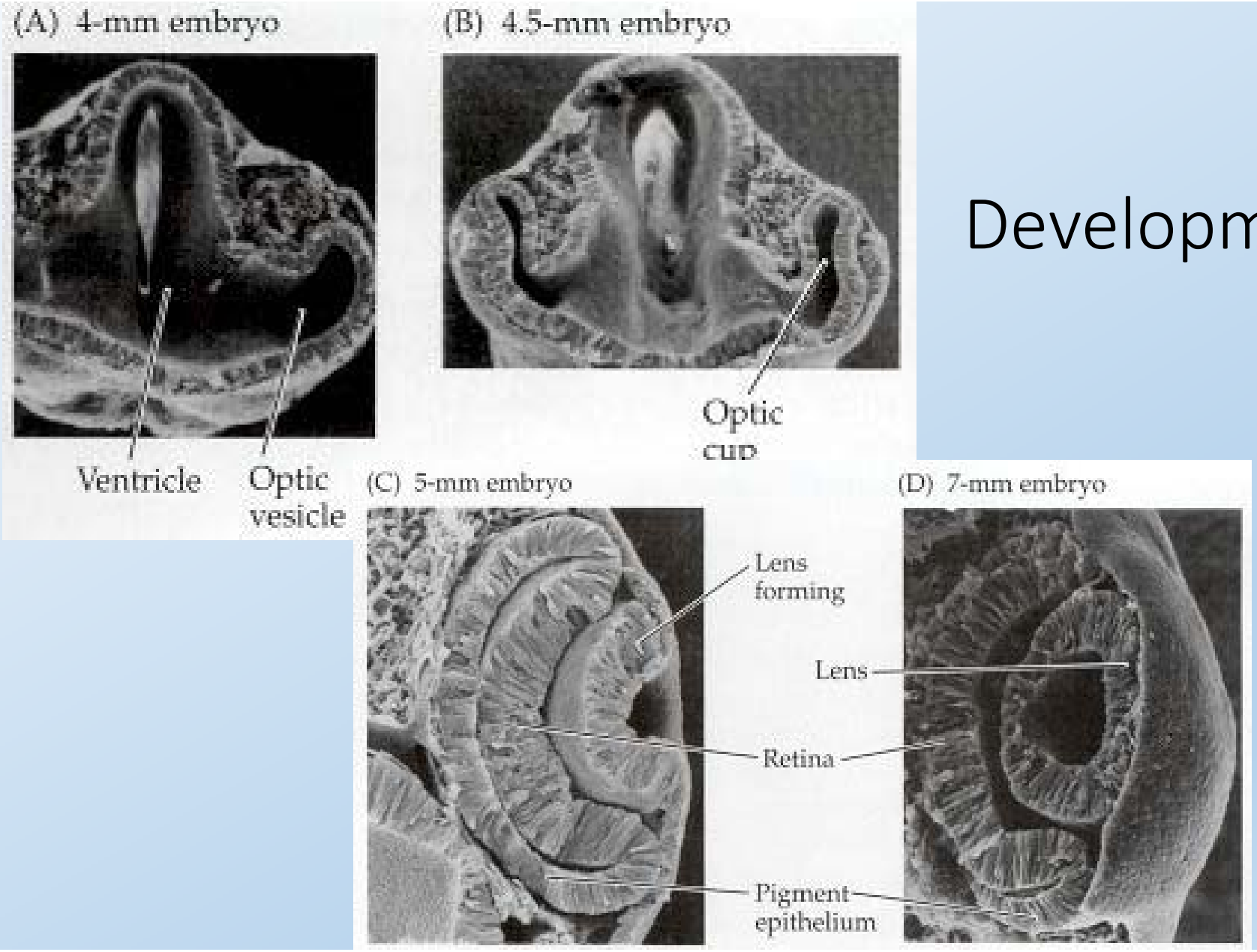
Computations in the early visual cortex, Journal of Physiology - Paris 97 (2003) 121–139

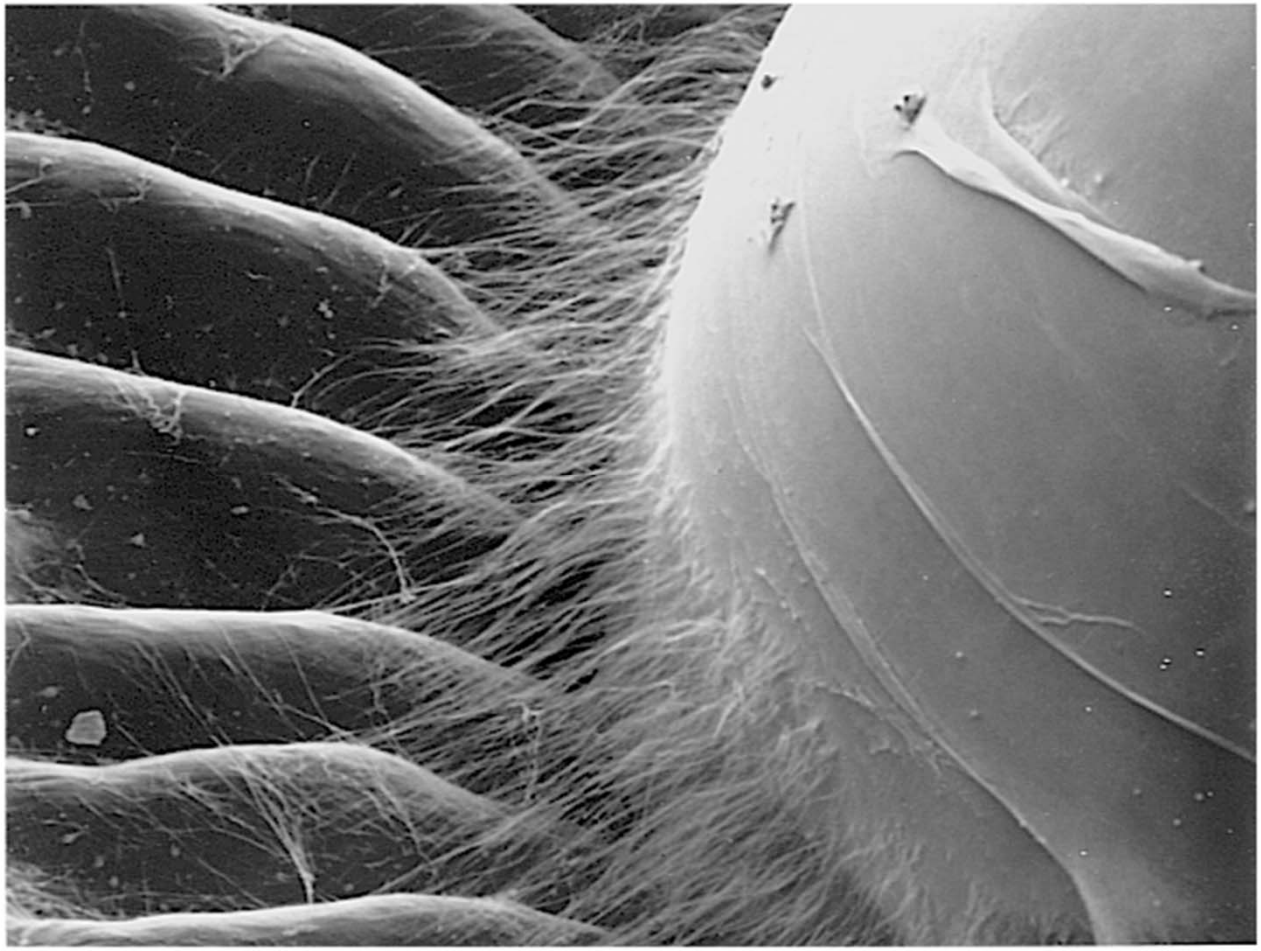
- What and where pathway

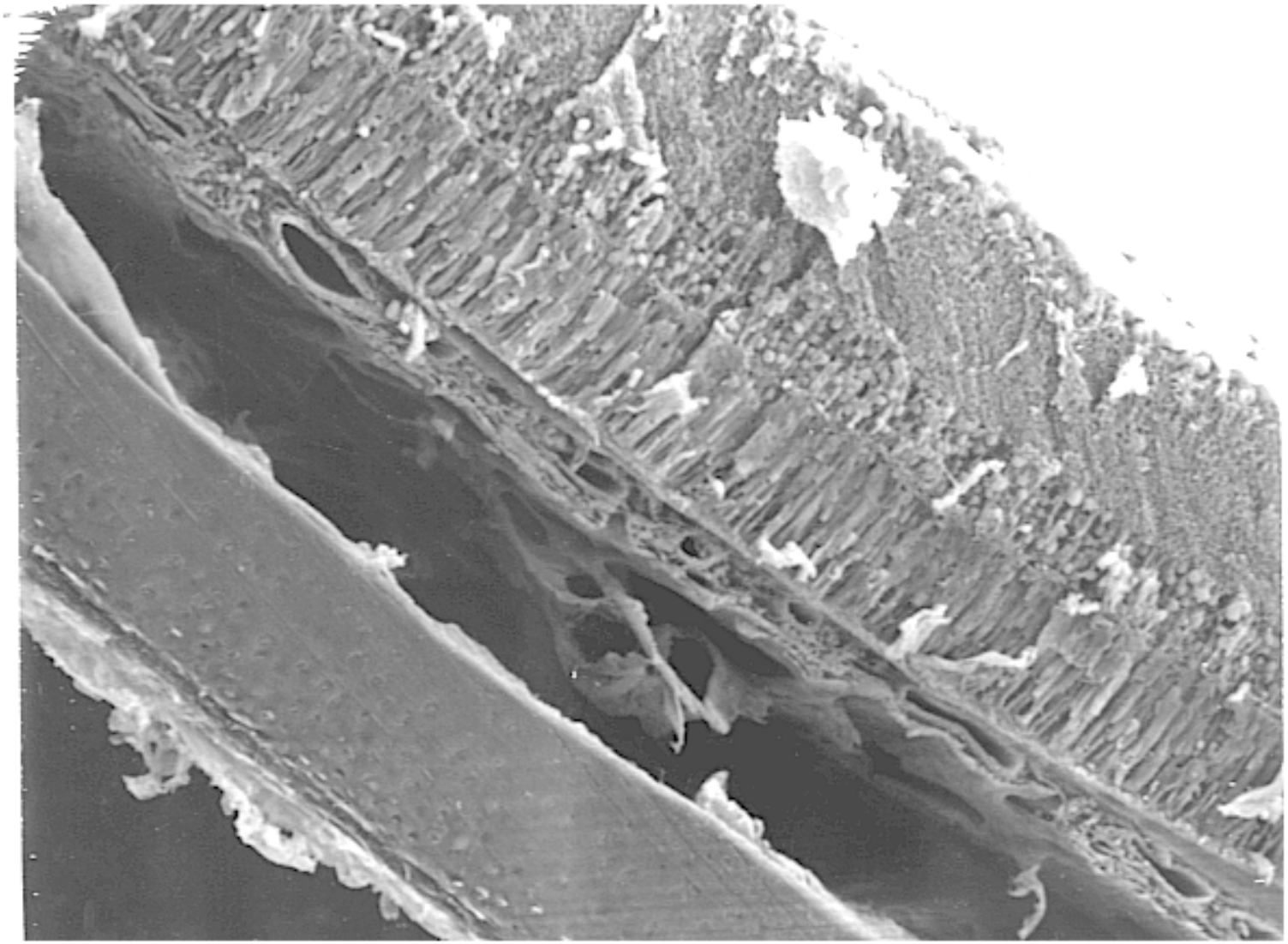
THE CAT

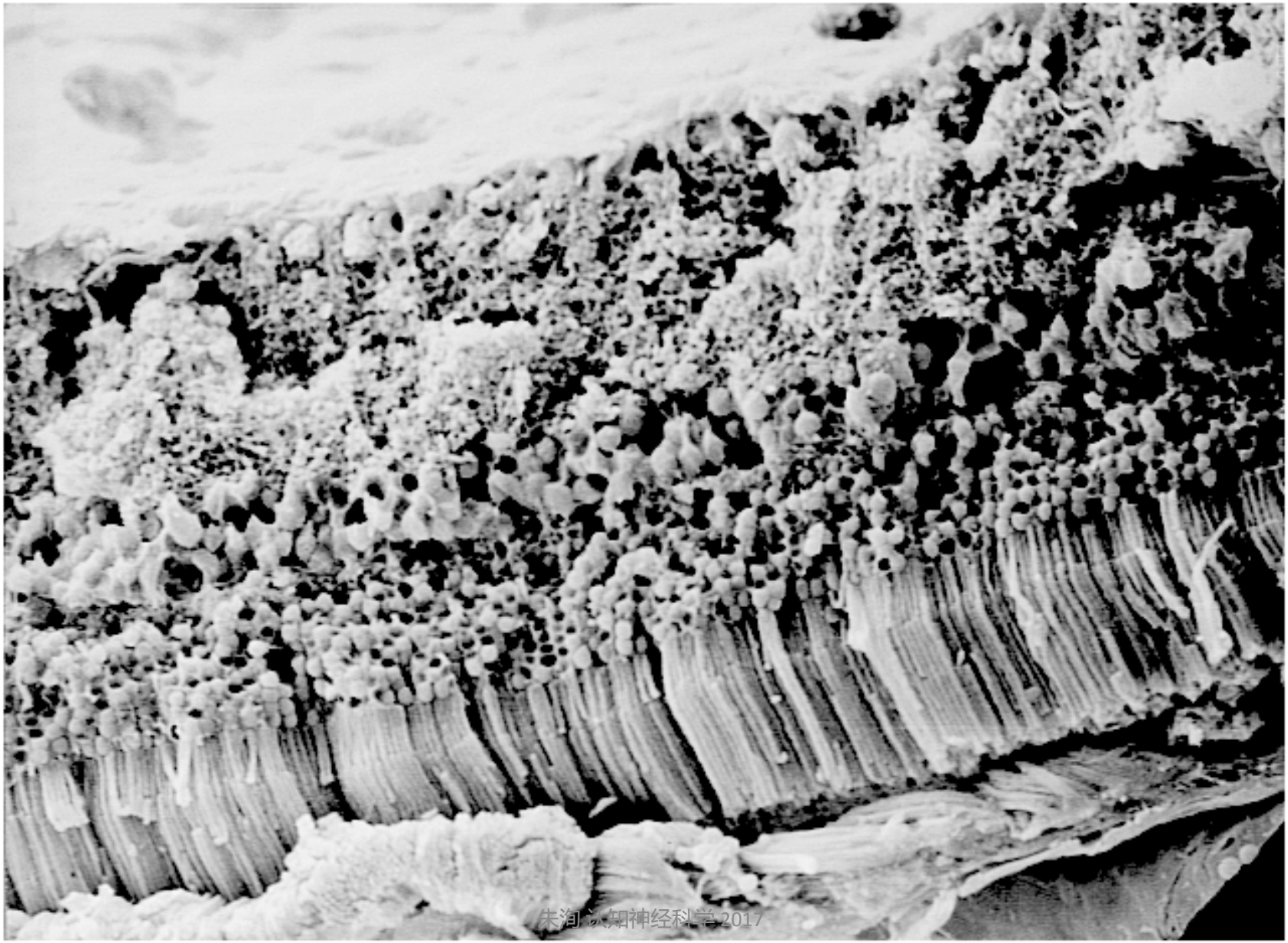


Development



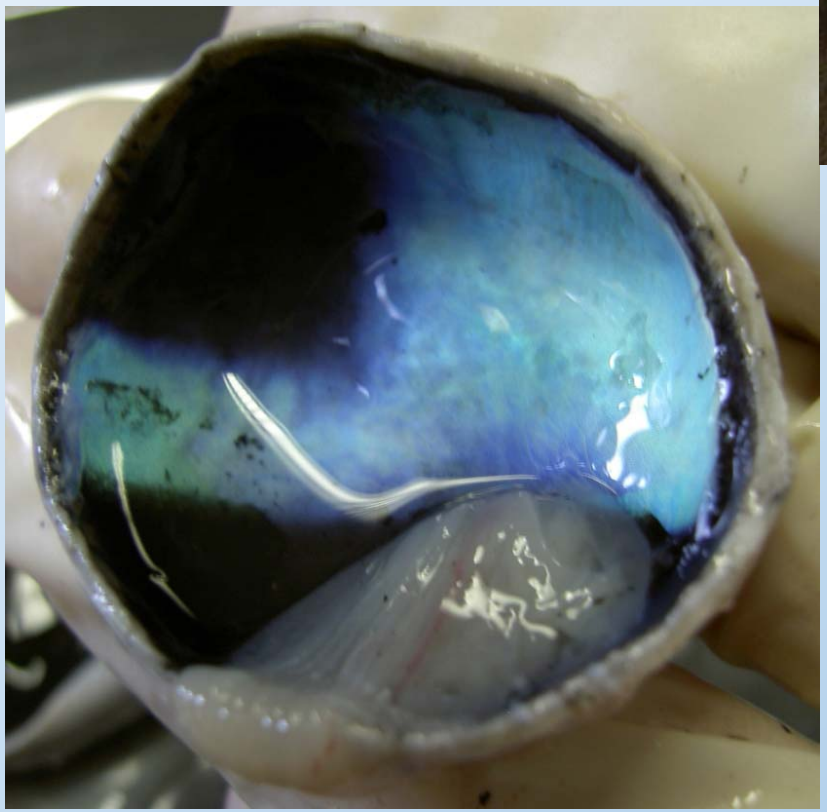


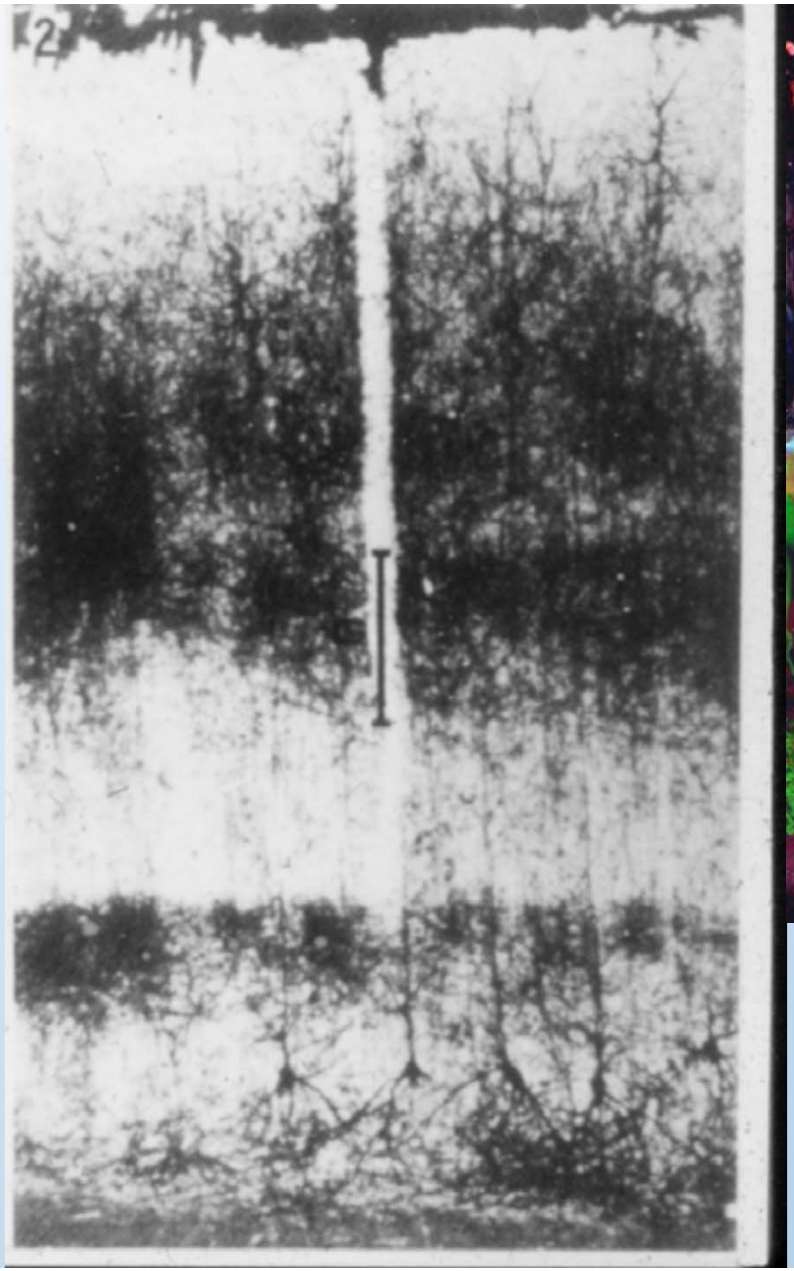


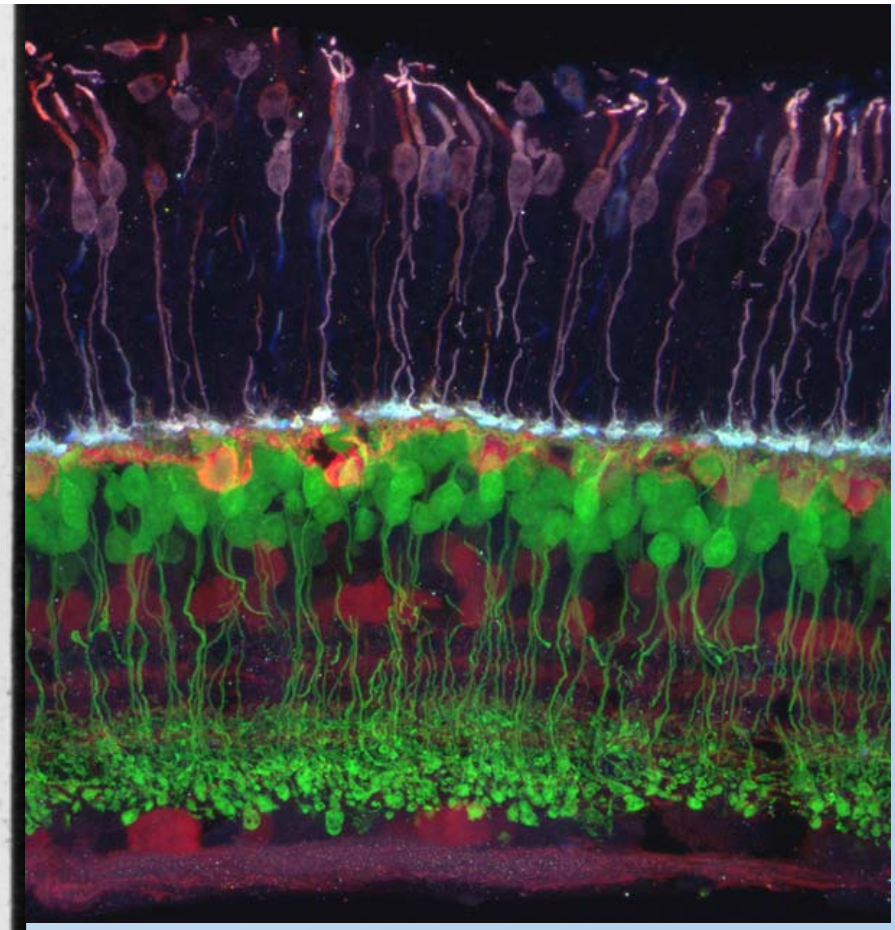


朱滢：认知神经科学 2017

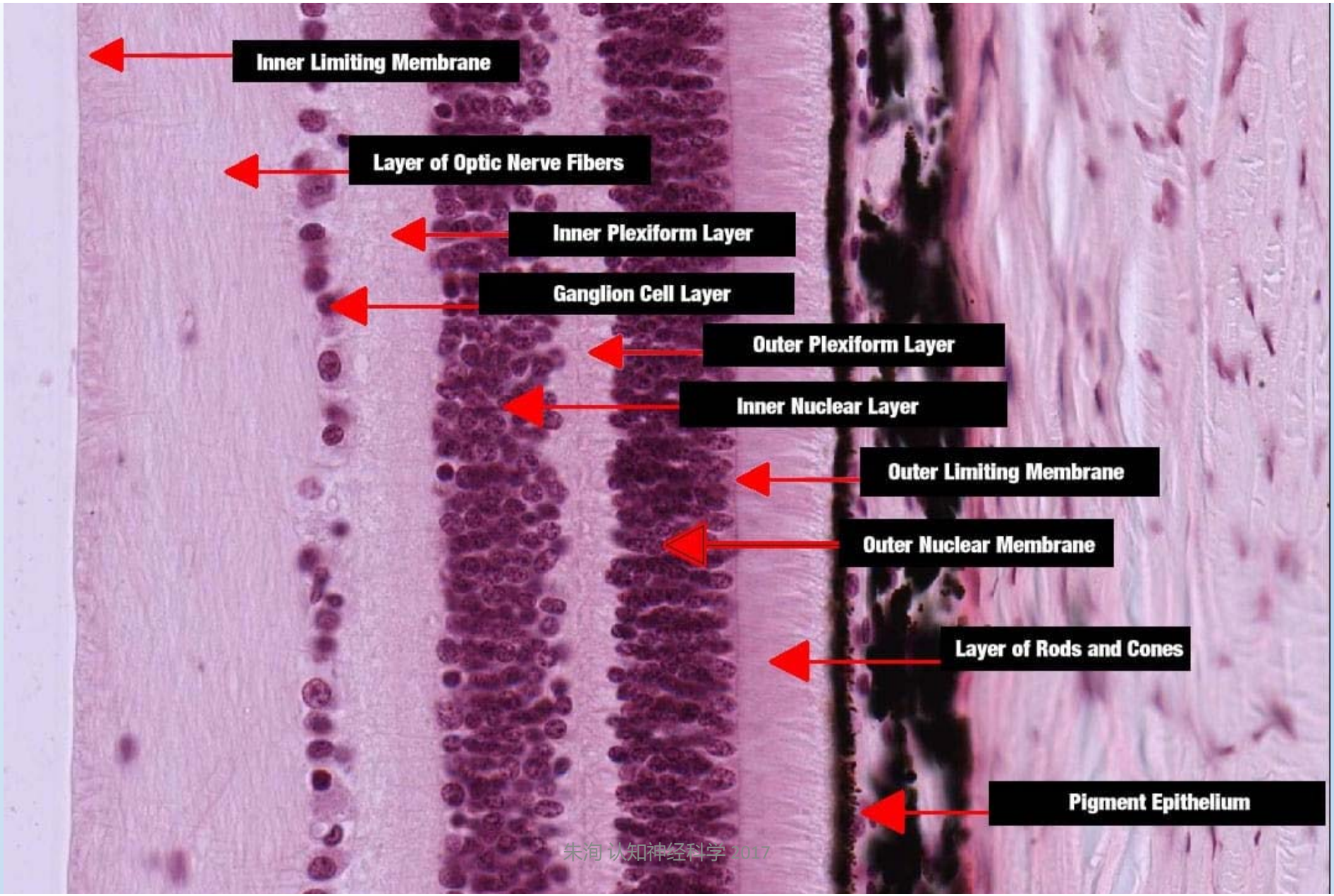
Ultrastructure

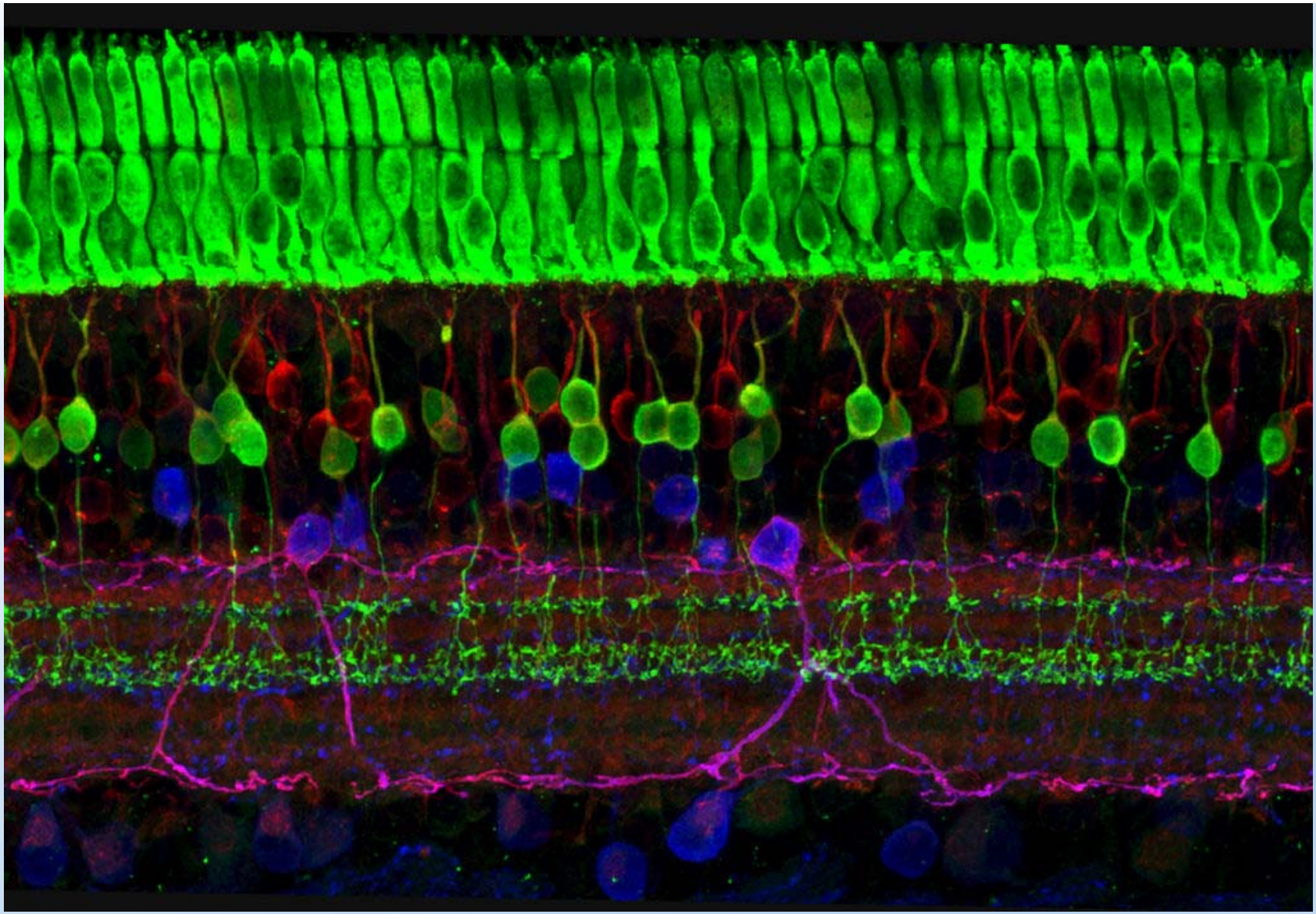


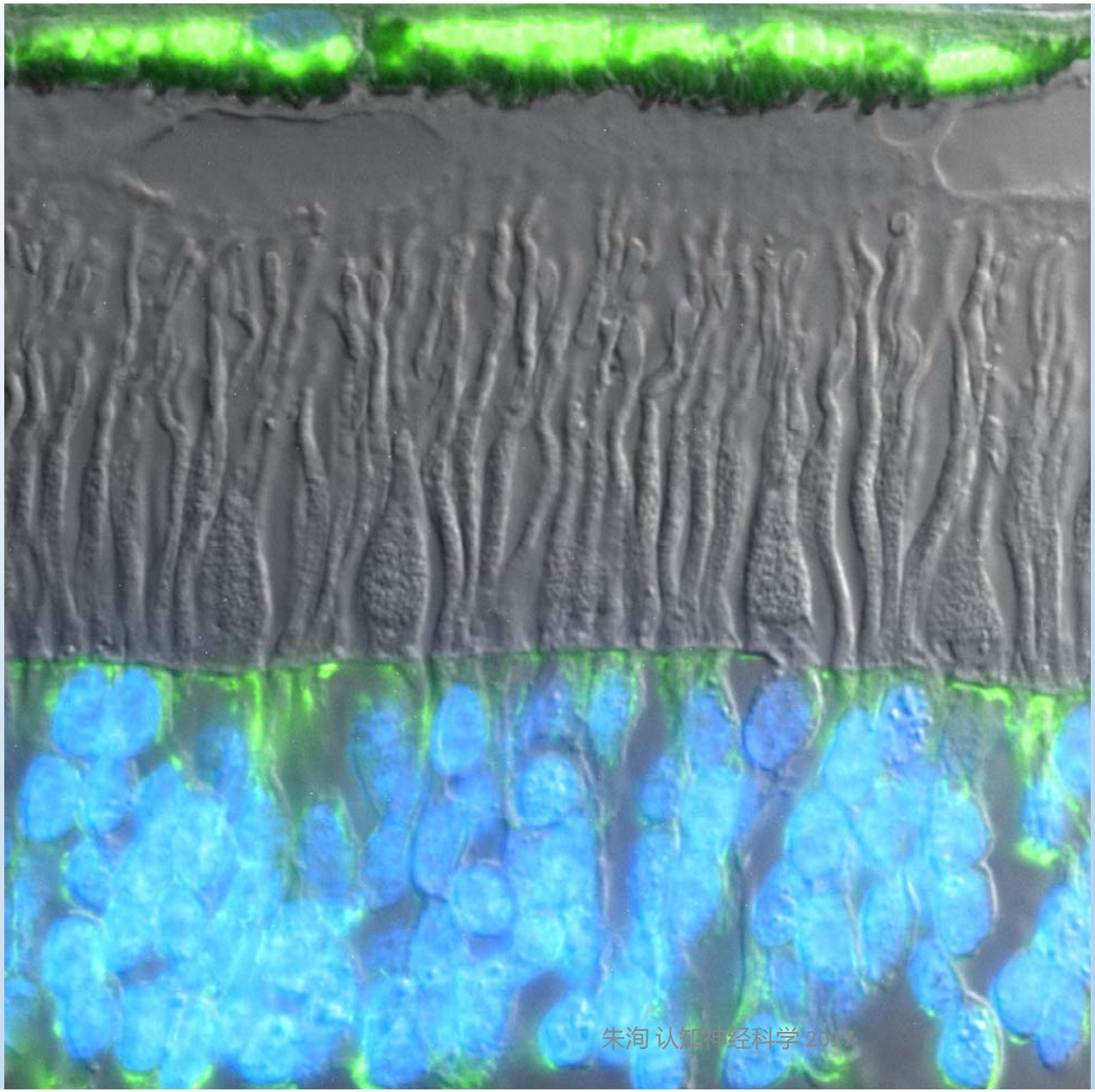




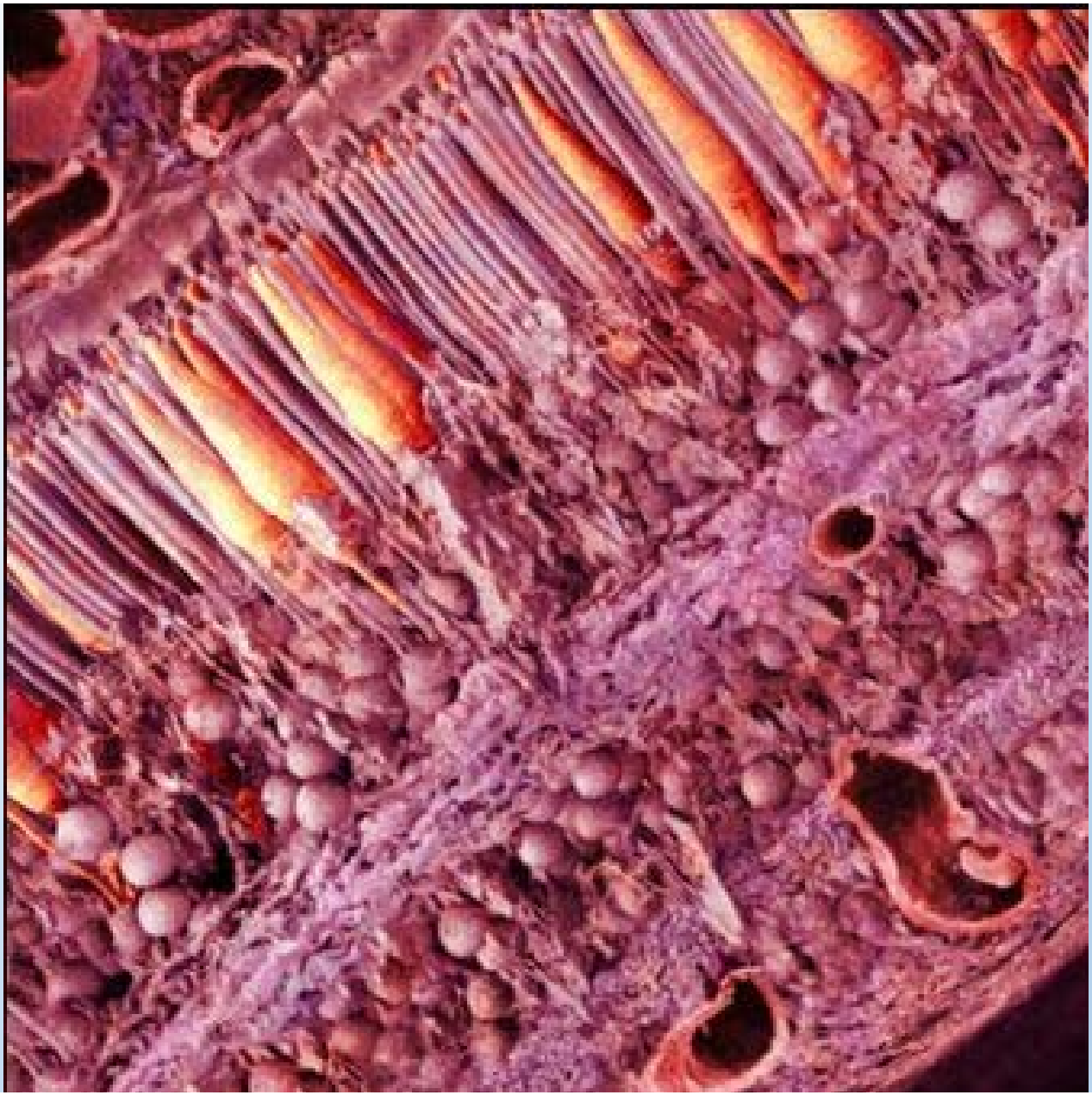
Micro structure of retina

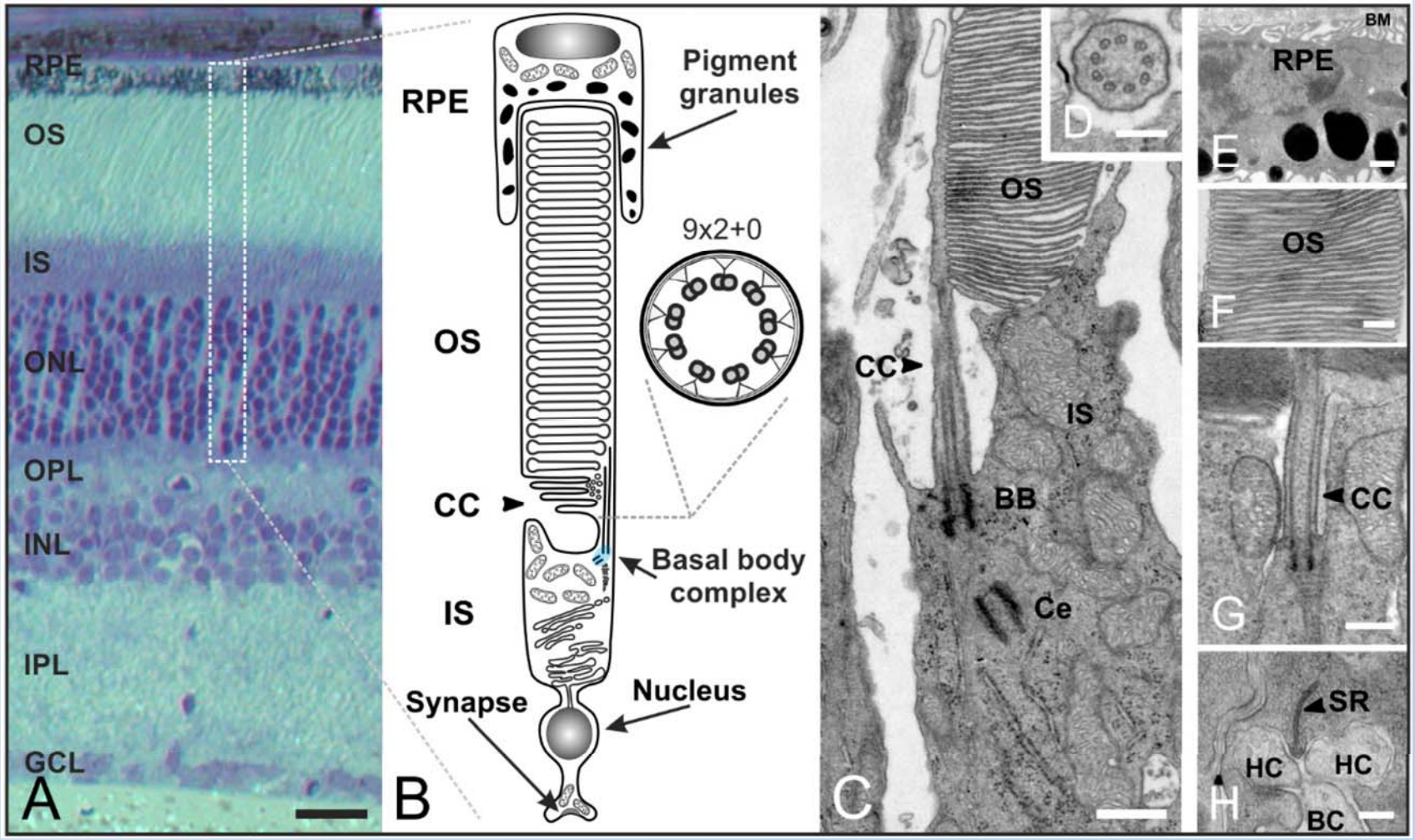


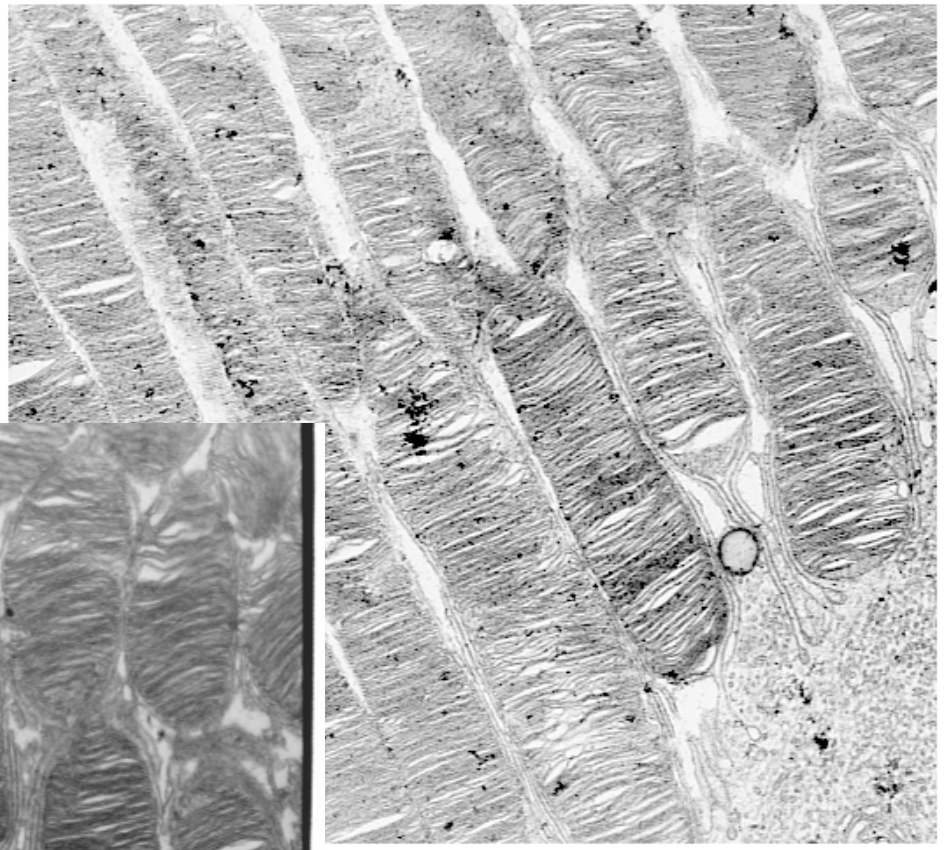


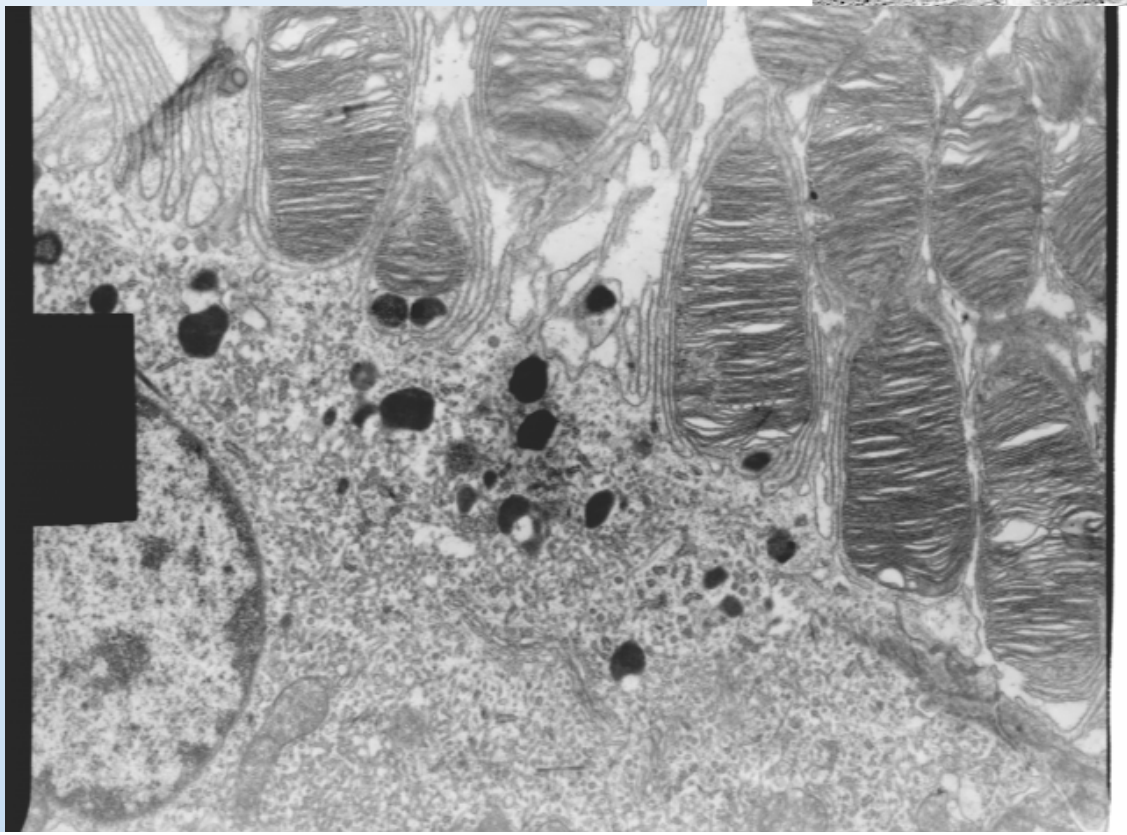


Rods and Corns

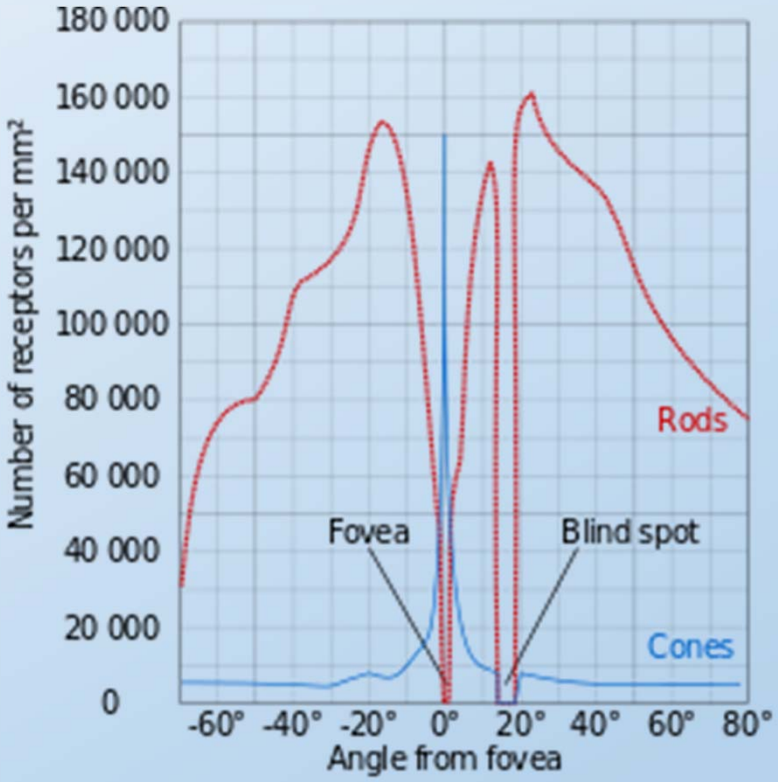



RPE
OS
IS
ONL
OPL
INL
IPL
GCL
A
RPE
Pigment granules
9x2+0
OS
CC
IS
Basal body complex
Synapse
Nucleus
B
OS
CC
IS
BB
Ce
C
D
BM
RPE
E
OS
F
CC
G
SR
HC
HC
BC
H

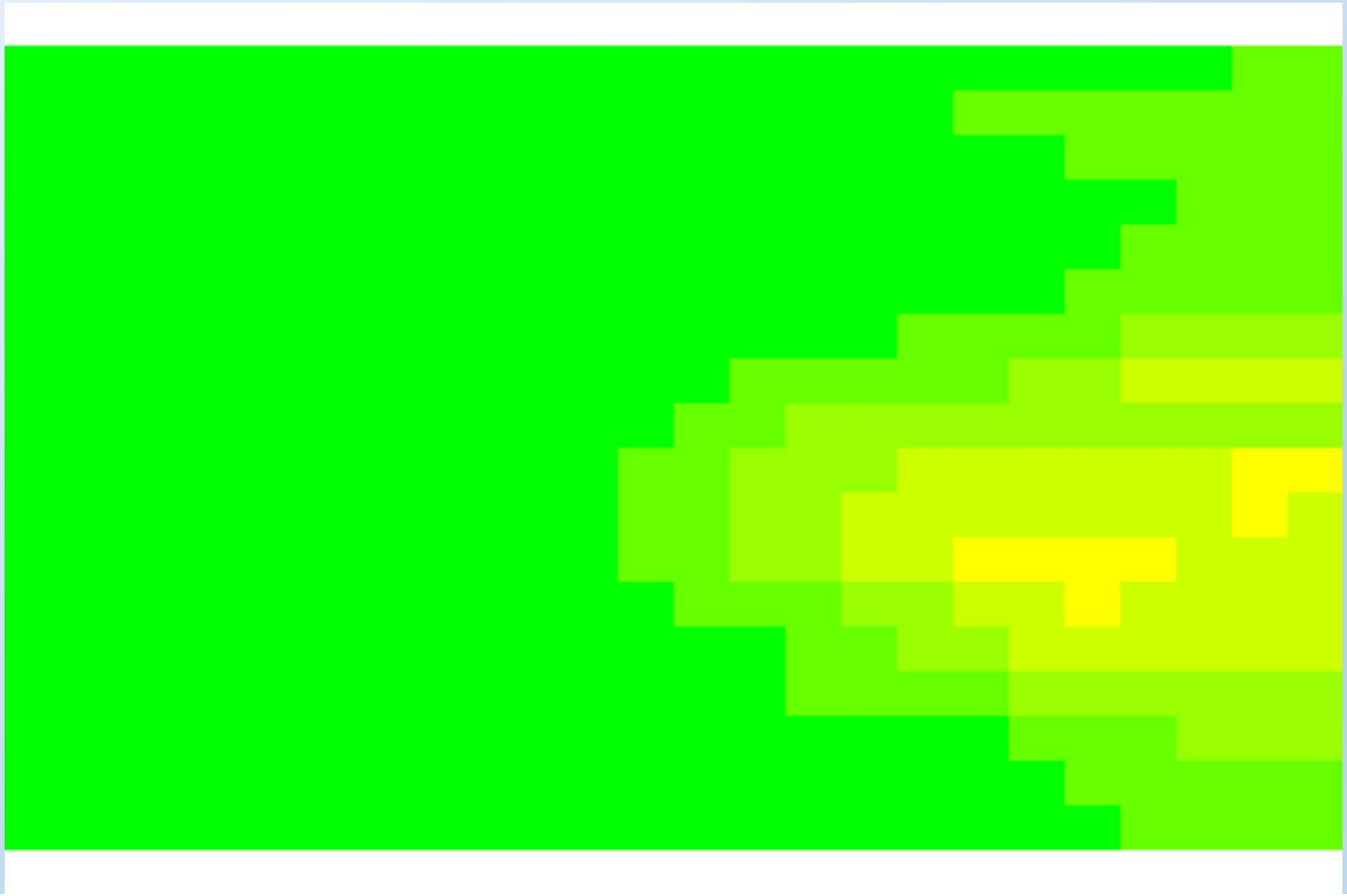




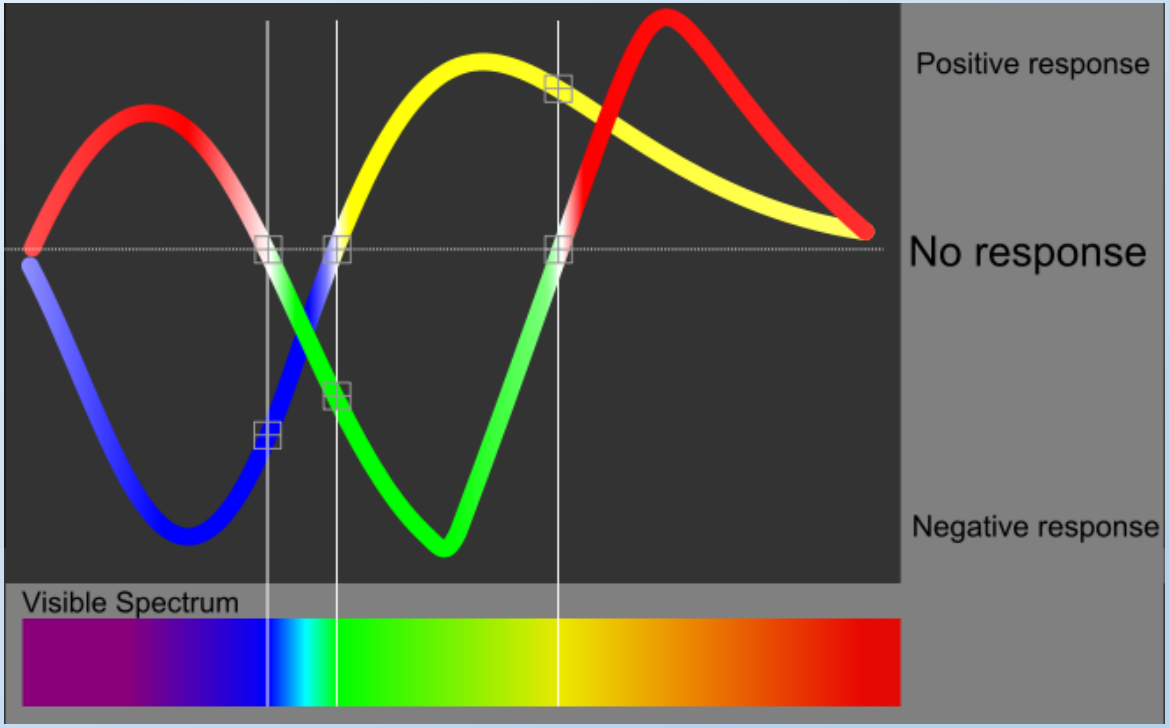
Distribution



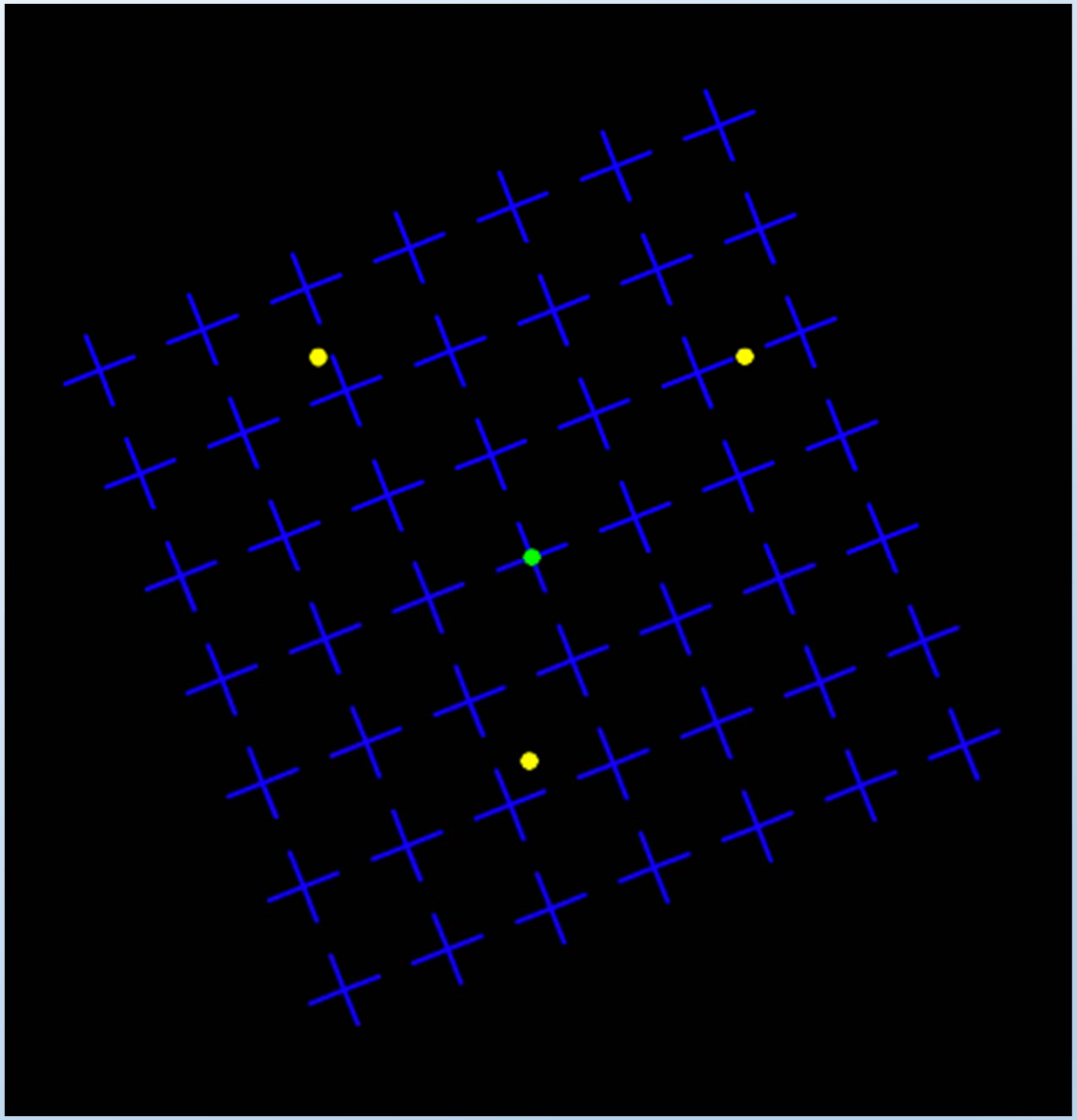
Blind point



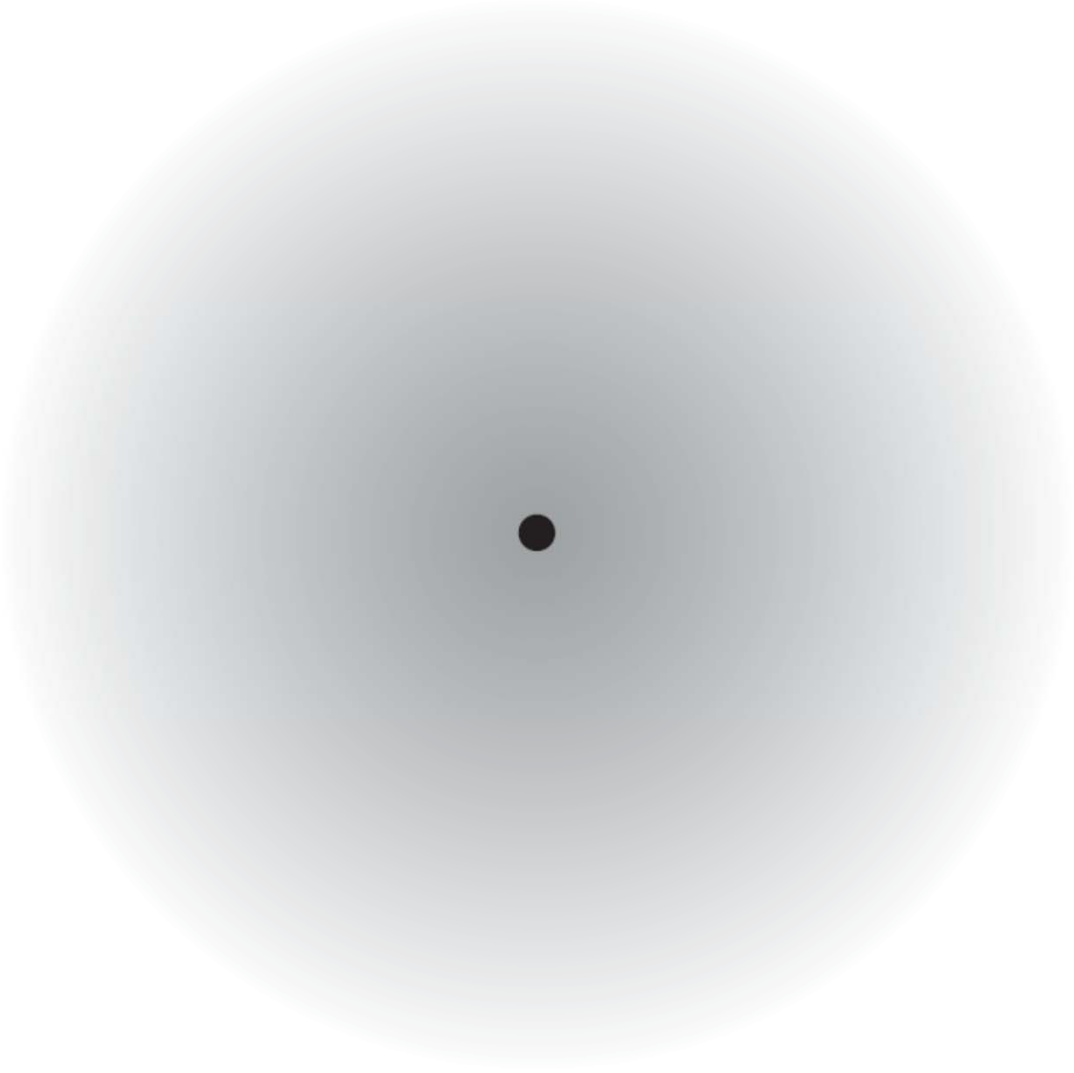
Color vision

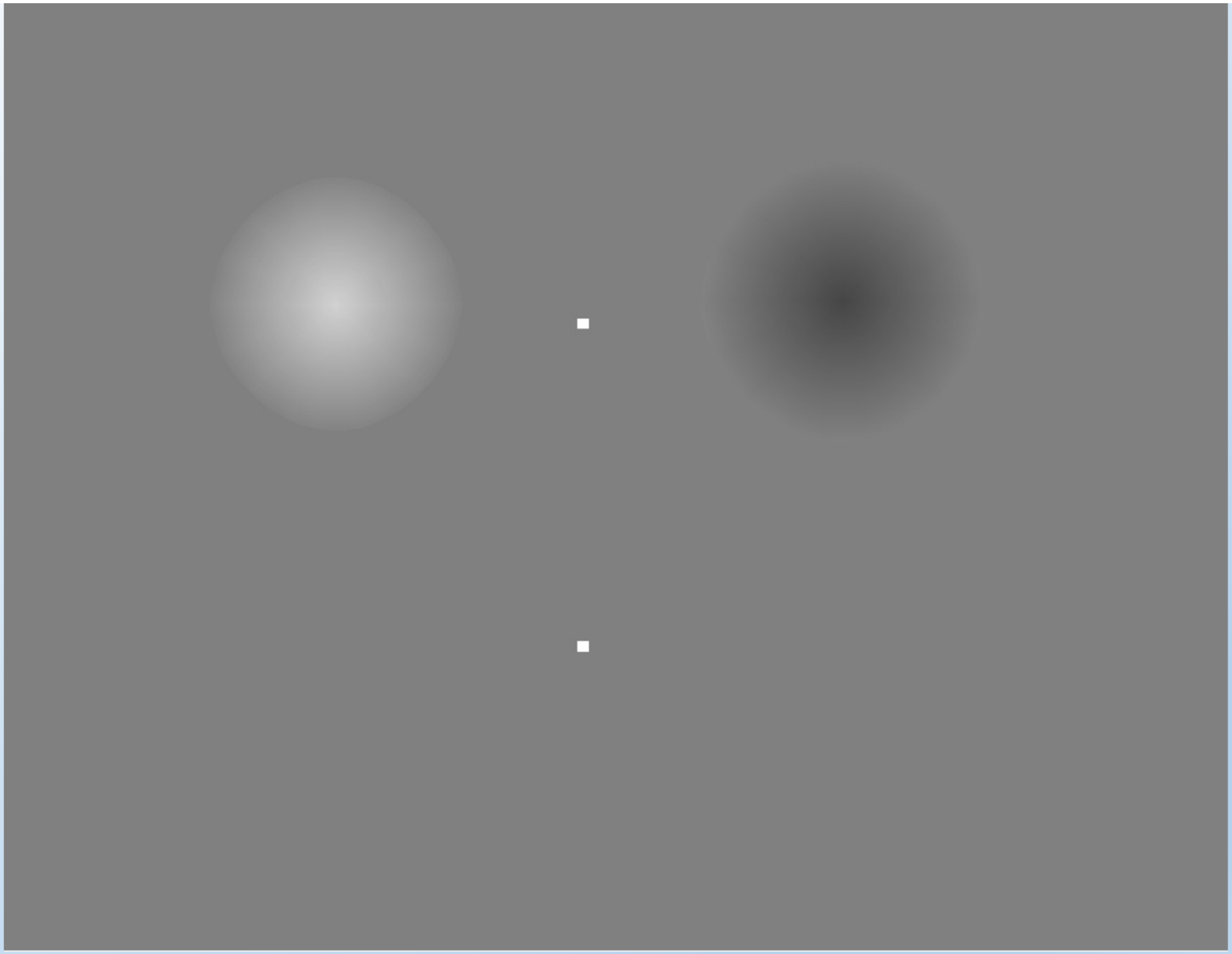


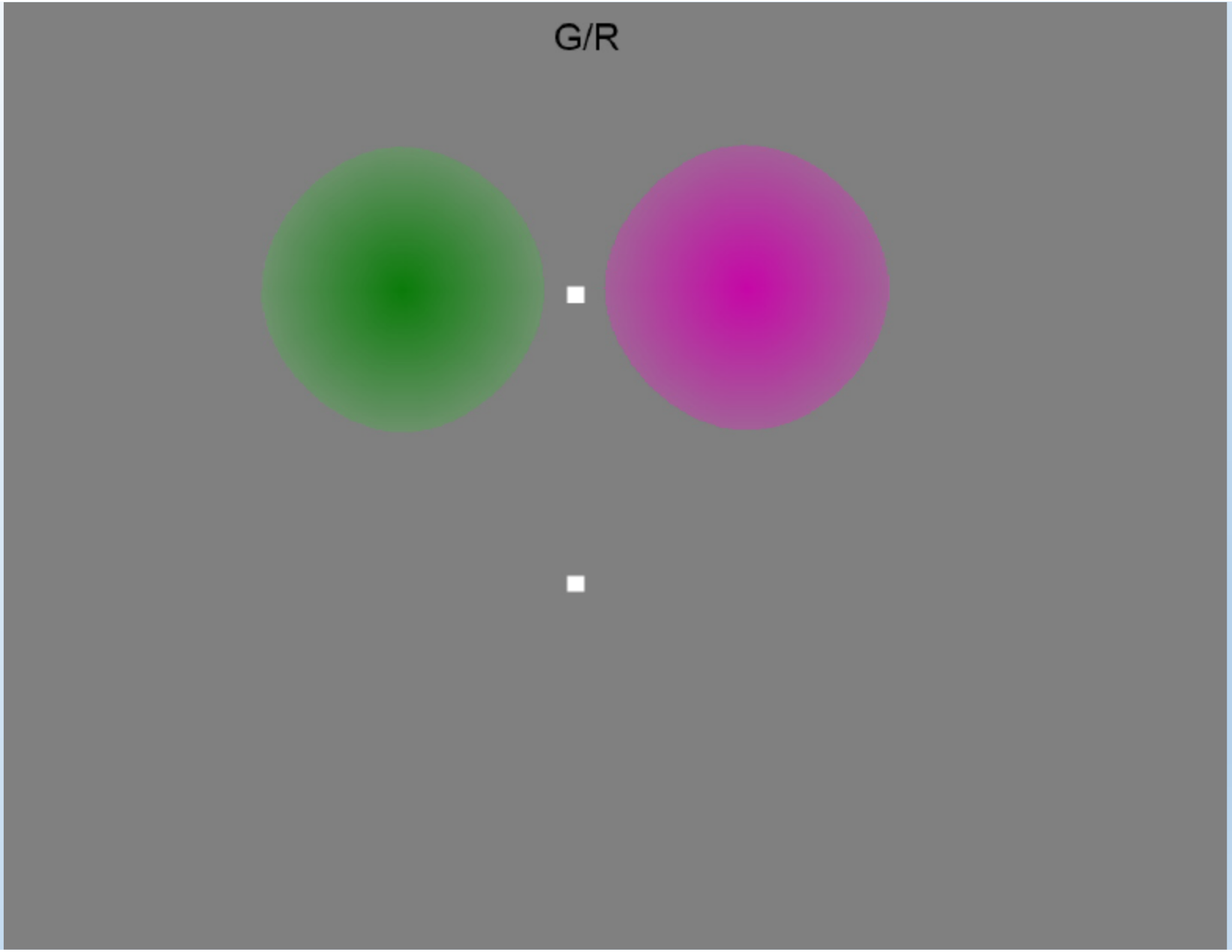
Motion-induced blindness



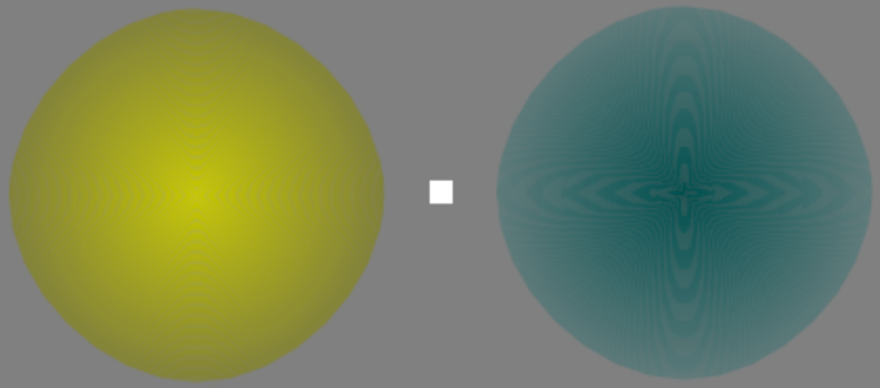
https://michaelbach.de/ot/mot-mil






G/R

off axis




keep staring at the black dot.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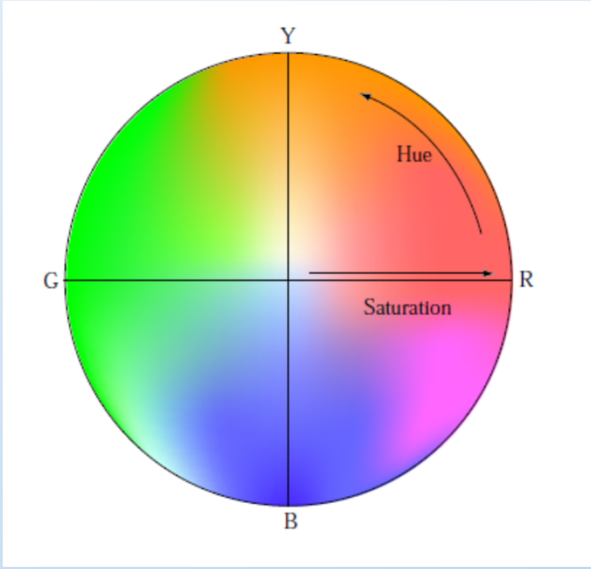
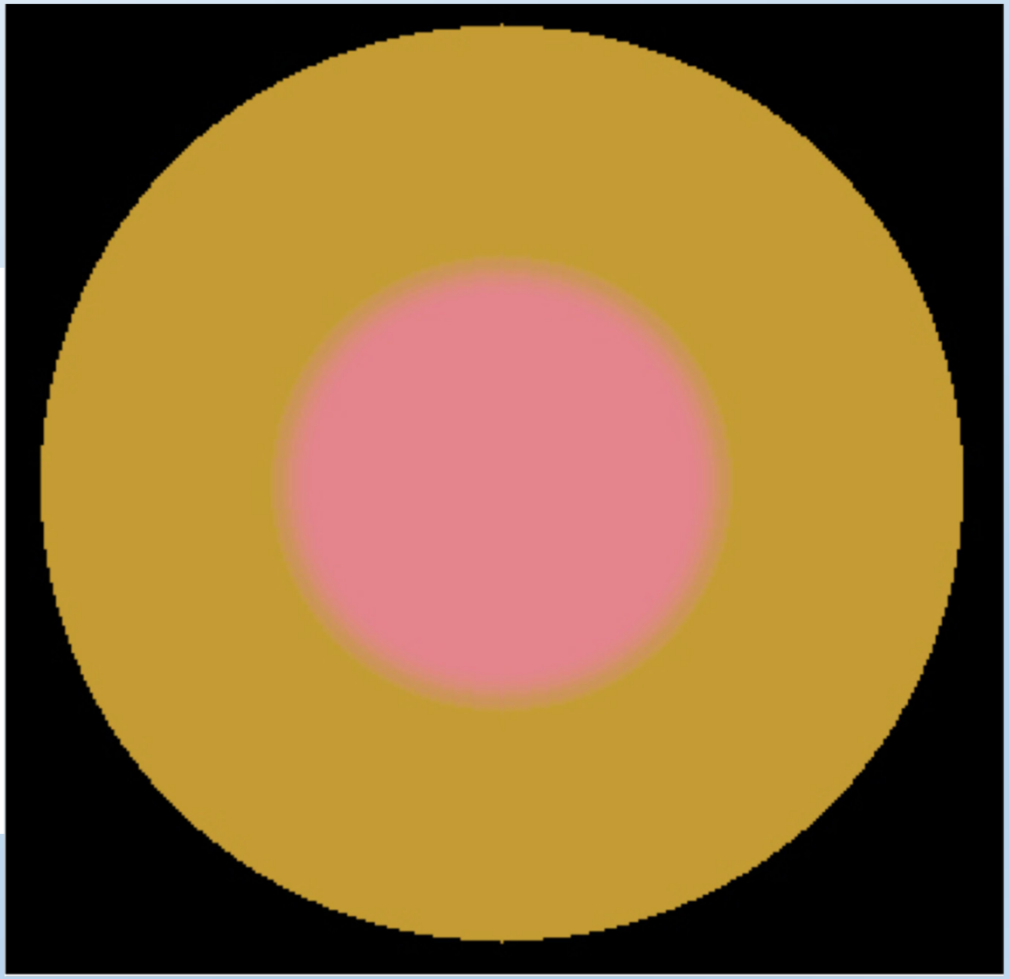
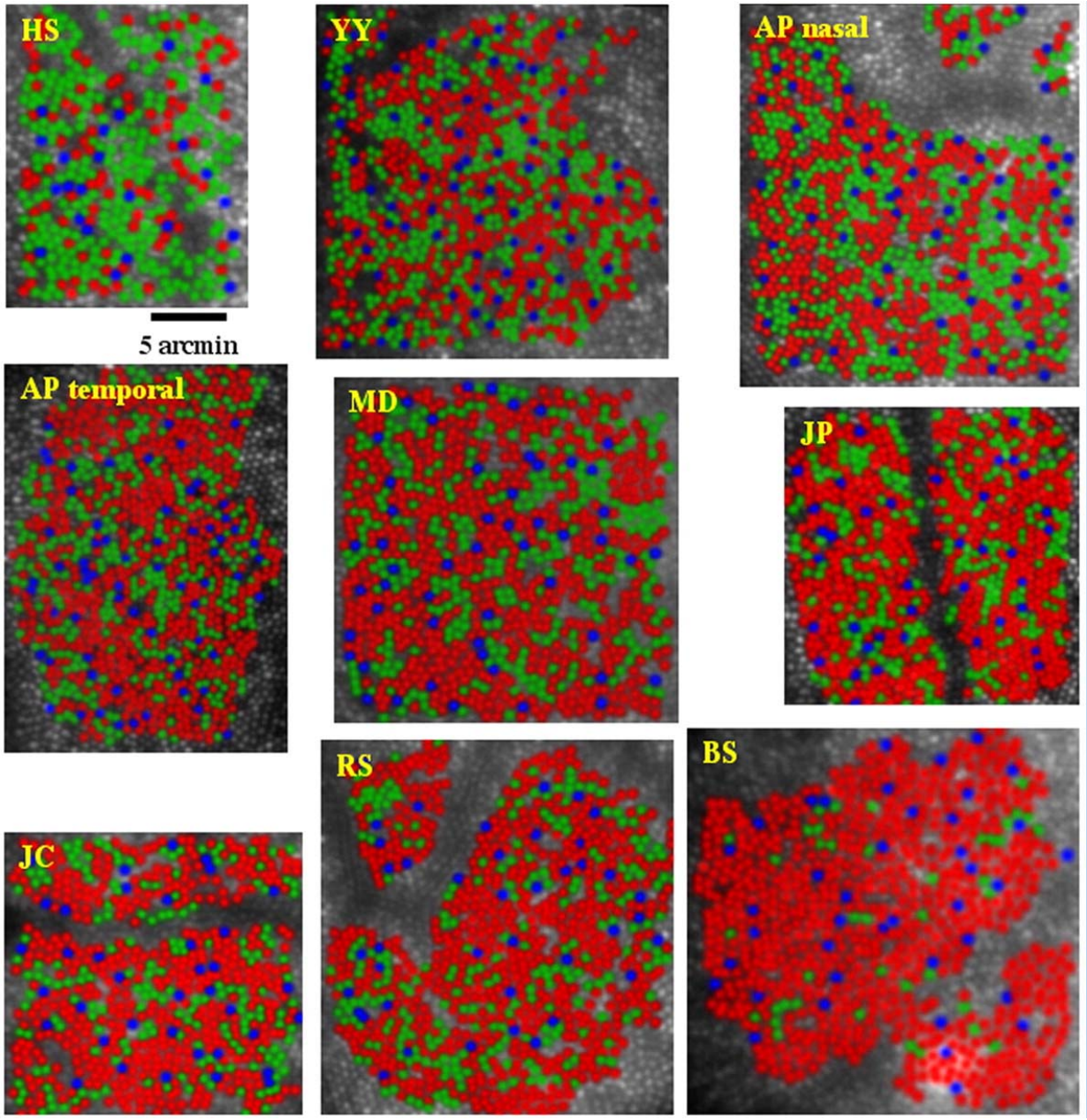
颜色与颜色竞争

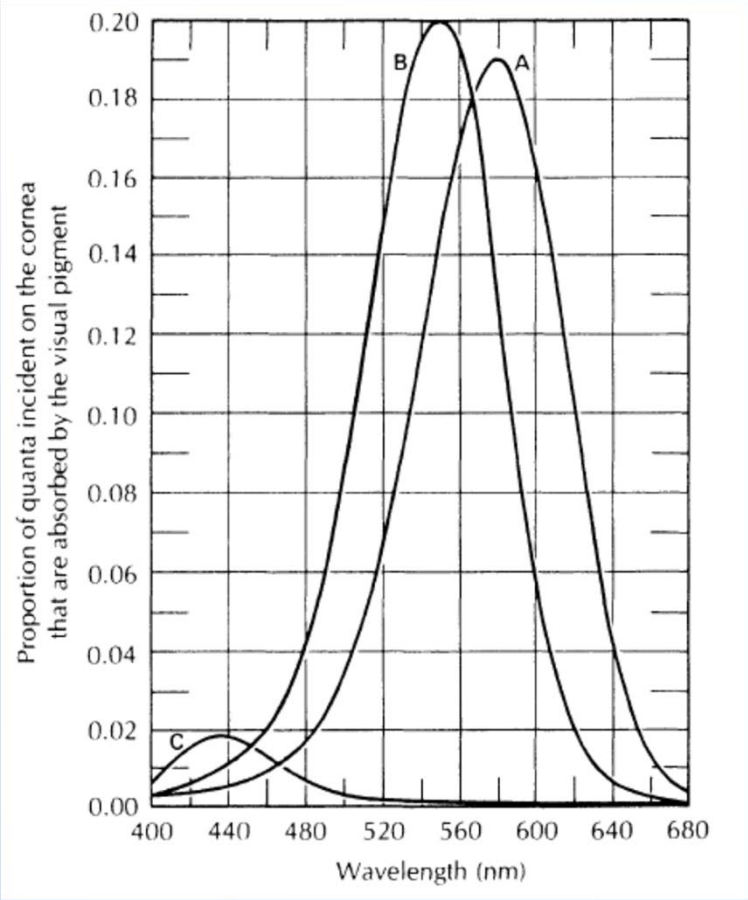


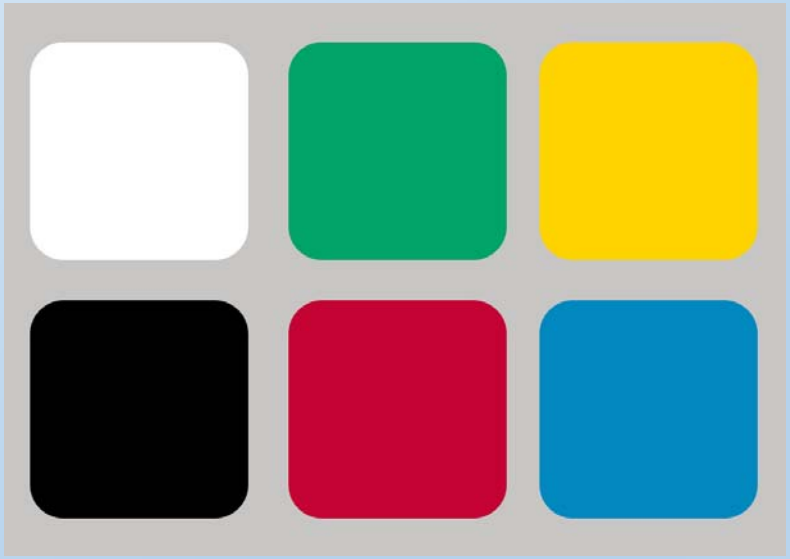




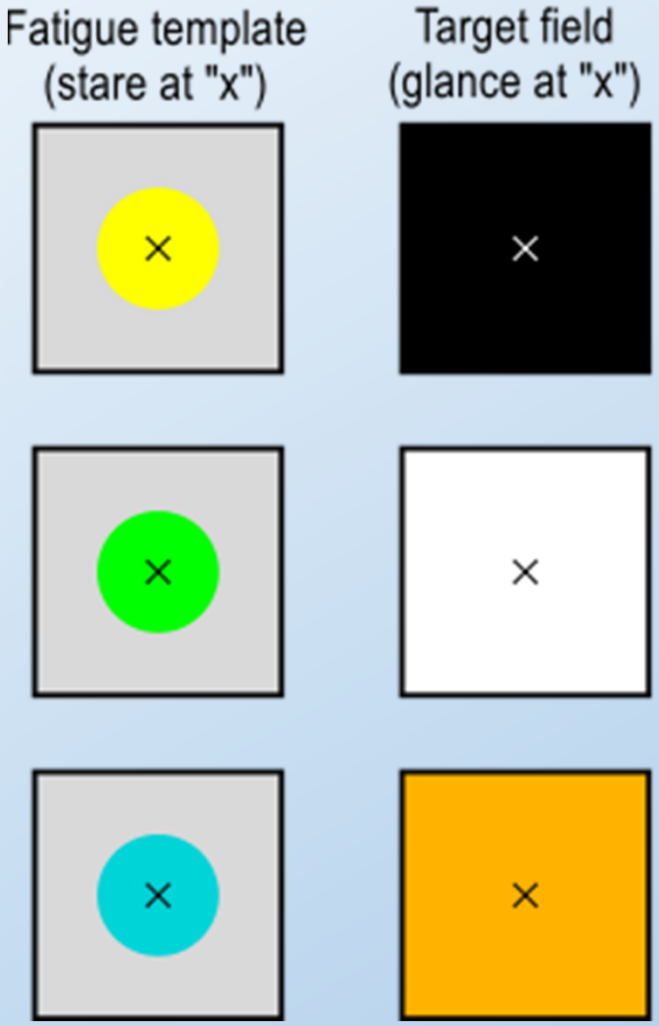
Organization of the Human Trichromatic Cone Mosaic Journal of Neuroscience 2005, 25 (42) 9669-9679

What we actually perceive

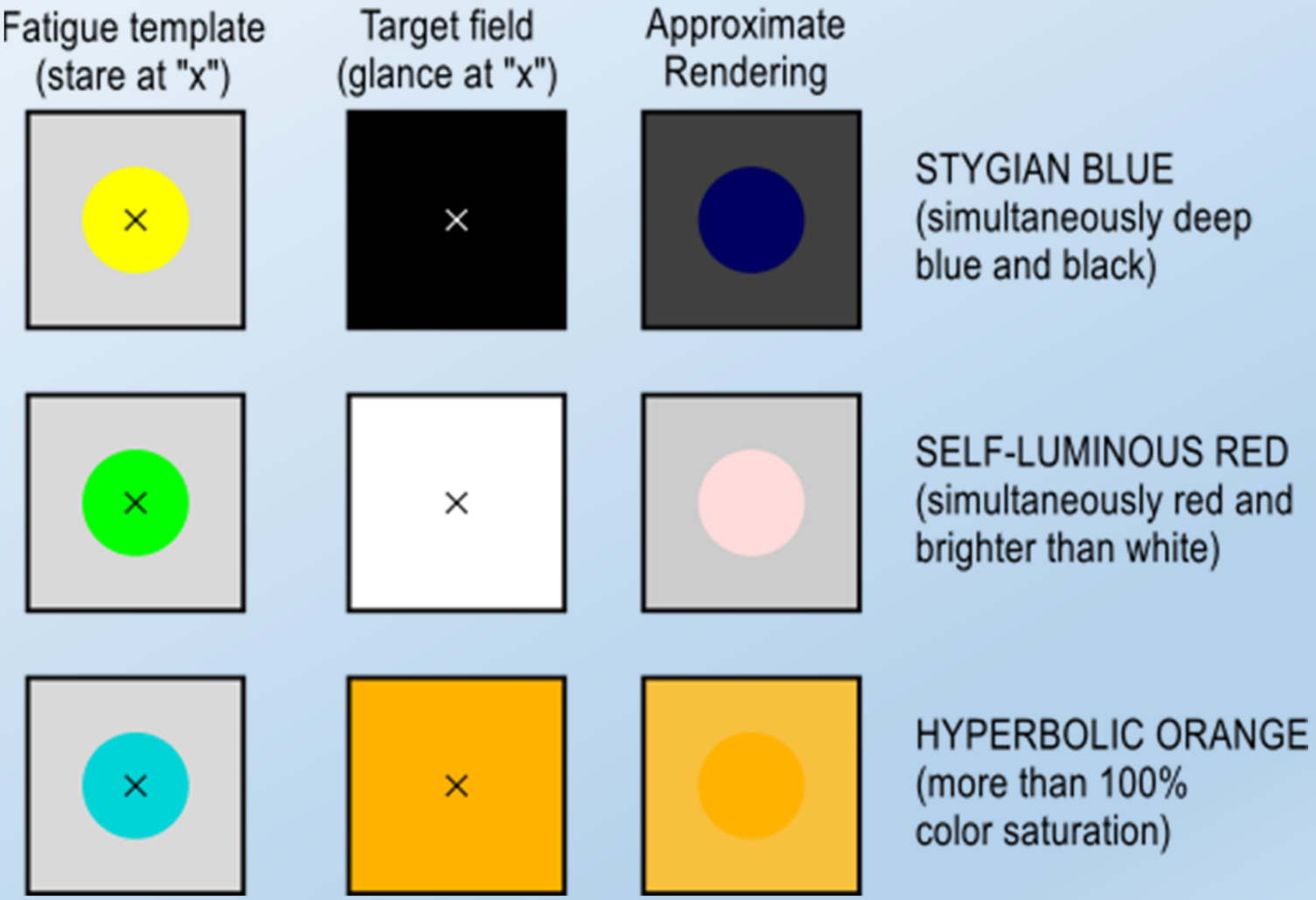




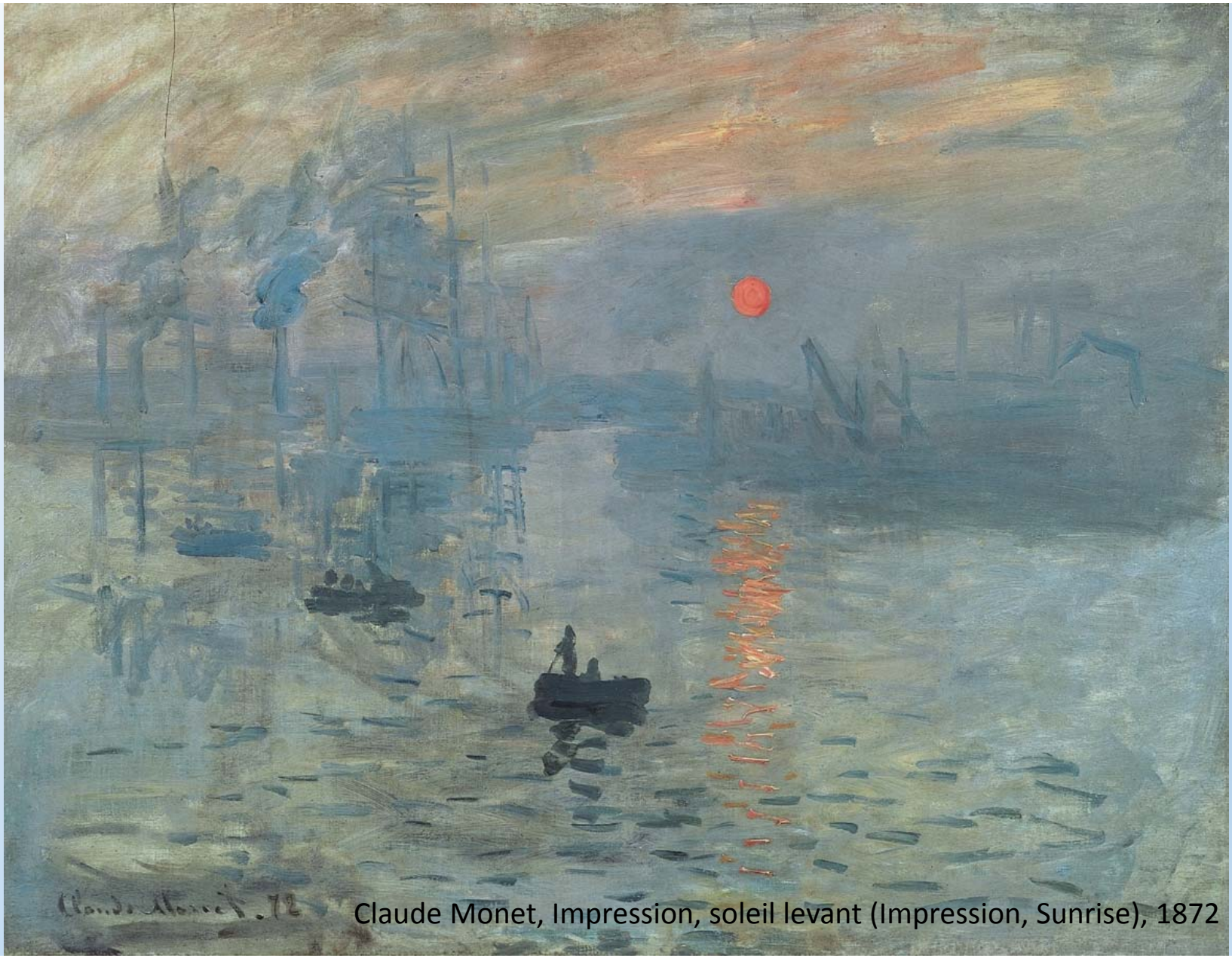
Impossible colors



Impossible colors




Starry Night by Vincent van Gogh (1889)



Claude Monet, Impression, soleil levant (Impression, Sunrise), 1872