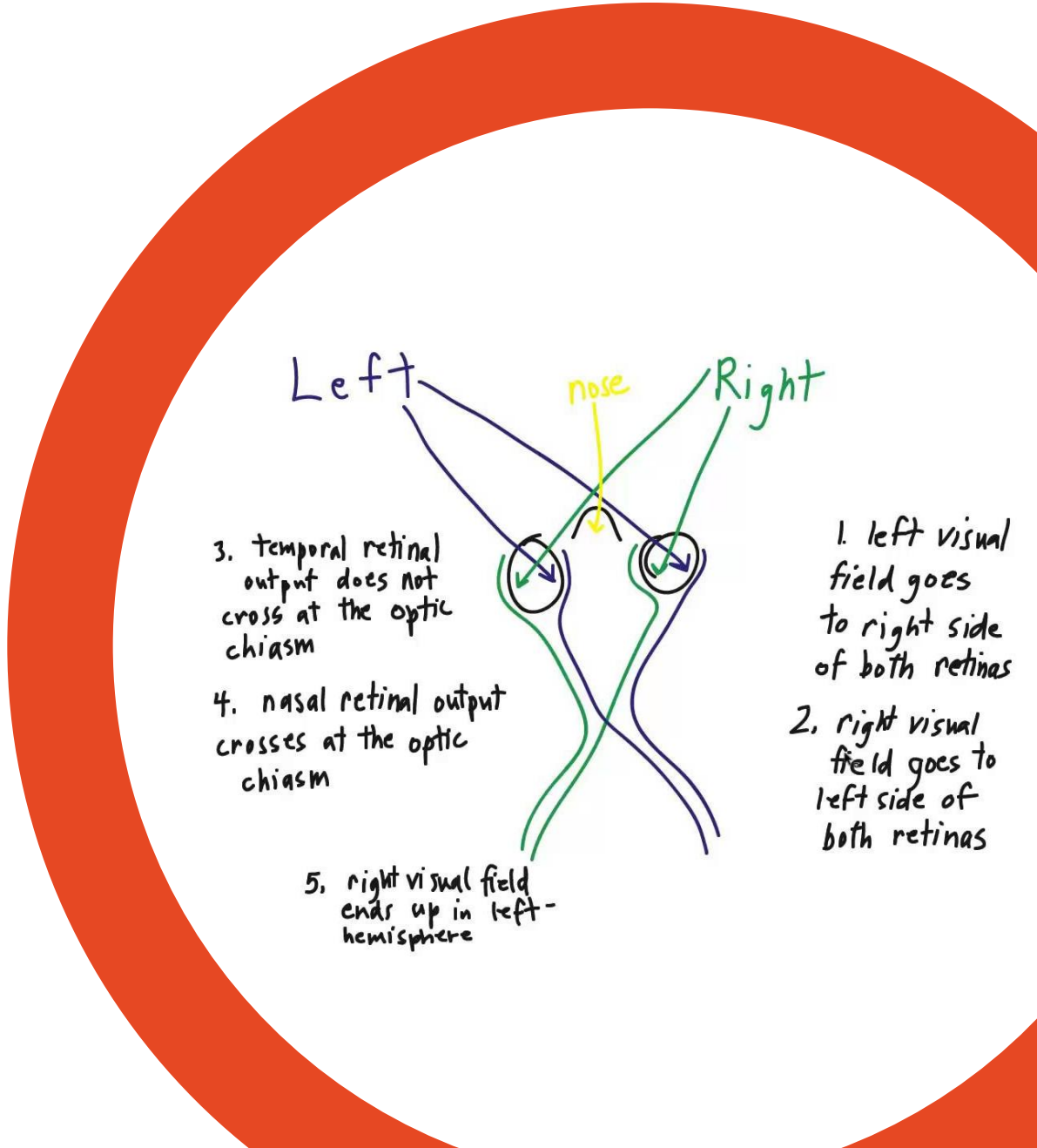
The Visual Pathways



Learning Objectives

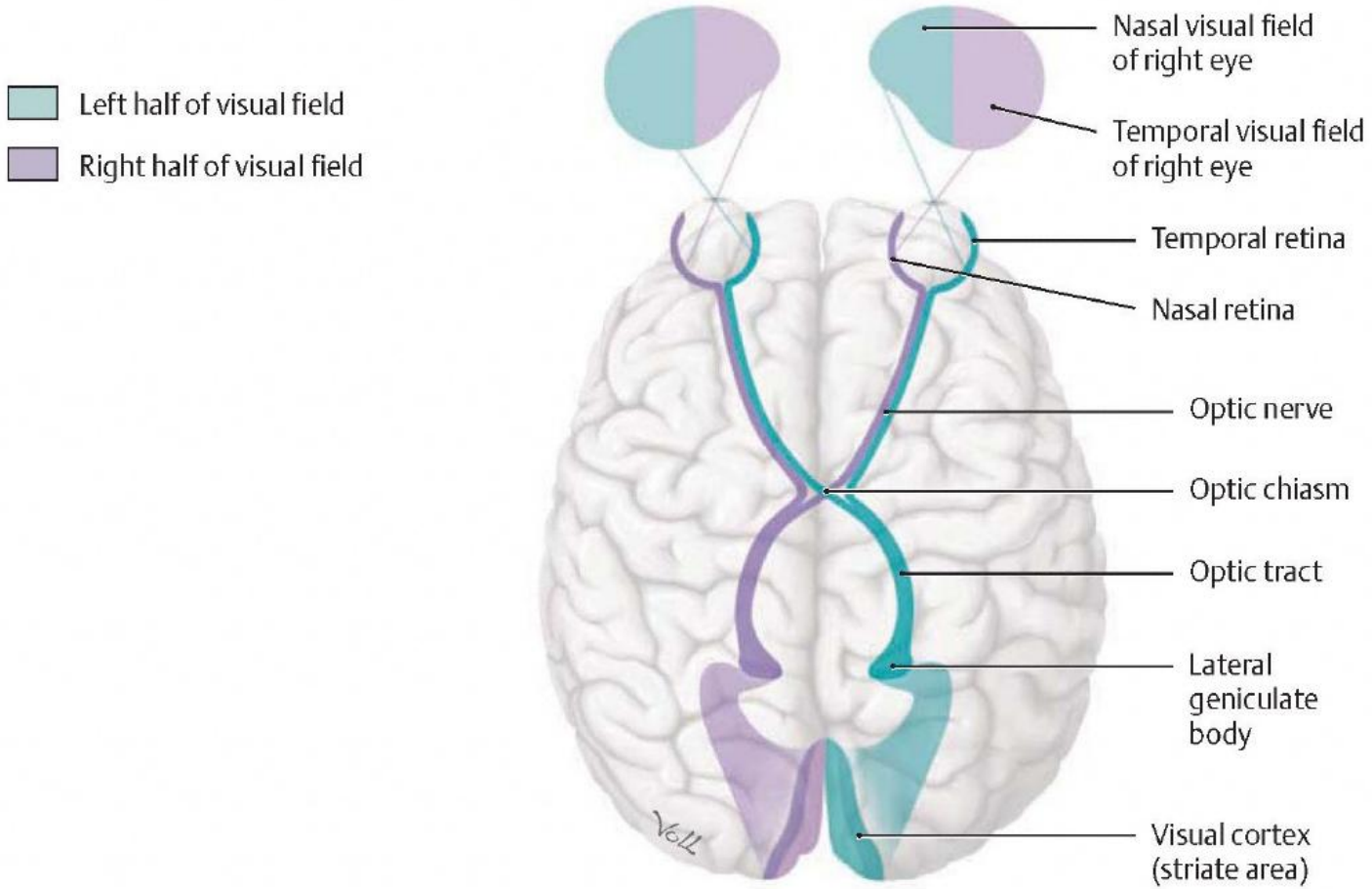
1. Describe the concept of visual fields
2. Trace the central visual pathways from the retina to the visual cortex.
3. Explain the visual deficits produced by damage to the visual fibers at different locations along the visual pathway
4. Recognize the deficits produced by lesions of the striate and extra striate cortical areas

OBJ. # 1

The Visual Fields

Binocular visual field is defined as the space we see with both eyes when the eyes are in primary position

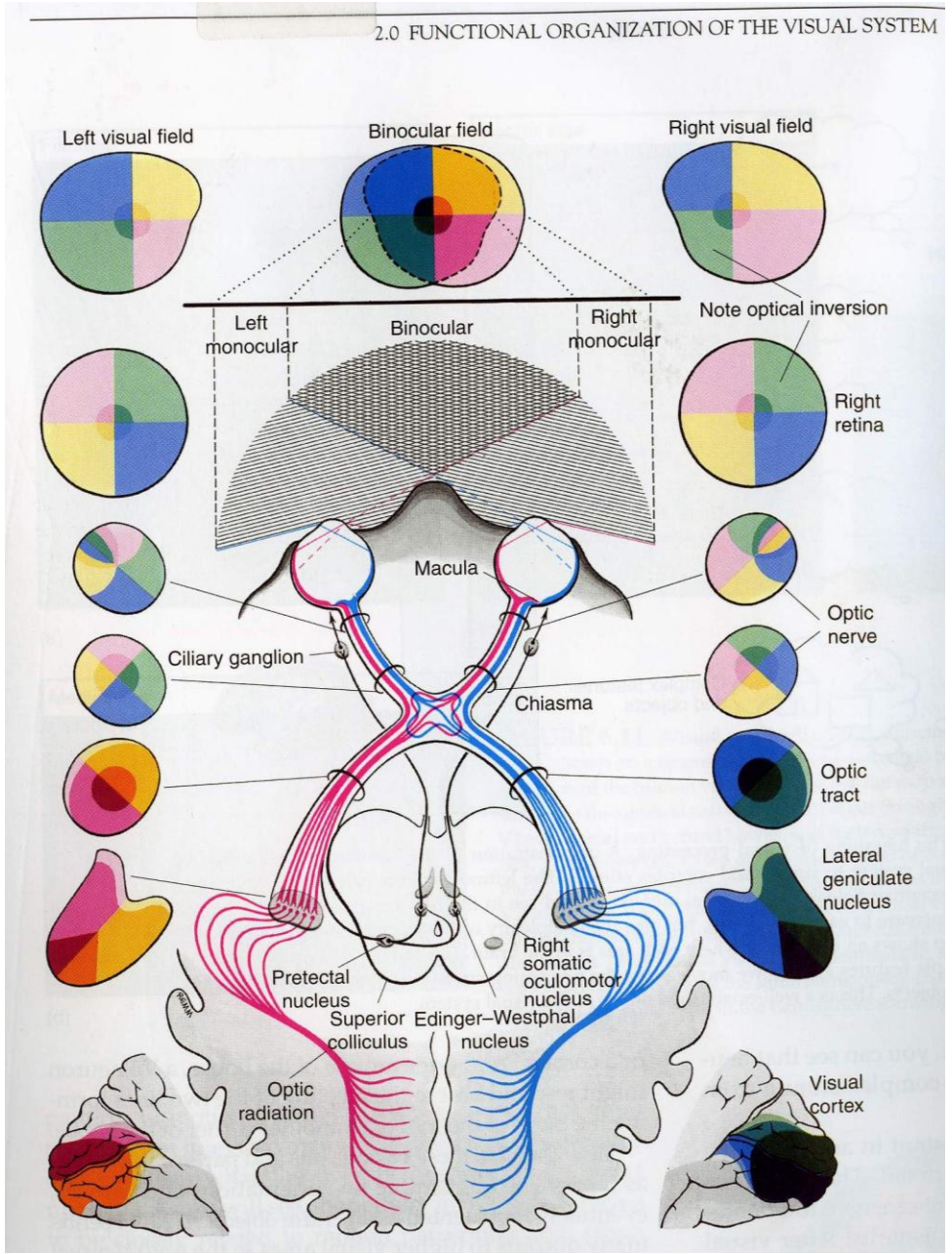
OBJ. # 2



B Representation of each visual field in the contralateral visual cortex
Superior view.

Illustrator: Markus Voll

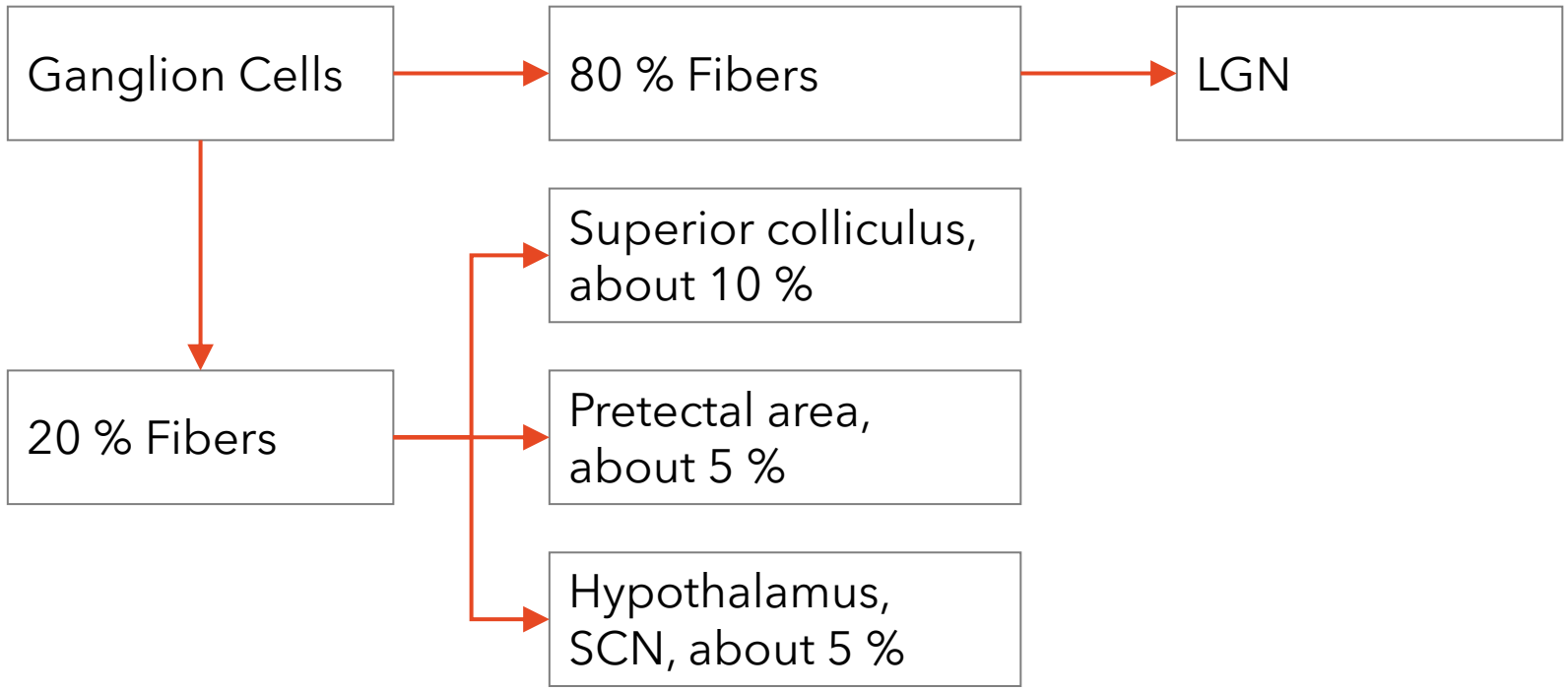
pp. 358-359


2.0 FUNCTIONAL ORGANIZATION OF THE VISUAL SYSTEM
Left visual field
Binocular field
Right visual field
Left monocular
Binocular
Right monocular
Note optical inversion
Right retina
Macula
Optic nerve
Ciliary ganglion
Chiasma
Optic tract
Lateral geniculate nucleus
Right somatic oculomotor nucleus
Pretectal nucleus
Superior colliculus
Edinger–Westphal nucleus
Optic radiation
Visual cortex

OBJ. # 2

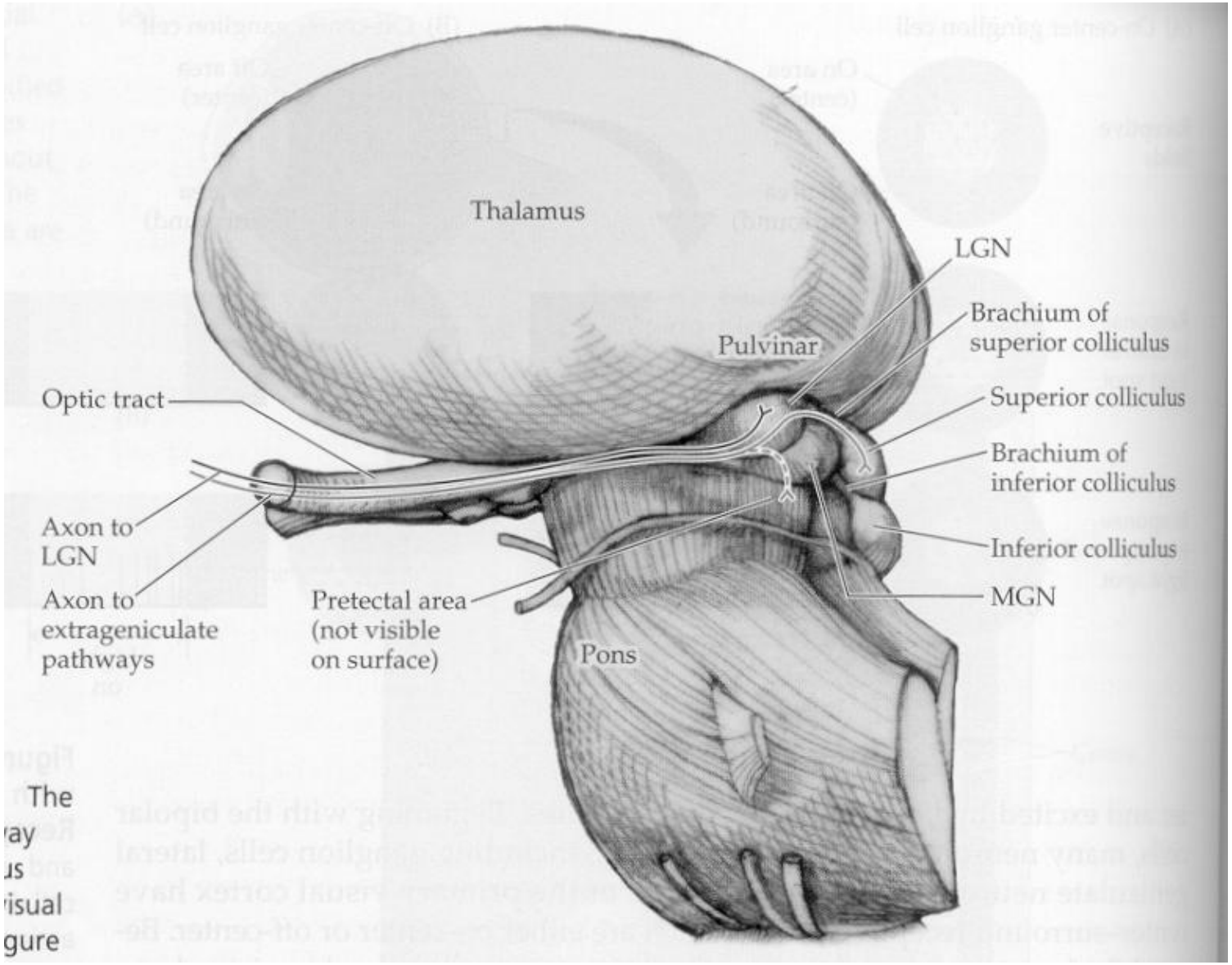
Retinal Output

OBJ. # 2



OBJ. # 2

Trajectory Of The Visual Pathway



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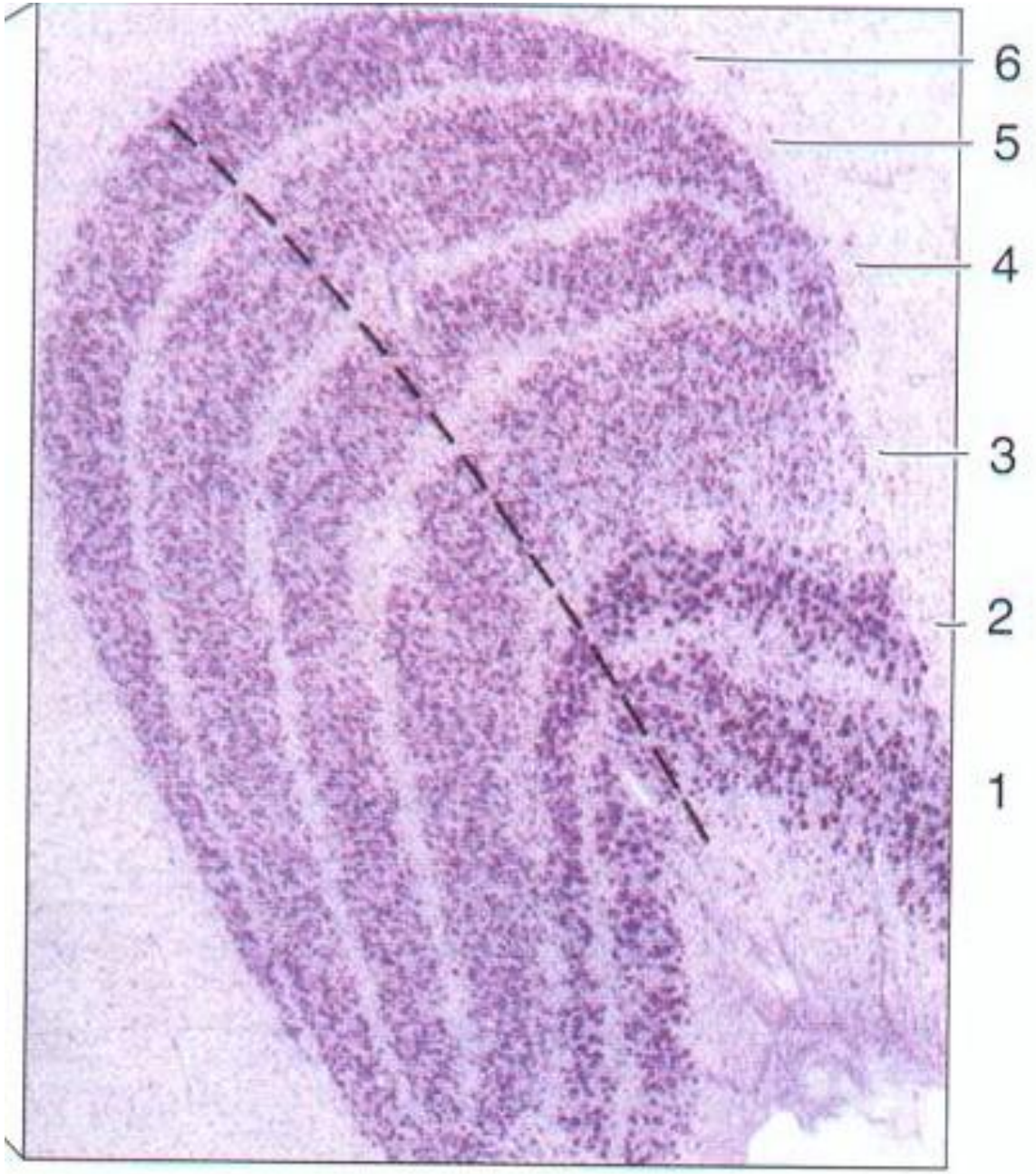
OBJ. # 2

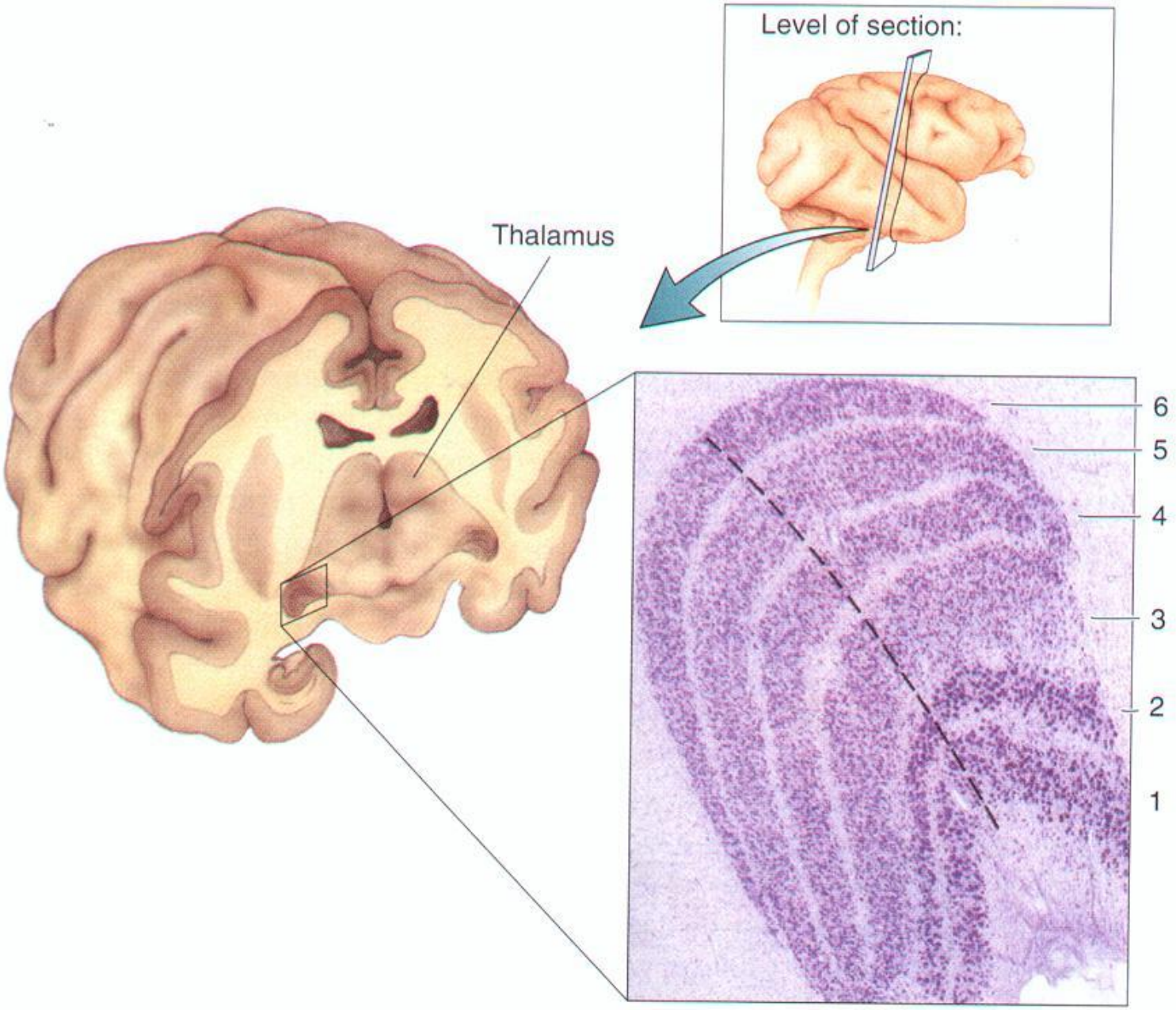
Lateral Geniculate Nucleus

Retinotopy

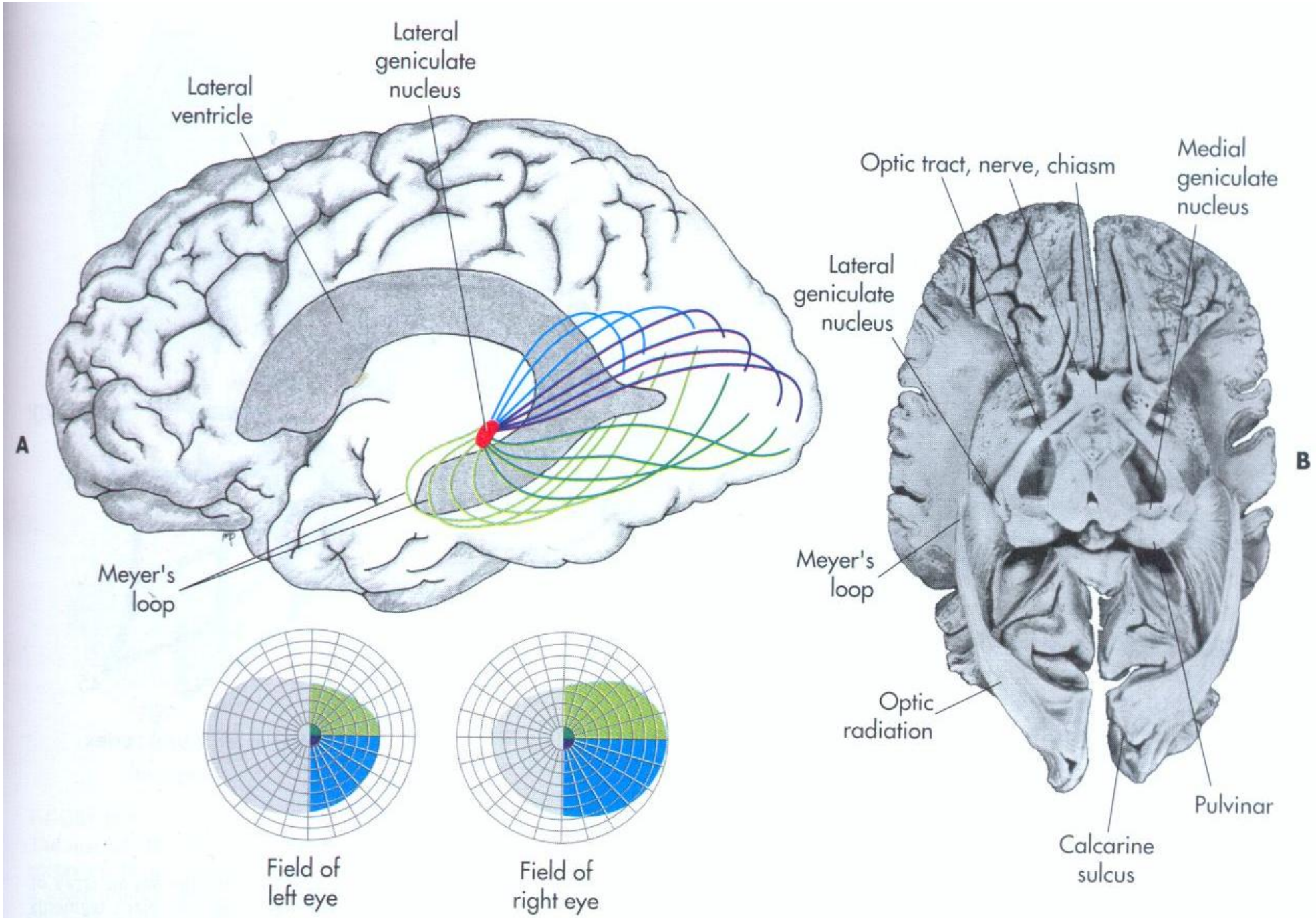
- Each layer has a complete retinotopic map
- Each point in space is represented 6 times
- Fovea is over-represented in the LGN



OBJ. # 2



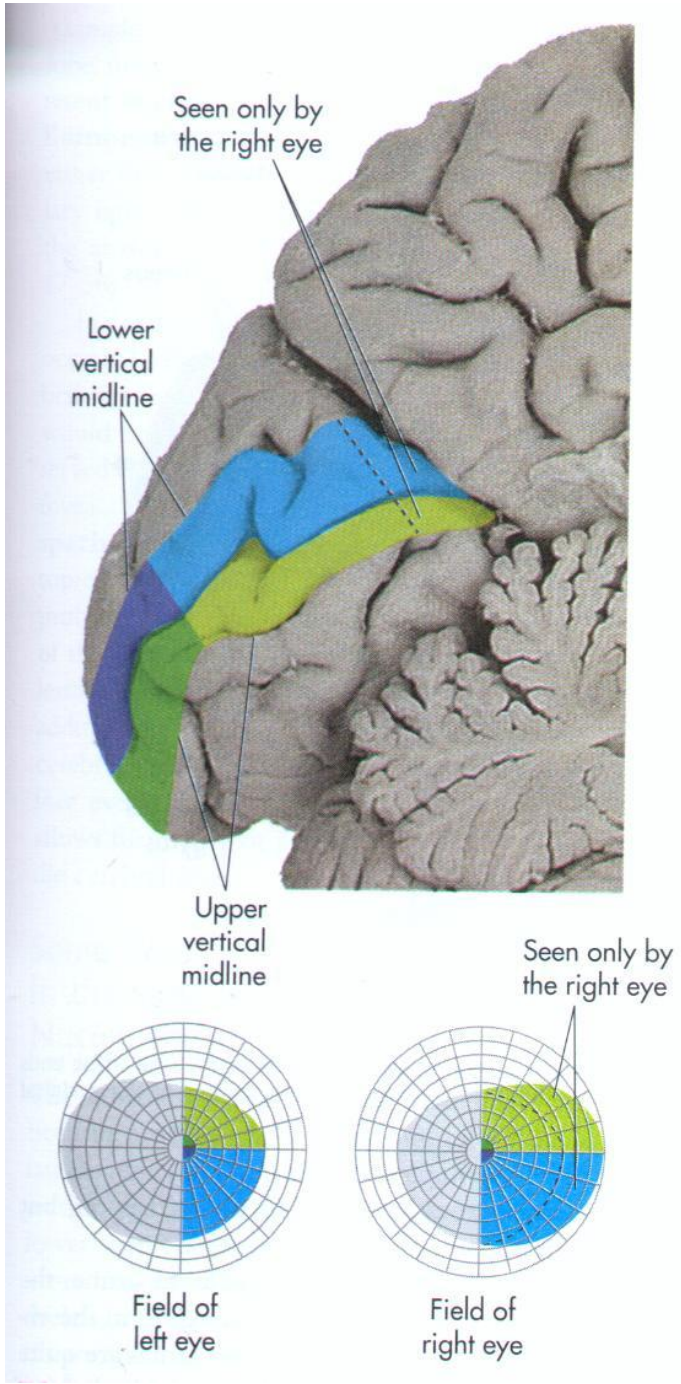
OBJ. # 2


Lateral ventricle
Lateral geniculate nucleus
A
Meyer's loop
Field of left eye
Field of right eye
Optic tract, nerve, chiasm
Medial geniculate nucleus
Lateral geniculate nucleus
B
Meyer's loop
Optic radiation
Pulvinar
Calcarine sulcus

OBJ. # 2

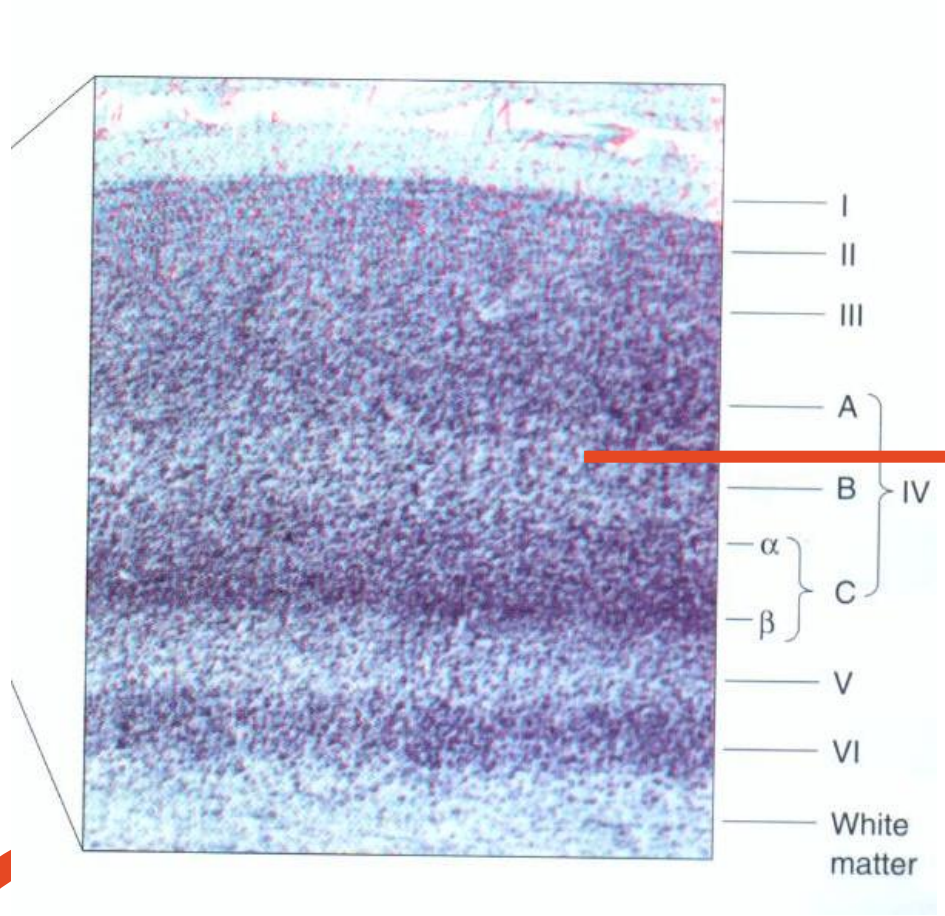
The occipital lobe - the primary visual cortex: the calcarine Sulcus

The most posterior half of the calcarine sulcus is the representation of the fovea



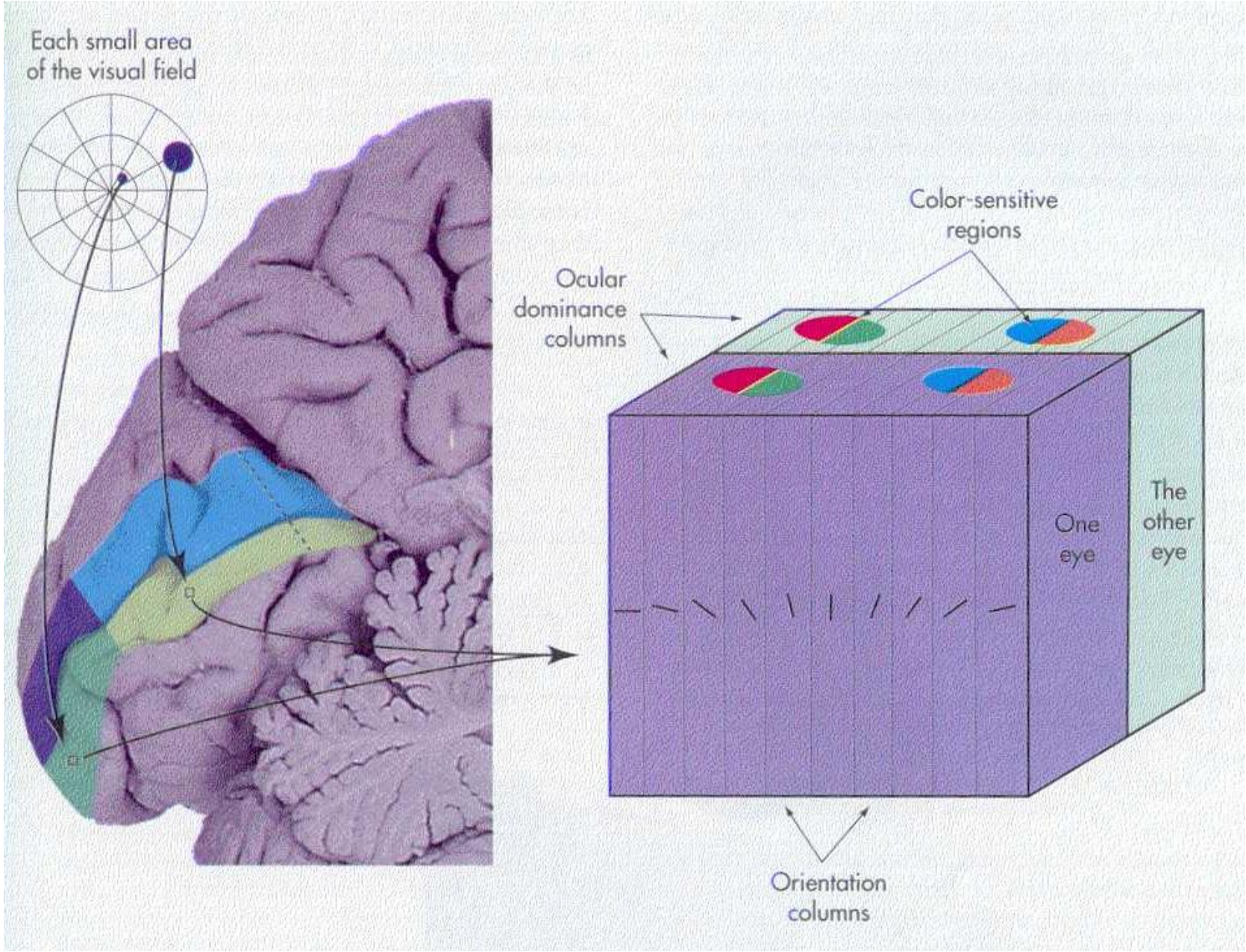
The Layers Of The Primary Visual Cortex Or Striate Cortex

OBJ. # 2



The myelinated Fibers in lamina IV B of the calcarine cortex named the Stria of Gennari

OBJ. # 2


Each small area
of the visual field
Color-sensitive
regions
Ocular
dominance
columns
One
eye
The
other
eye
Orientation
columns

Visual Information Is Processed Through 3 Different Channels

OBJ. # 2

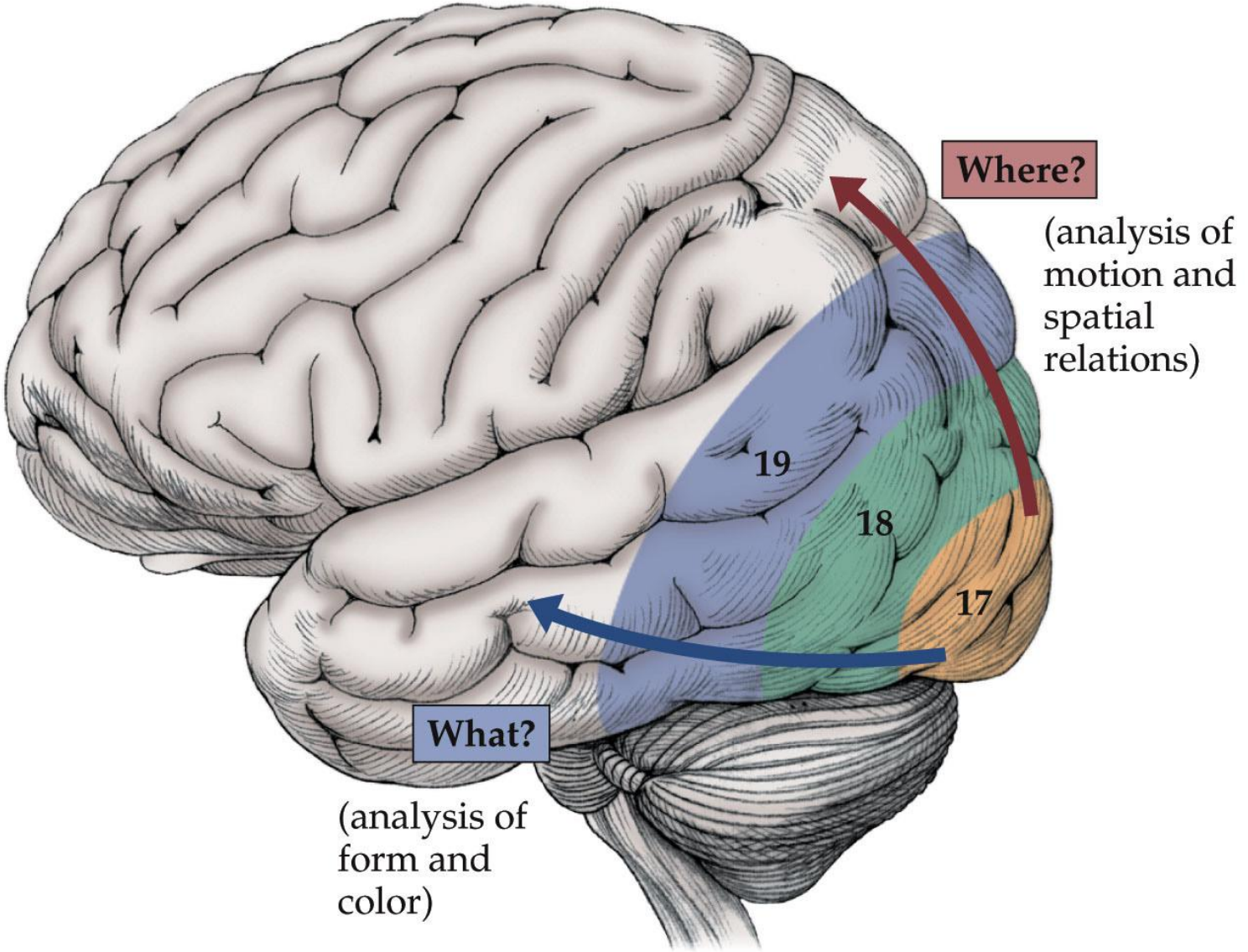
Specialized in object motion information

Specialized in fine special information about object shape

Specialized in the analysis of object color

OBJ. # 2

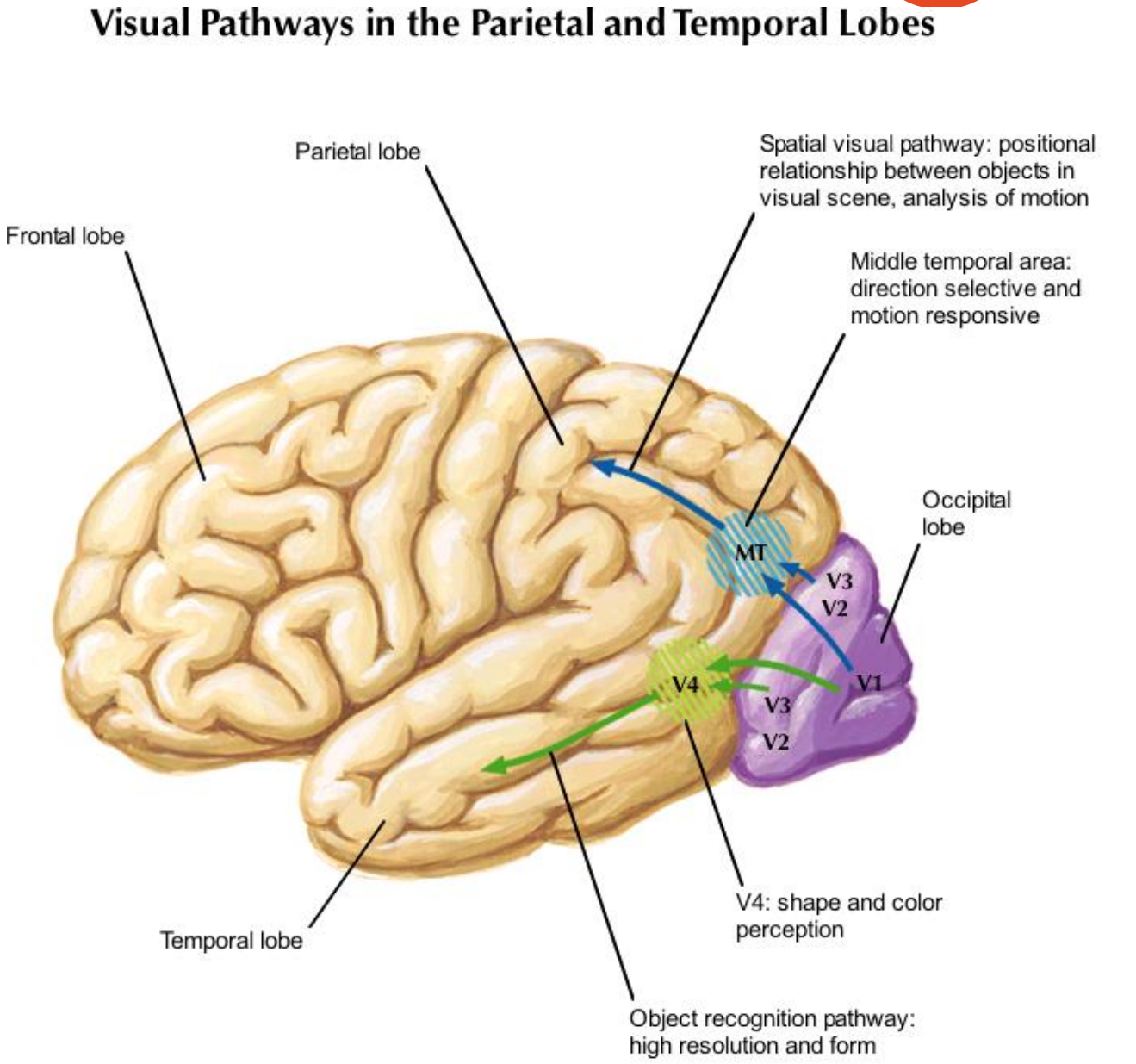
The What And Where Pathways



NEUROANATOMY 2e, Figure 19.12

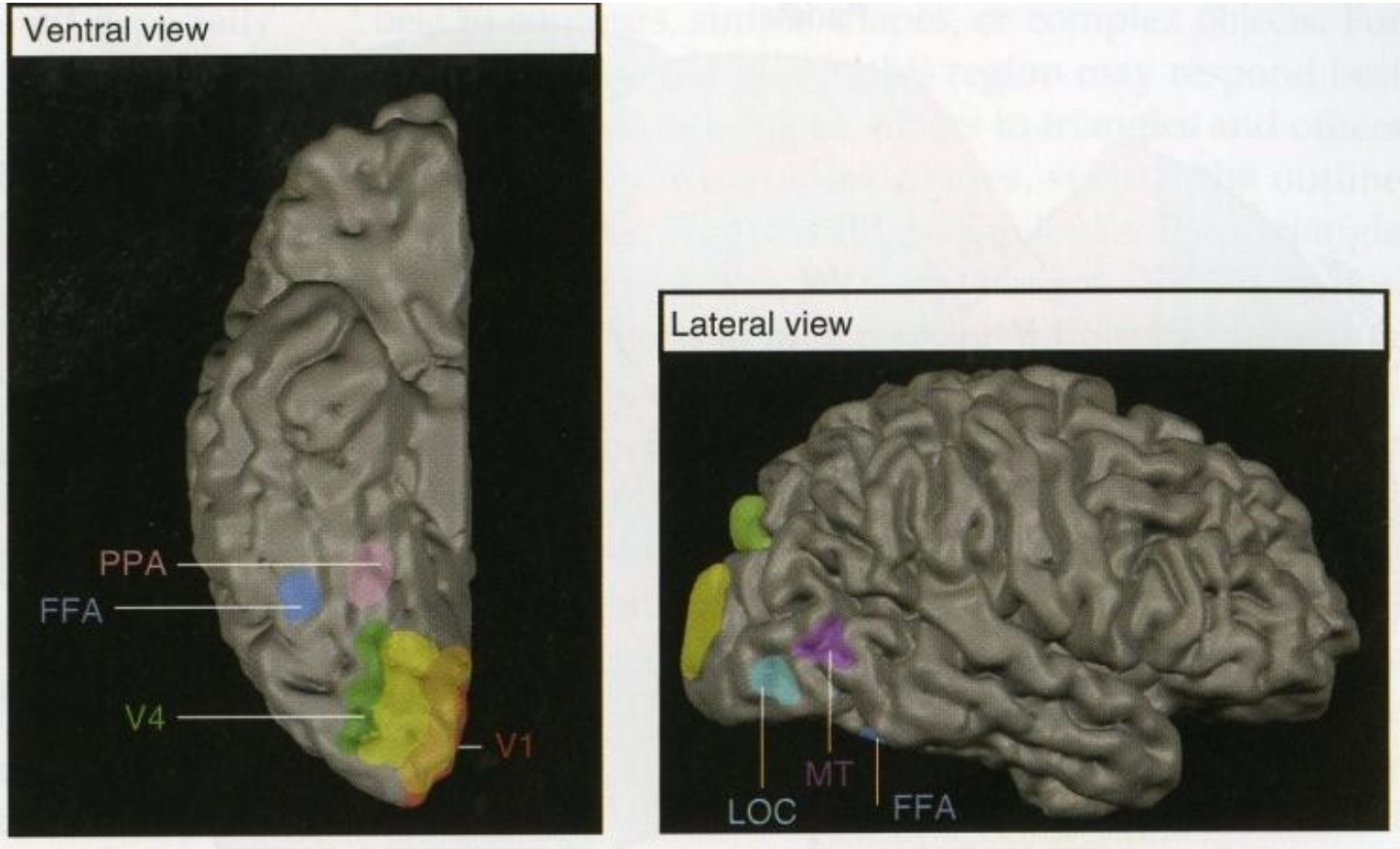
The Visual Cortex

OBJ. # 2



OBJ. # 2

Object And Face Recognition Areas



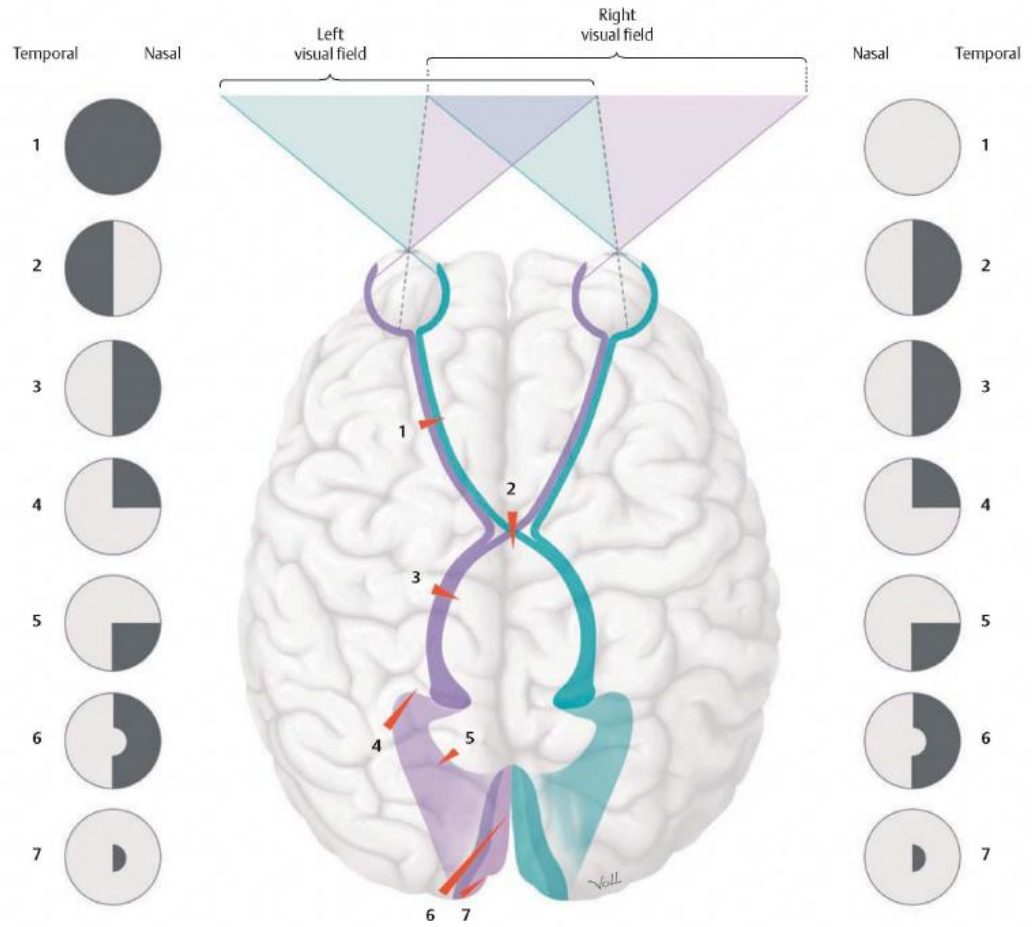
LOC area
Lateral occipital complex area

FFA
Fusiform face area

PPA
Parahippocampal place area

OBJ. # 3 & 4

The Visual Deficits



A Visual field defects (scotomata) and their location along the visual pathway

1 Unilateral optic nerve lesion.
2 Lesion of the optic chiasm.
3 Unilateral lesion of the optic tract.
4 Unilateral lesion of the optic radiation.
5 Unilateral lesion in the medial part of the optic radiation.
6 Lesion of the occiptal lobe.
7 Lesion of the cortical areas of the occipital pole.

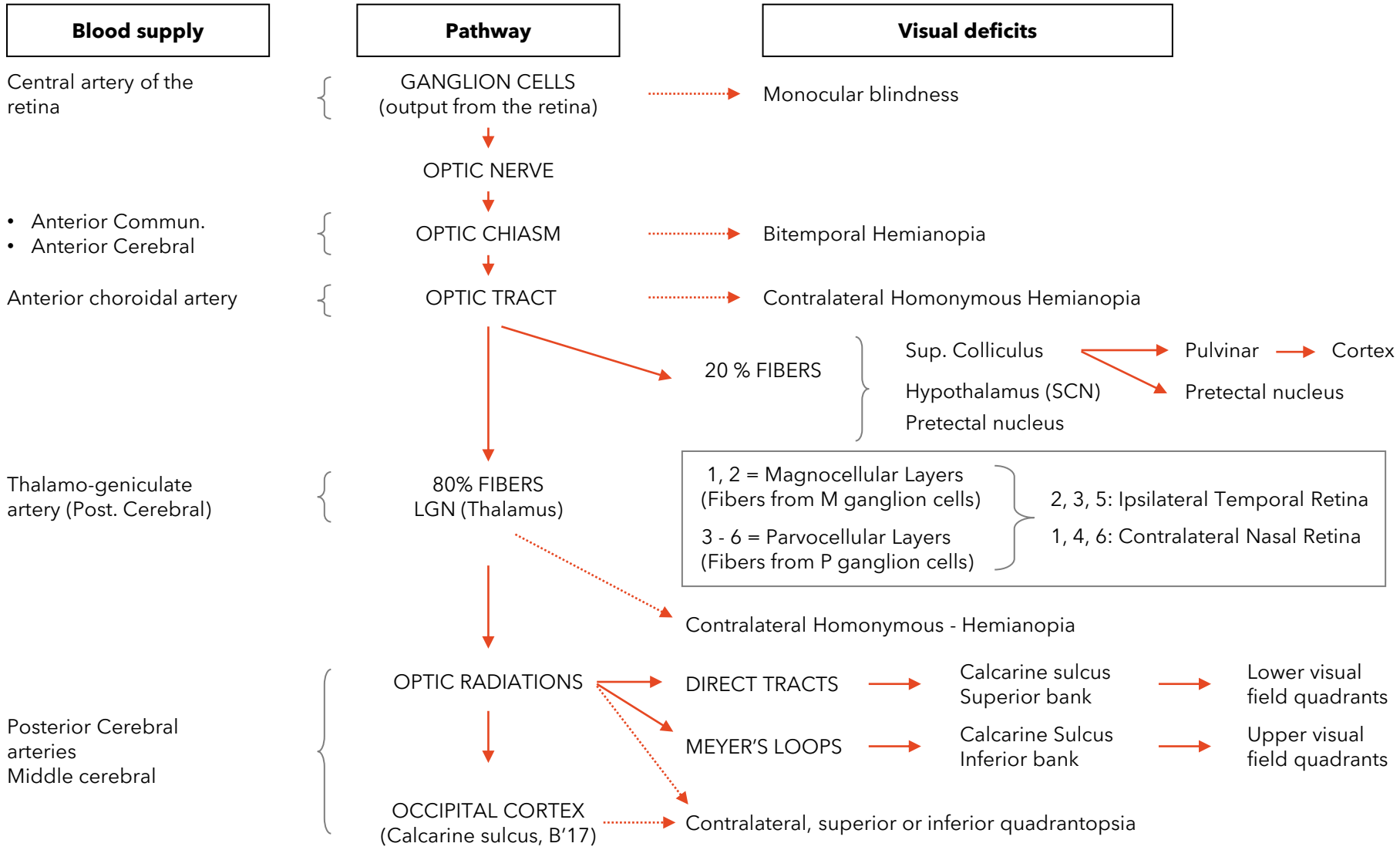
Illustrator: Markus Voll pp. 360-361

Schuenke et al. THIEME Atlas of Anatomy • Head and Neuroanatomy

Thieme

Visual Pathways

OBJ. # 3 & 4



Visual Deficits

OBJ. # 3 & 4

Lesion to the optic nerve	→	Monocular blindness
Lesion to the central part of the optic chiasm	→	Bitemporal hemianopsia
Lesions to the optic tracts	→	Contralateral homonymous hemianopsia
Lesions to the optic radiations	→	Homonymous hemianopsia of a quadrant ↓ Contralateral superior or Inferior quadrantopsia

Cognitive Deficits Produced By Damage To Visual Cortical Areas

OBJ. # 3 & 4

Damage to the primary visual cortex results in loss of vision on the contralateral visual field. In some cases the macula is spared due to collateral blood supply to the occipital pole from the MCA

Some patients show what is known as **blindsight**. These patients report complete loss of visual perception however they can perform some visual tasks such as indicate the direction of movement of an object in their blind visual field

OBJ. # 3 & 4

Cognitive Deficits Produced By Damage To Visual Cortical Areas

Damage to the ventral pathway

- **Cortical color blindness or achromatopsia** - Produced by damage to area V4 and/or other color processing areas on the ventral temporal lobe

- **Visual agnosia** – Produced by lesions of the ventral pathway, object area - LOC

OBJ. # 3 & 4

Cognitive Deficits Produced By Damage To Visual Cortical Areas

Damage to the dorsal pathway

Visual neglect - Produced by damage to the posterior parietal cortex

Motion Blindness - Produced by lesion of the area MT and surrounding areas

Cognitive Deficits Produced By Damage To Visual Cortical Areas

OBJ. # 3 & 4

Damage to the dorsal pathway

Balint's syndrome – Patients have difficulty to scan a complex visual scene or identify moving objects. They are able to perceive small regions of the visual fieldat a time. Patients have optic ataxia, ocular apraxia, and simultanagnosia

OPTIC ATAXIA

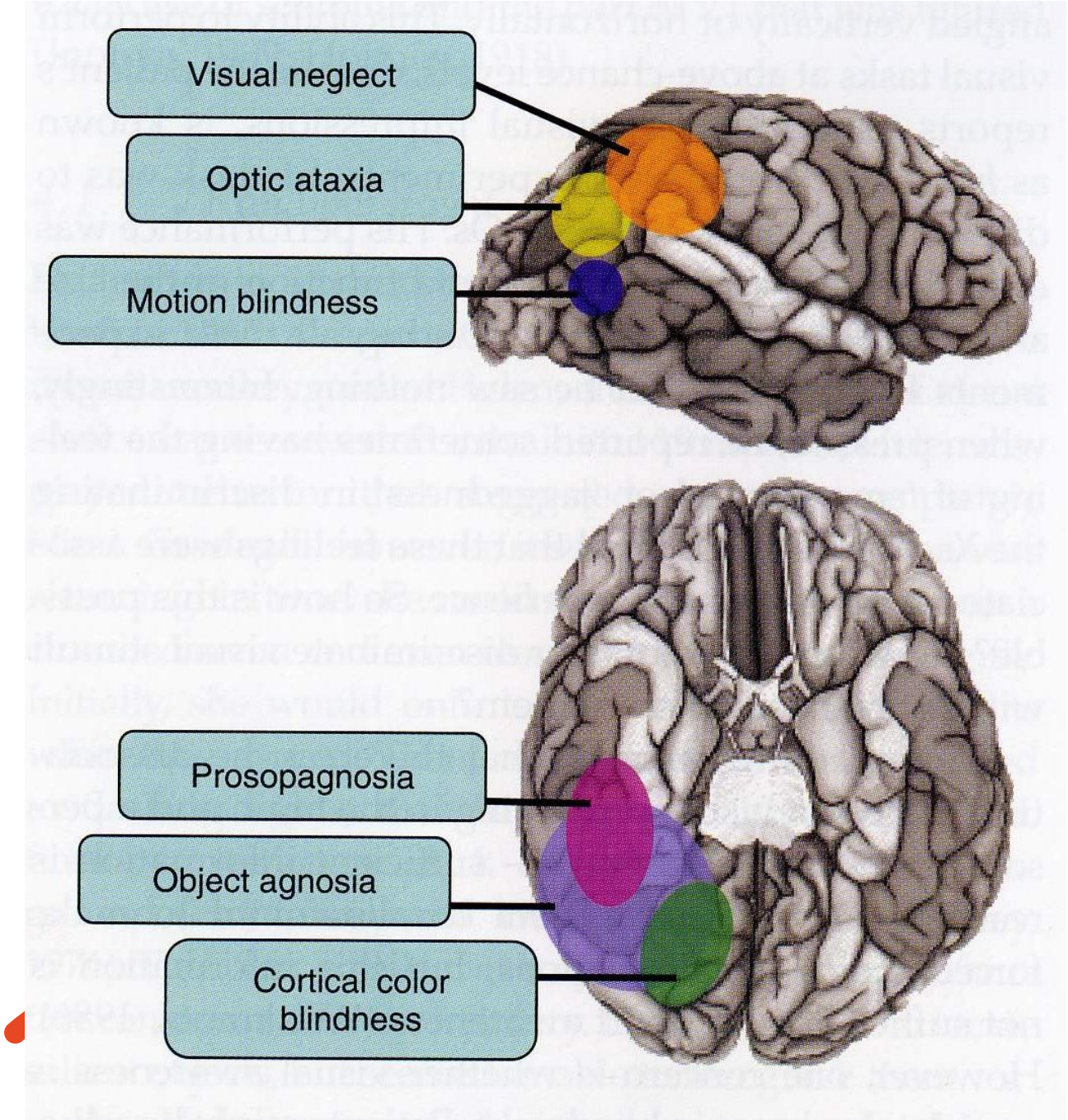
Inability to reach for an object in space under visual guidance or point to a target

OCULAR APRAXIA

Difficulty in directing the gaze towards an object through saccades

SIMULTANAGNOSIA

Inability to perceive more than one object in the visual field simultaneously



Dorsal and ventral visual areas and cognitive visual deficits

OBJ. # 3 & 4