THE CENTRAL VISUAL SYSTEM
It’s the neural pathway that leaves the eye and it include:
The Optic Nerve, Optic Chiasm, and Optic Tract
The visual field is the entire region of the space that could be seen by both eye looking straight ahead. Right and Left Visual Hemifields are defined by the space divided by the midline.
In the LGN is present the segregation of input by Eye and by Ganglion Cell Type.
Retinotopy
Neighboring representation of the object are spatially kept along all the visual pathway.
In the cortex there is an overrepresentation of central visual field.
Perception is based on the brain’s interpretation of this information.
THE STRIATE CORTEX

Macaque monkey

Human

Calcarine fissure
Lamination of the Striate Cortex (I – VI)

**Spiny stellate cells:** Spine-covered dendrites mainly in layer IVC, they receive information from LGN

**Pyramidal cells:** Spines; thick apical dendrite; mainly layers III, IVB, V, VI

Inhibitory neurons: Lack spines; All cortical layers; Forms local connections

Magnocellular LGN neurons: Project to layer IVC\(\alpha\)
Parvocellular LGN neurons: Project to layer IVC\(\beta\)

Koniocellular LGN axons: Bypasses layer IV to make synapses in layers II and III
THE STRIATE CORTEX

Outputs of the Striate Cortex:
Layers II, III, and IVB: Projects to other cortical areas
Layer V: Projects to the superior colliculus and pons
Layer VI: Projects back to the LGN

Receptive Fields in Layer IV C
Layer IVC: Monocular; center-surround receptive field (like in LGN)
Layer IVCα: Insensitive to the wavelength – projection from Magno
Layer IVCβ: Center-surround color opponency - projection from Parvo

Binocularity
Layers superficial to IVC: First binocular receptive fields in the visual pathway
Ocular Dominance Columns

Information coming from the left and the right eye (already segregate in LGN) is kept separate in layer IV of the visual cortex.

Only on layer III mixing of the information from the two eyes.

Layer IV

- Left eye input
- Right eye input

Layer III

- Binocular input
- Monocular input

Layers 1, 2, 3

Layers 5, 6

Layer VI
Cytochrome Oxidase Blobs

Cytochrome oxidase is a mitochondrial enzyme used for cell metabolism

**Blobs**: Cytochrome oxidase staining in cross sections of the striate cortex. Each centered on a ocular dominance stripe in layer IV

Color-sensitive, monocular, with no orientation or direction selectivity.

They are specialized for the analysis of object color

The neuron observed in the space between Blobs (**interblob**) are binocular, with orientation or direction selectivity.
Receptive Fields outside Layer IVC
Orientation Selectivity: Neuron fires action potentials in response to bar of particular orientation
Receptive Fields
Direction Selectivity: Neuron fires action potentials in response to moving bar of light

Visual stimulus

Receptive field
Direction of movement

Layer IVB cell discharge in response to left-right stimulus movement

Layer IVB cell discharge in response to right-left stimulus movement
THE STRIATE CORTEX

Parallel Pathways: Magnocellular; Koniocellular; Parvocellular

Extrastriate cortical areas

Layer IVB
Layer IVC

V1

LGN
Magnocellular
M-type ganglion cells
Magnocellular pathway (motion)

Blob
Blob pathway (color)

Interblob
Layer IVC

Parvocellular
P-type ganglion cells
Parvo-interblob pathway (shape)
Cortical Module: dimension of 2x2mm.
Necessary and sufficient module for the visual perception
THE EXTRASTRIATE CORTEX

Dorsal stream (V1, V2, V3, MT, MST, Other dorsal areas)
- Analysis of visual motion and the visual control of action
- In Area MT (temporal lobe) most cells: Direction-selective; Respond more to the motion of objects than their shape
- Area MST (parietal lobe) for navigation, directing eye movements, motion perception

Ventral stream (V1, V2, V3, V4, IT, Other ventral areas)
- Perception of the visual world and the recognition of objects,
- Area V4 orientation and perception of color
- Area IT is major output of V4. Receptive fields respond to a wide variety of colors and abstract shapes. Important also for memory