Visual System

- Superior visual field
- Macula
- Inferior visual field
- Superior retina
- Inferior retina
- Lateral geniculate nucleus
- Parieto-occipital sulcus
- Cuneus
- Calcarine sulcus
- Lingual gyrus
- Meyer's loop
Visual System

**Parvocellular layers:**

Input: Retinal ganglion P cells

Output: Primary or 1° visual cortex, layer 4Cβ

**Magnocellular layers:**

Input: Retinal ganglion M cells

Output: Primary or 1° visual cortex, layer 4Coα

(Courtesy of Tim Andrews and Dale Purves, Duke University School of Medicine.)

Simple cell

Stimulus: on off
Complex cell

Stimulus: on  off
V1 physiology: direction selectivity
V1 physiology: orientation selectivity

Hubel & Wiesel, 1968
Columnar architecture of V1

Retinotopic map

Columnar architecture

1 mm
Columnar architecture

Perpendicular electrode penetration: same orientation preferences and ocular dominance.

Tangential electrode penetration: orientation preference and/or ocular dominance varies.
Human ocular dominance columns
a. 

In vivo  

In vitro  

In vitro patched

30 μm

b. 

Orientation tuning

180°  

90°  

0°  

270°

20% ΔF/F

1 s

c. 

140 mV

1 s

0.4 mV

d. 

Connection probability

ΔOri (degree)

10/26  P = 0.040

11/44

4/24

0  0.25  0.5

e. 

Connection probability

ΔDir (degree)

6/13  P = 0.034

3/16

4/22

4/16

0  0.25  0.5  0.75  1

2/5
Simple cells are thought to reflect the convergence of axons from the LGN whose receptive fields were arranged in a row.

In contrast, complex cells in V1 receive input from simple cells that have a common orientation preference but different spatial locations.
Ocular Dominance Columns
Organization of the cortex can be imaged by recording changes in the reflectance of light off of the surface.
Orientation columns in primate cortex. Orientation changes around a radial axis but remains constant along an angle.