Binocular and Monocular Portions of the Visual Field

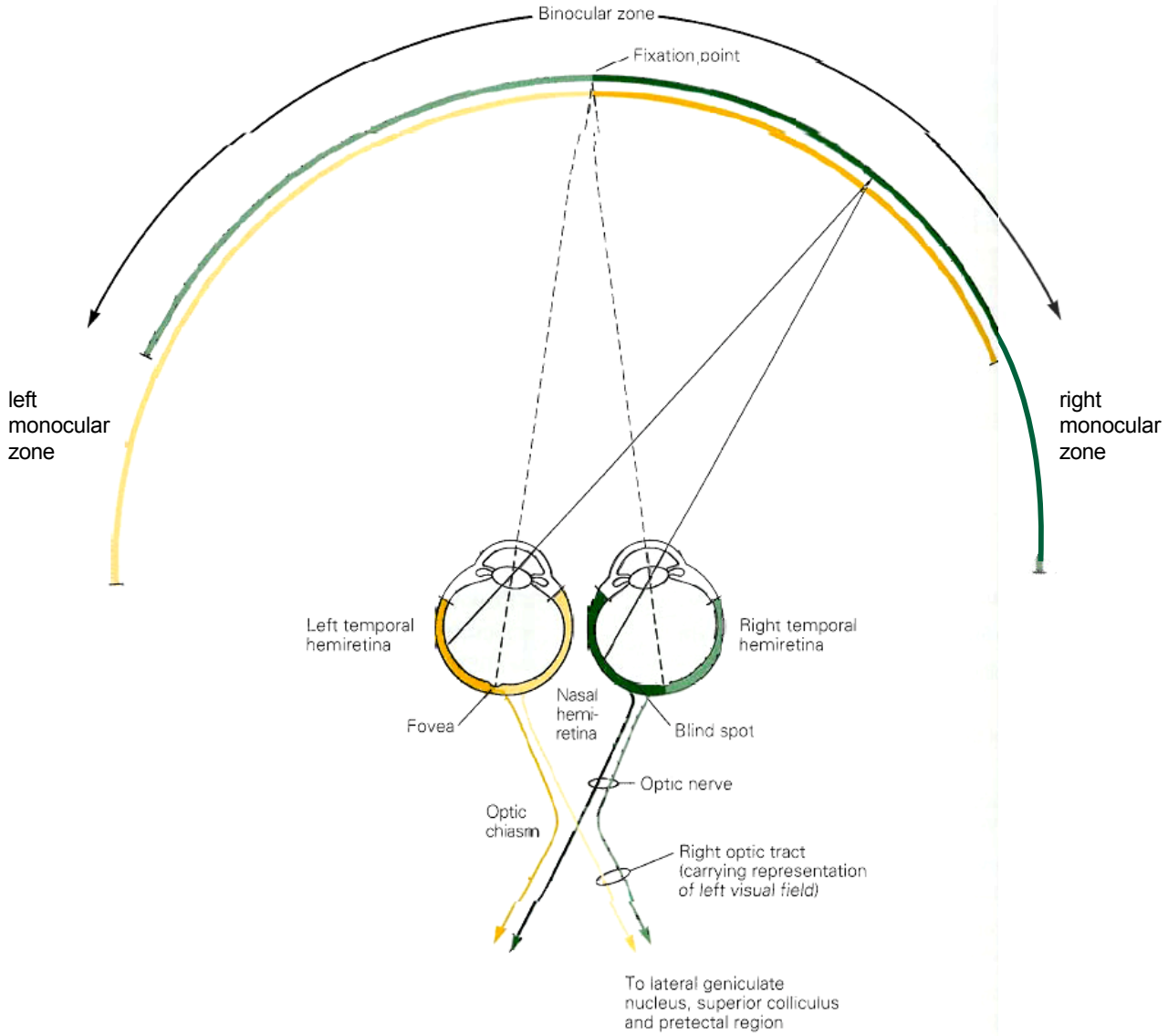


Fig. 27-1, Kandel et al., 4th edition

Segregation of Inputs into the LGN

- **Magnocellular pathway**
  Layers 1 & 2
- **Parvocellular pathway**
  Layers 3 - 6
- **Contralateral input**
  Layers 1, 4, 6
- **Ipsilateral input**
  Layers 2, 3, 5
- Point-to-point topography of visual field is preserved between retina and LGN

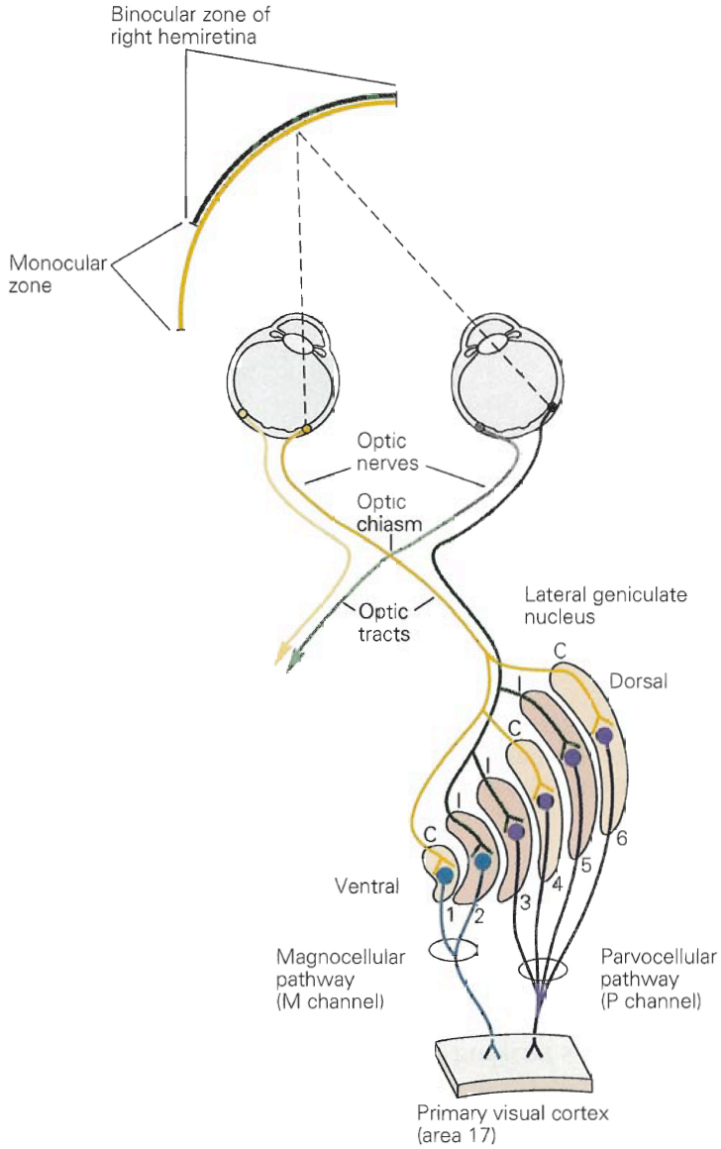
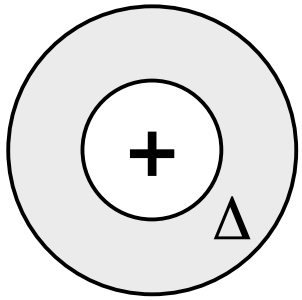


Fig. 27-6, Kandel et al., 4th edition

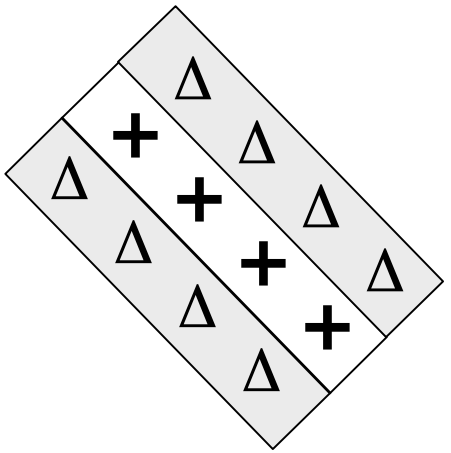
Transformation of Receptive Field Properties from LGN to Primary Visual Cortex

LGN Neuron



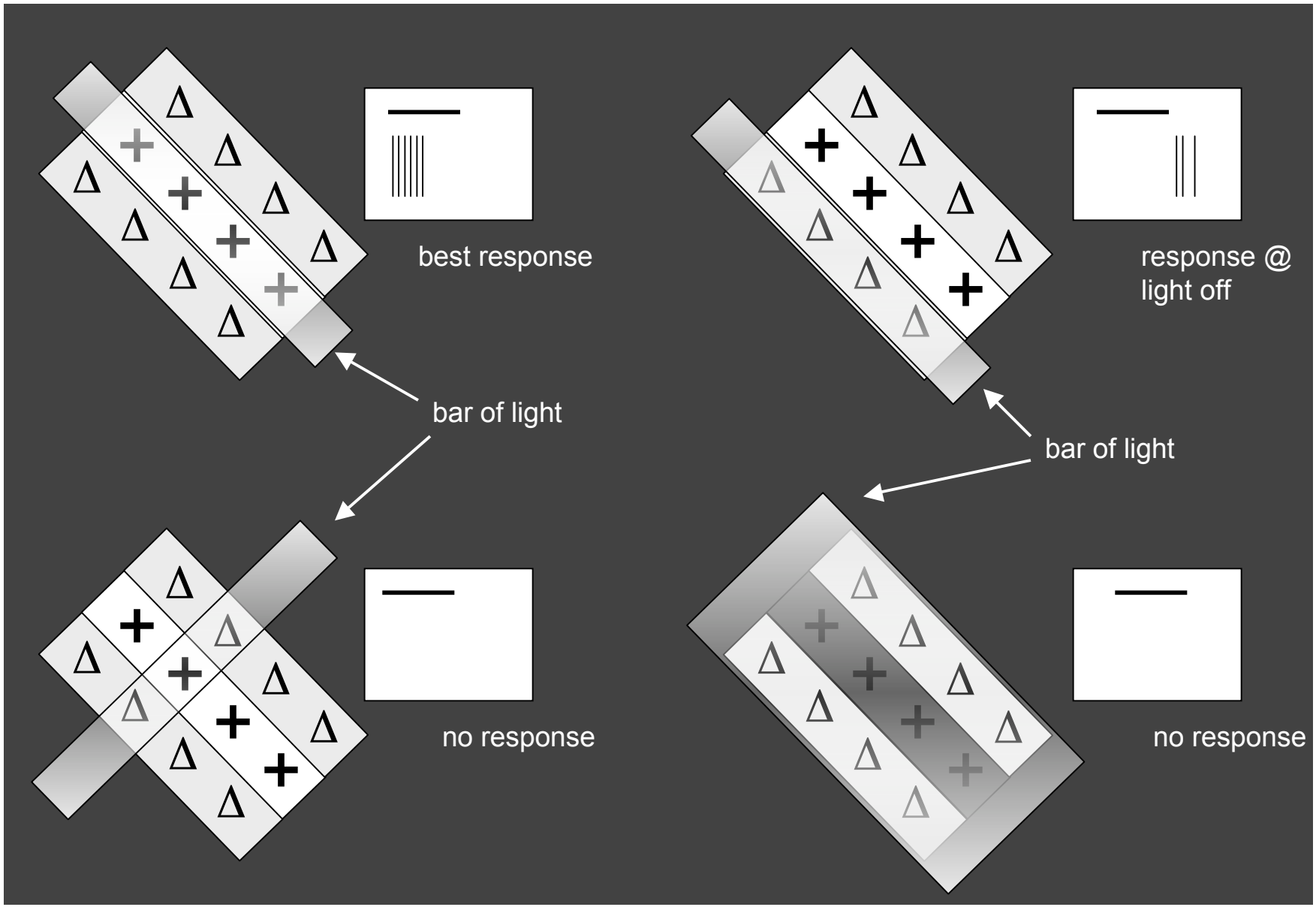
Circular Receptive Field
(e.g., on-center, off-surround)

"Simple Cell" in Cortex

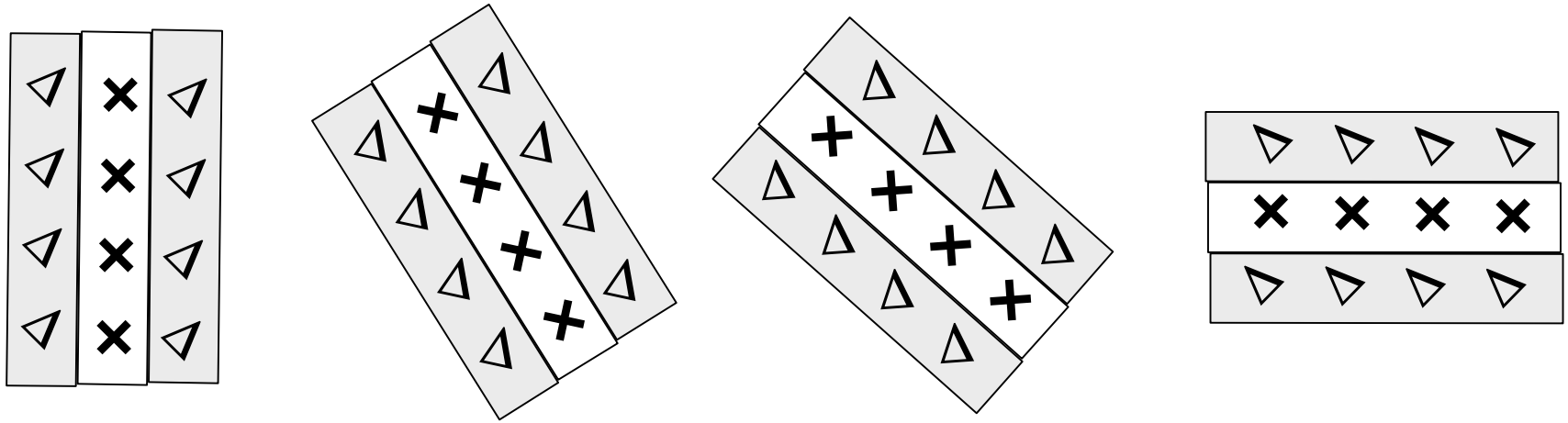


Rectangular Receptive Field
(e.g., on-center, off-flanks)

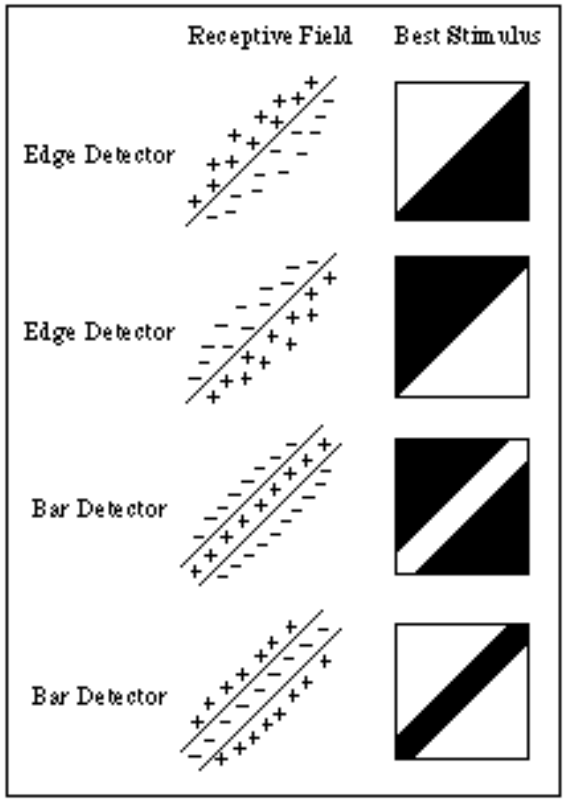
Orientation Selectivity of Simple Cells



Simple Cells Can Have Different Orientation Selectivities



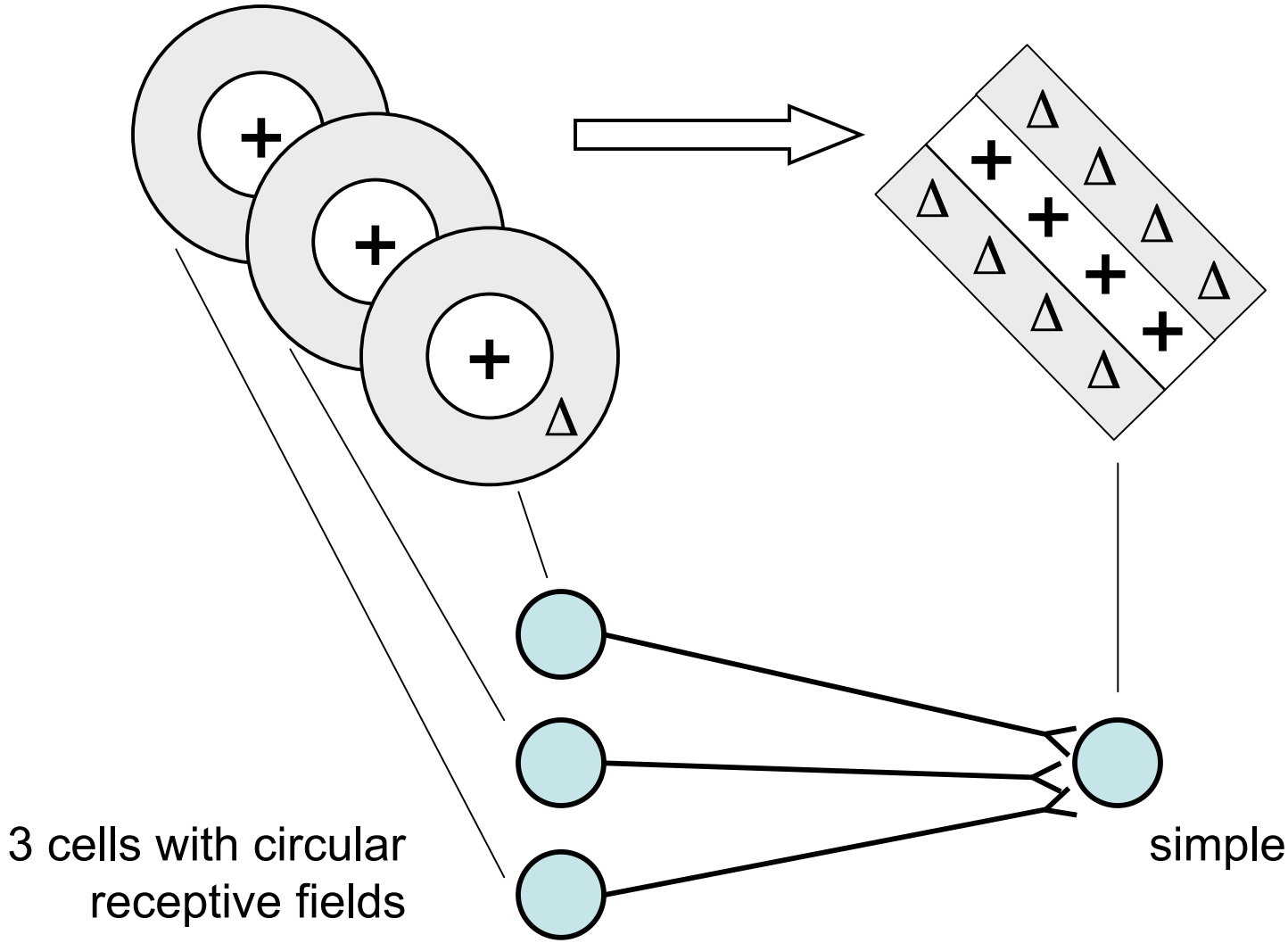
Examples of Simple Cell Receptive Fields



http://www.cquest.utoronto.ca/psych/psy280f/ch4/orientSelec.html

Simple cells can be used to detect edges and contours

Hypothetical Wiring Diagram for Generating a Simple Cell Receptive Field



Schematic of Orientation Selectivity in the Primary Visual Cortex

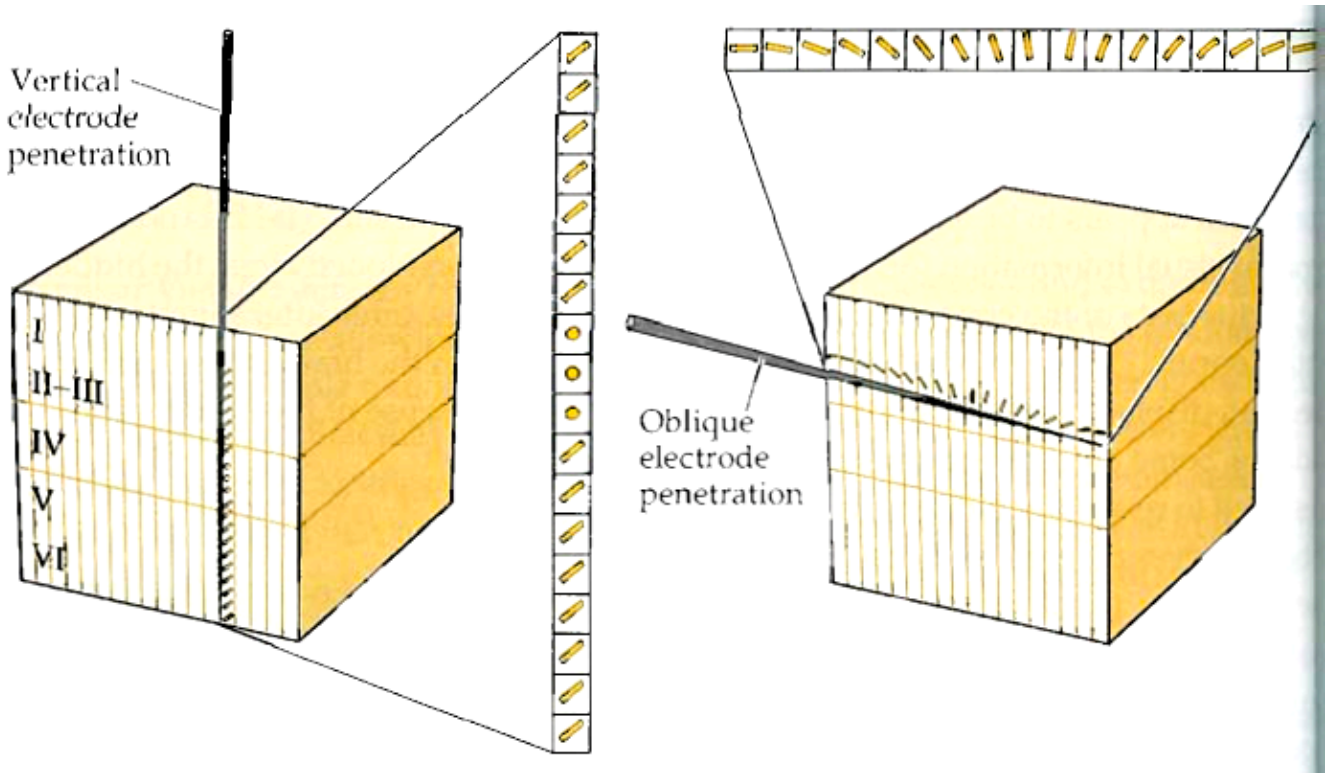
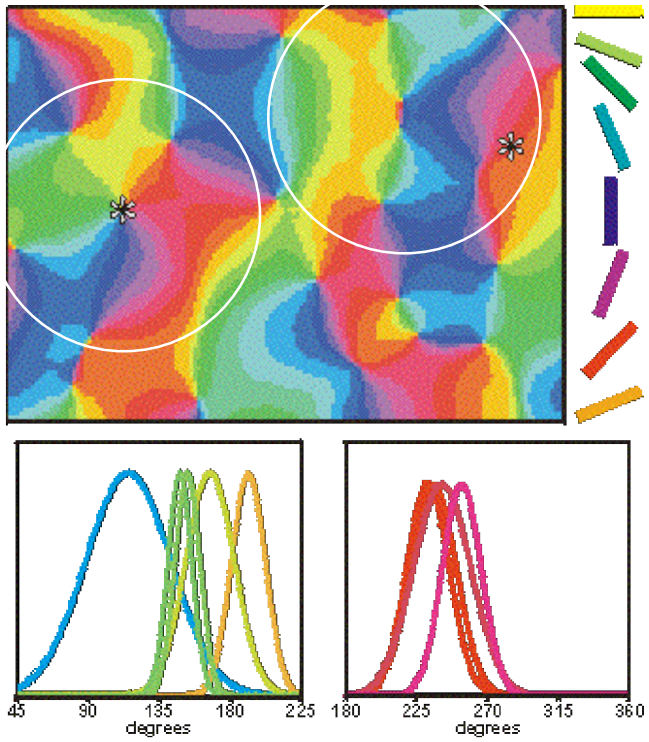


Fig. 11.12, Purves et al., Neuroscience, 3rd edition

- Oblique/tangential penetration reveals progressive change in orientation selectivity
- Vertical penetration reveals columnar organization of orientation selectivity

Pinwheel Arrangement of Orientation Columns Revealed by Optical Imaging of Intrinsic Signals



http://www.neuro.mpg.de/ research/csn/pinwheel/

Schematic of Ocular Dominance Columns

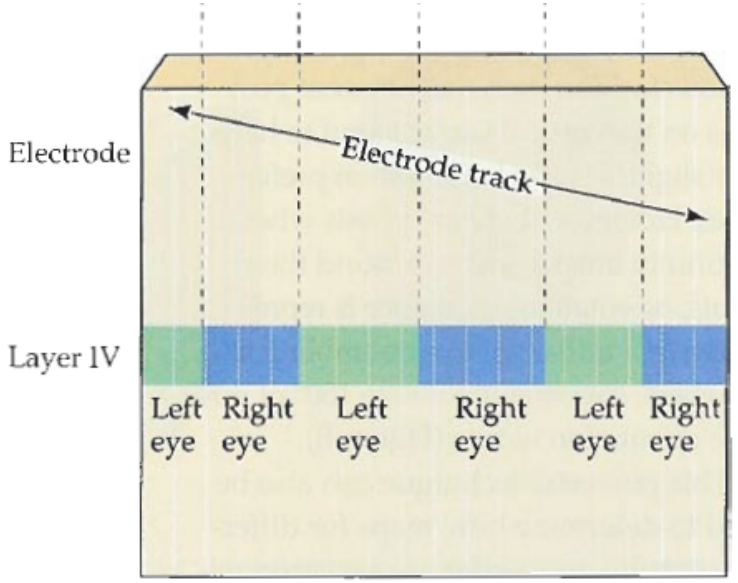


Fig. 11.13, Purves et al., Neuroscience, 3rd edition

- Alternating columns of cells showing preferential responses to right eye or left eye input
  - Monocular cells in layer 4
  - Binocular cells are found in other layers

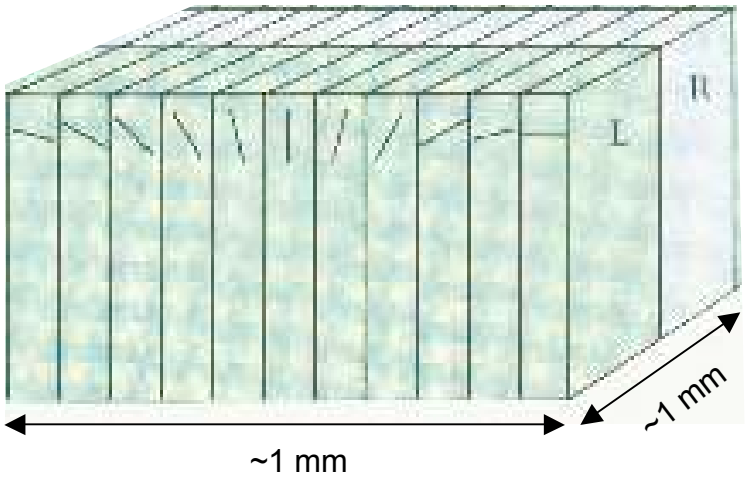
Ocular Dominance Columns in Primary Visual Cortex Revealed by Trans-Synaptic Labeling

- Injection of ^{3}H amino acid tracer into one eye
- Tracer is transferred trans-synaptically from retina to LGN to cortex
- Autoradiography of flattened cortical sheet reveals interdigitating regions of left eye vs. right eye inputs

Autoradiogram of V1

www.utoronto.ca/psy280sh/ PSY_Lecture_4_jpgs.html

Schematic of a Cortical Hypercolumn: A Unit of Information



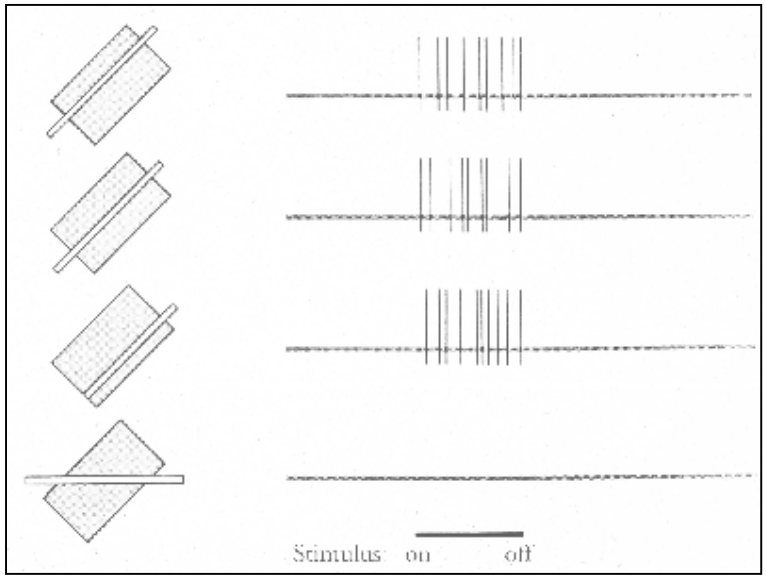
http://www-psych.stanford.edu/~lera/psych115s/notes/lecture3/figures.html

~1 mm x ~1 mm

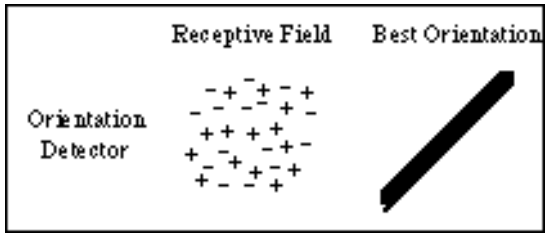
180^{o} orientation

one L + R pair

Complex Cell Receptive Field Properties



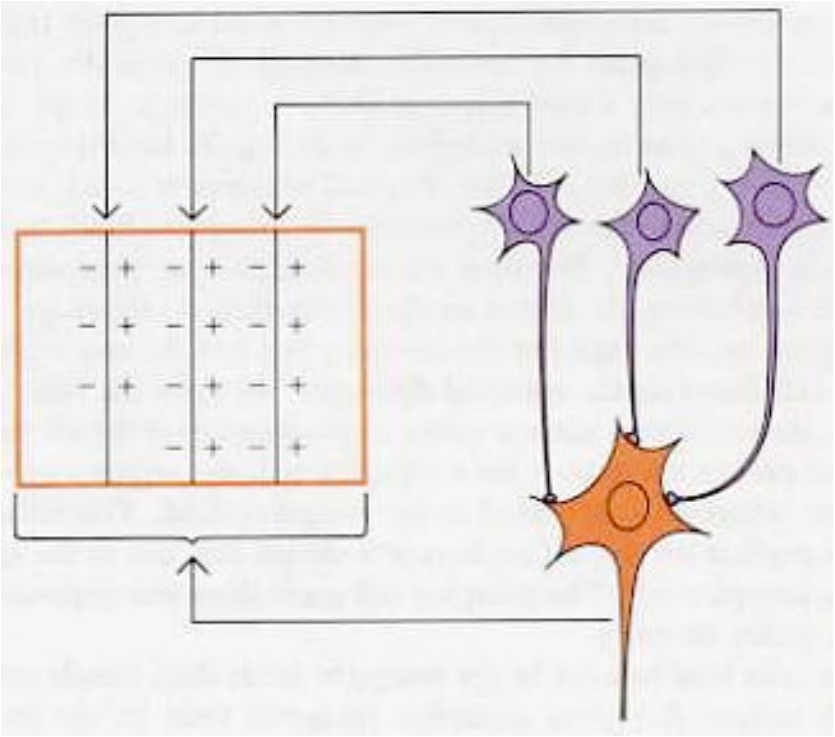
http://www-psych.stanford.edu/~lera/psych115s/notes/lecture3/figures.html



http://www.cquest.utoronto.ca/psych/psy280f/ch4/orientSelec.html

- "On" and "off" regions throughout receptive field
- Orientation selective

Hypothetical Wiring Diagram for Generating a Complex Cell's Receptive Field



http://neuro.med.harvard.edu/site/dh/b18.htm

Construction of complex cell receptive field via input from multiple simple cells