

# Chapter 6: Vision

General Principles of Sensory Processing

The Visual Stimulus

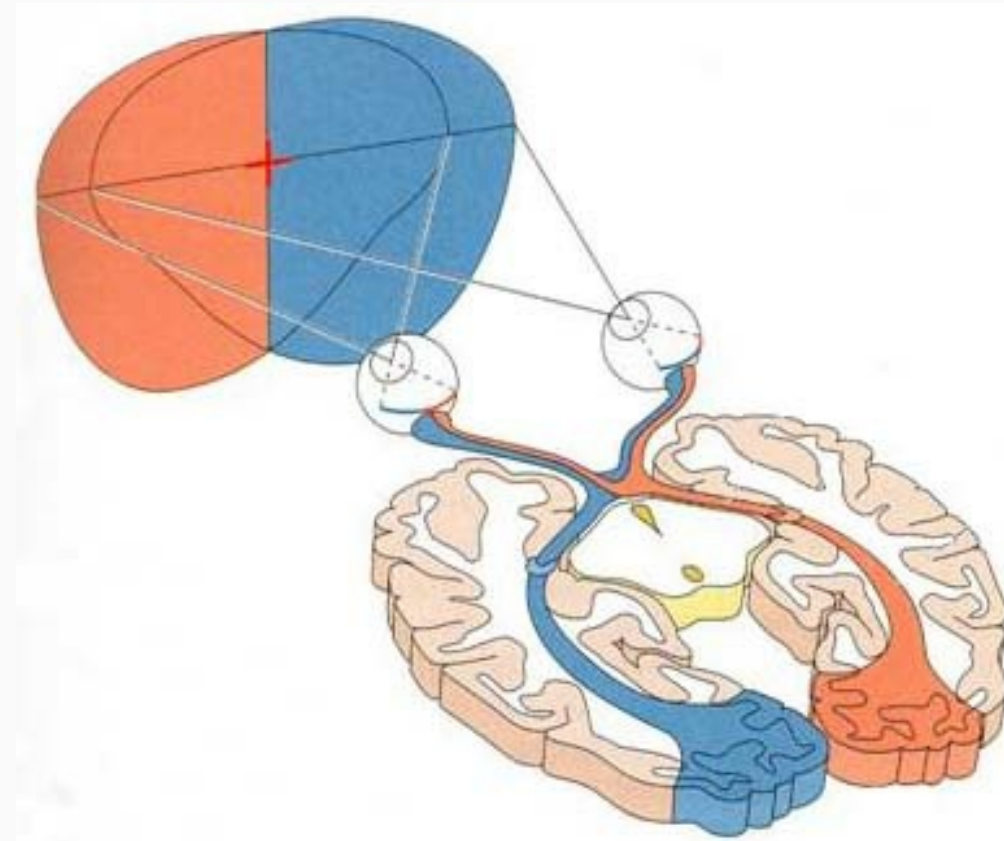
The Anatomy of the Visual System

Coding of Light and Dark

Coding of Color

**The Primary Visual Cortex**

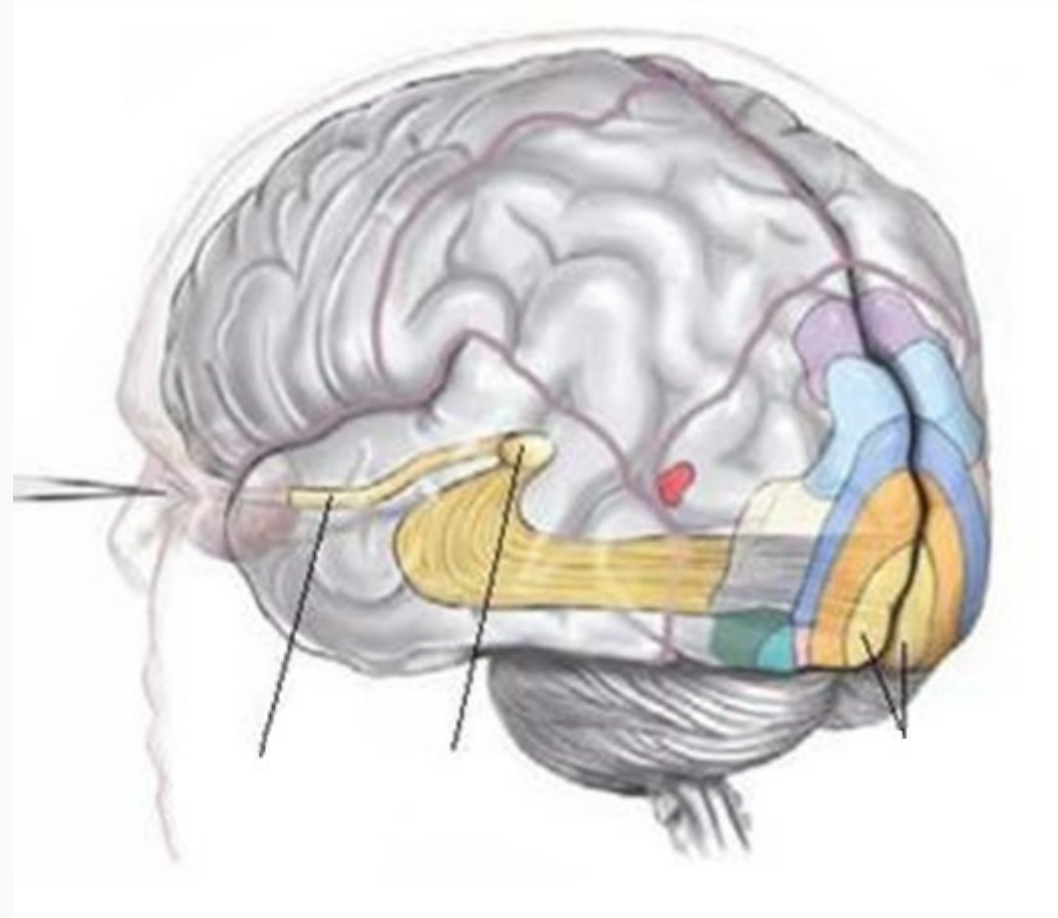
Perception of Visual Information



# The Primary Visual Cortex

## Primary Visual Cortex Represents Four Aspects of Visual Stimulus.

- location in the visual field
- color
- ocular dominance
- orientation



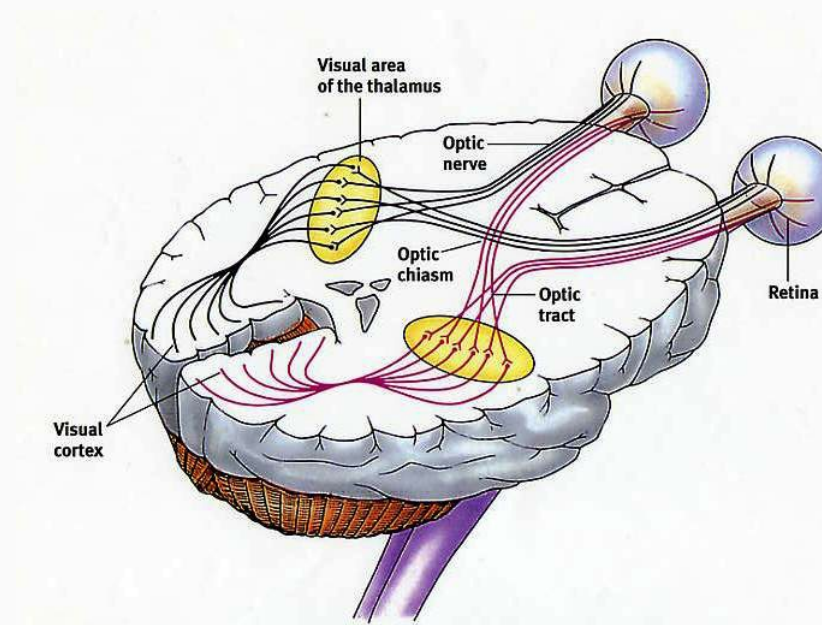
# The Primary Visual Cortex

Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Location in Visual Field.

- LGN is retinotopically organized relay to PVC
- parallel processing of magno- and parvocellular inputs
- parallel processing of binocular inputs



lateral geniculate nucleus

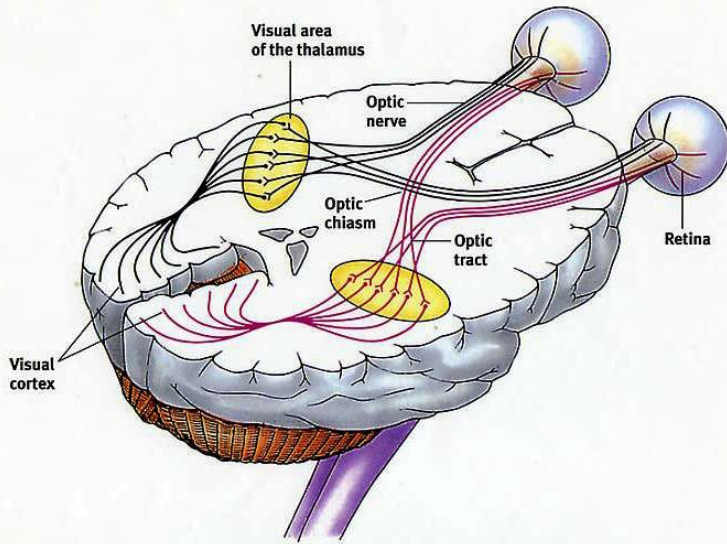


primary visual pathway

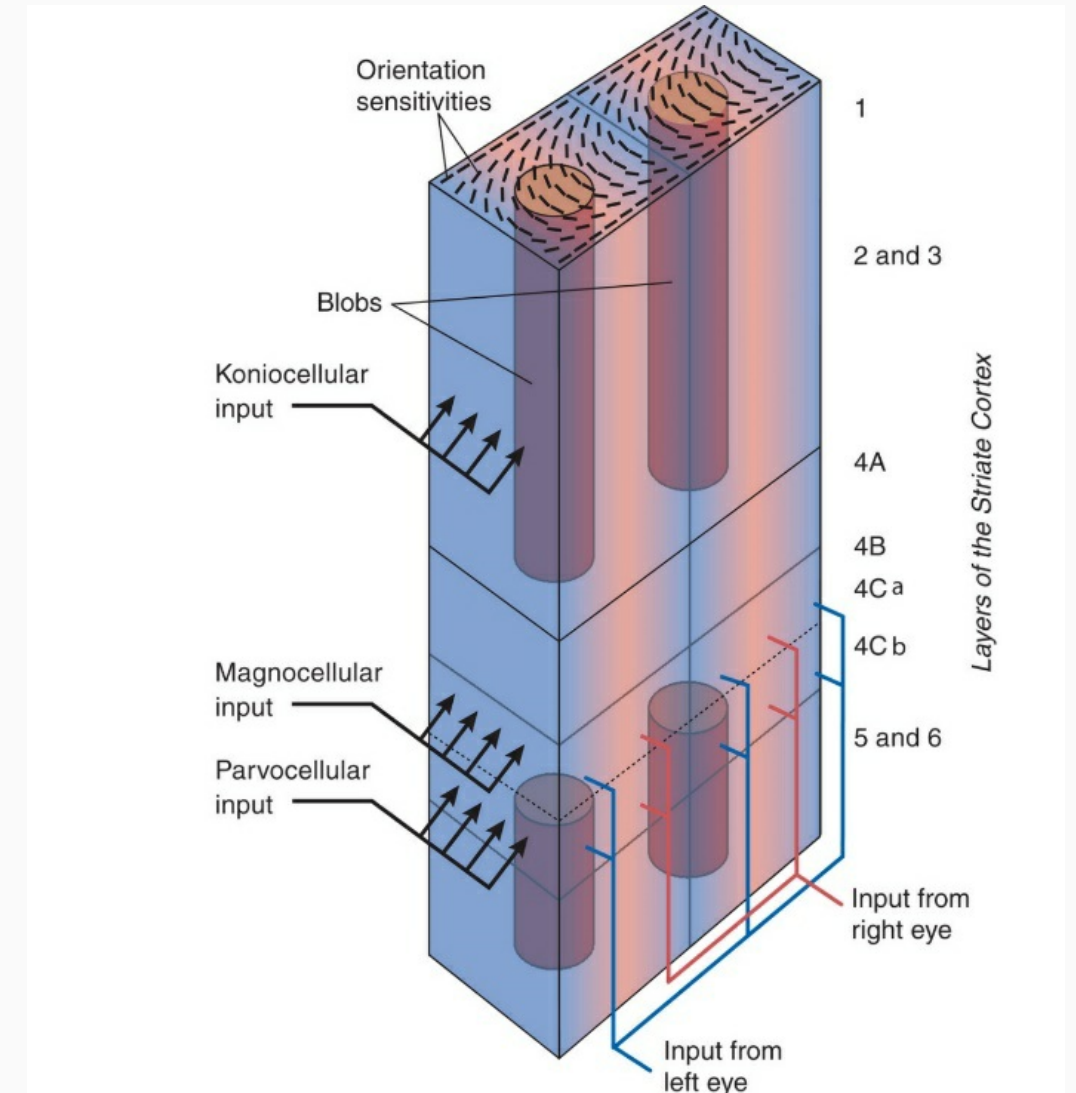
# The Primary Visual Cortex

Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Location in Visual Field.

- PVC is organized in computational columns
- parallel processing of magno- and parvocellular inputs
- convergent processing of binocular inputs
- in any cortical column, all receptive fields have roughly same retinotopic location, and these locations change systematically in nearby columns



primary visual pathway





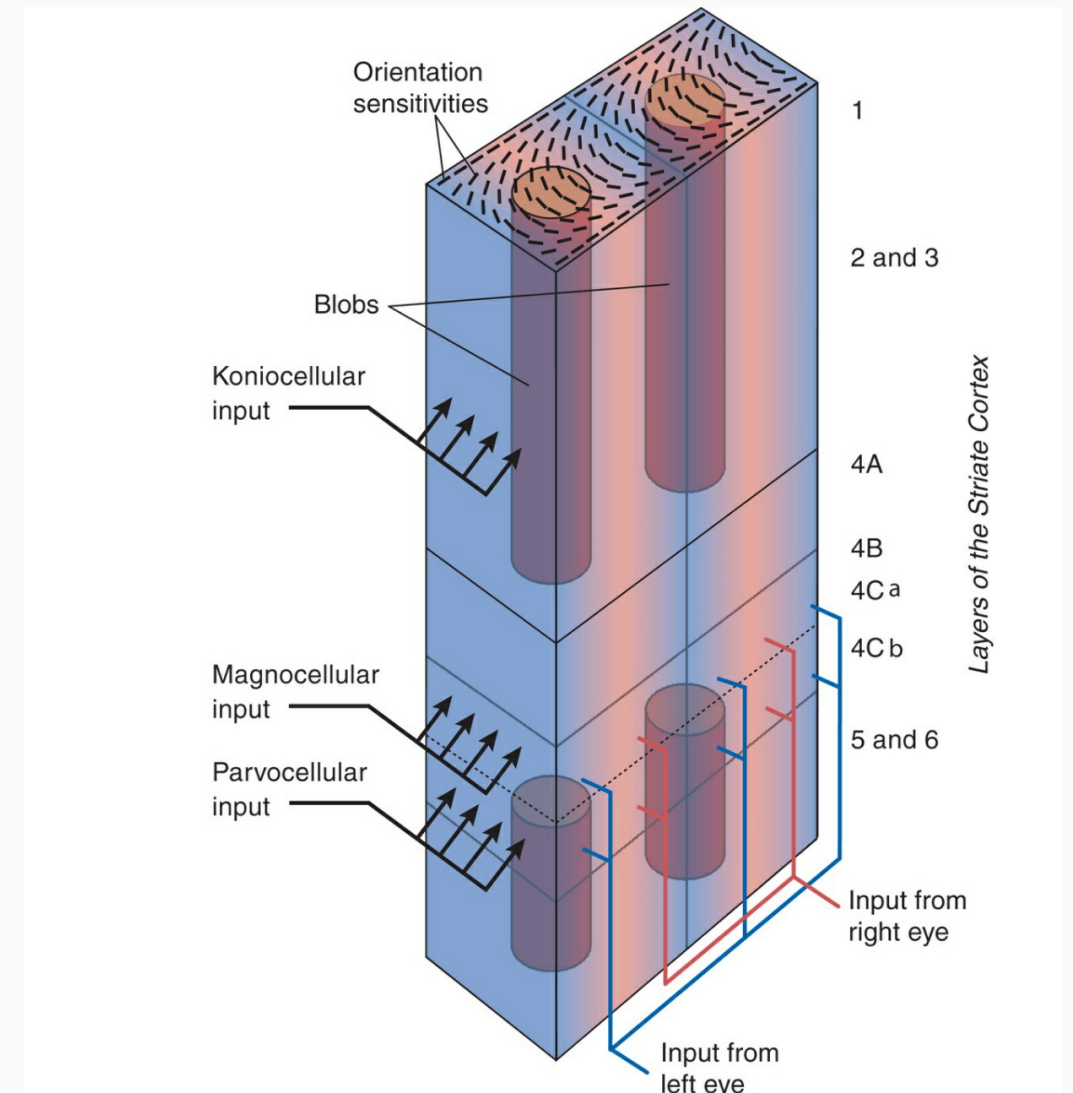
# The Primary Visual Cortex

## Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Color.

- parvocellular input from medium and long wavelength cones
- koniocellular input from short wavelength cones



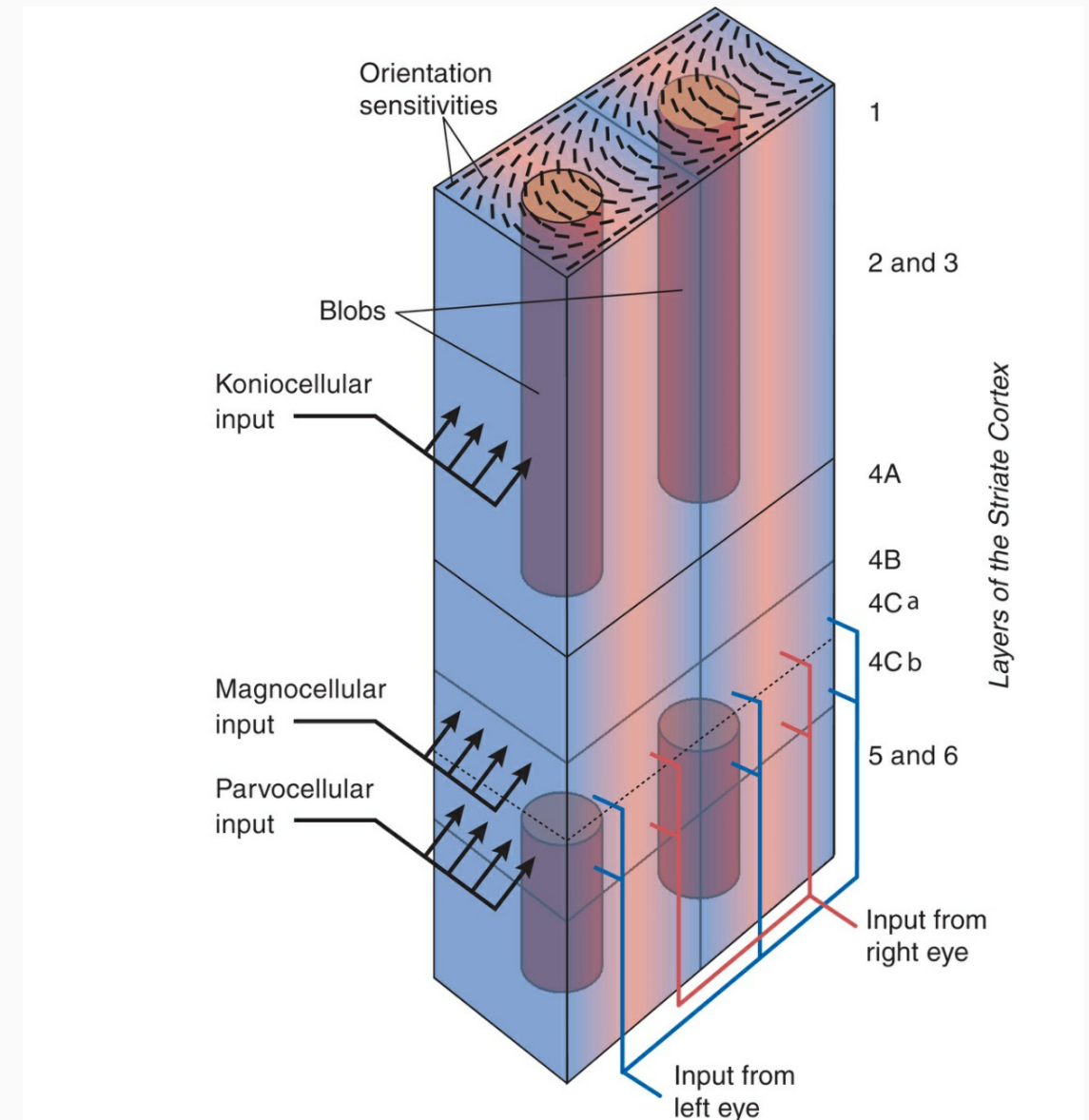
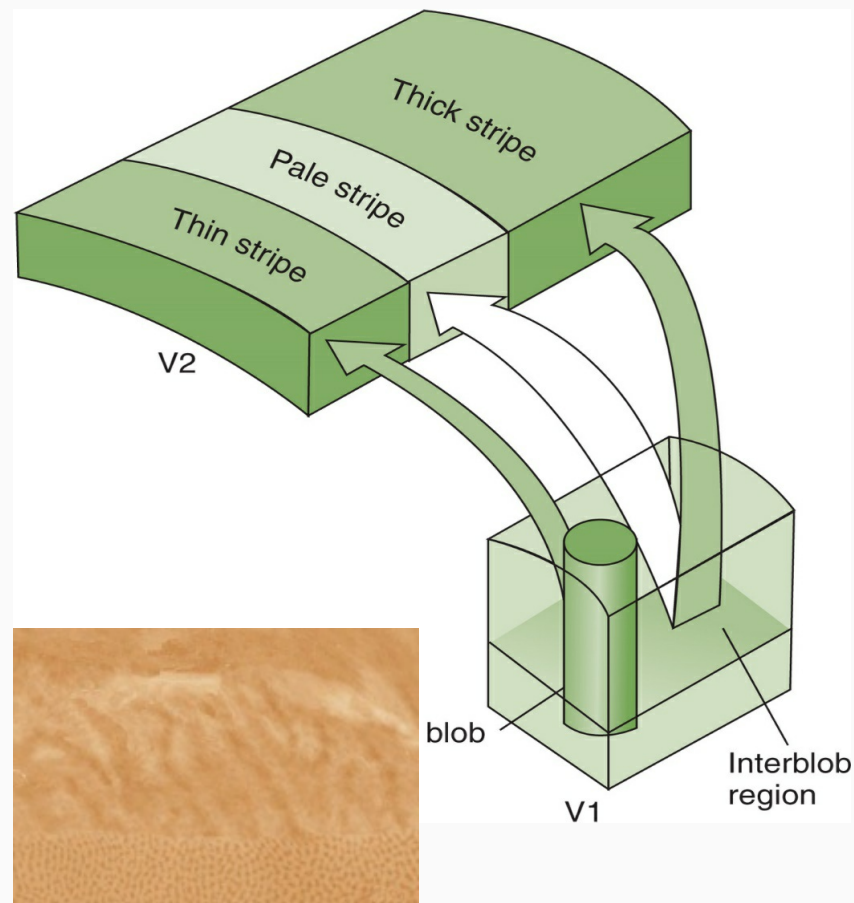
lateral geniculate nucleus



# The Primary Visual Cortex

## Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Color.

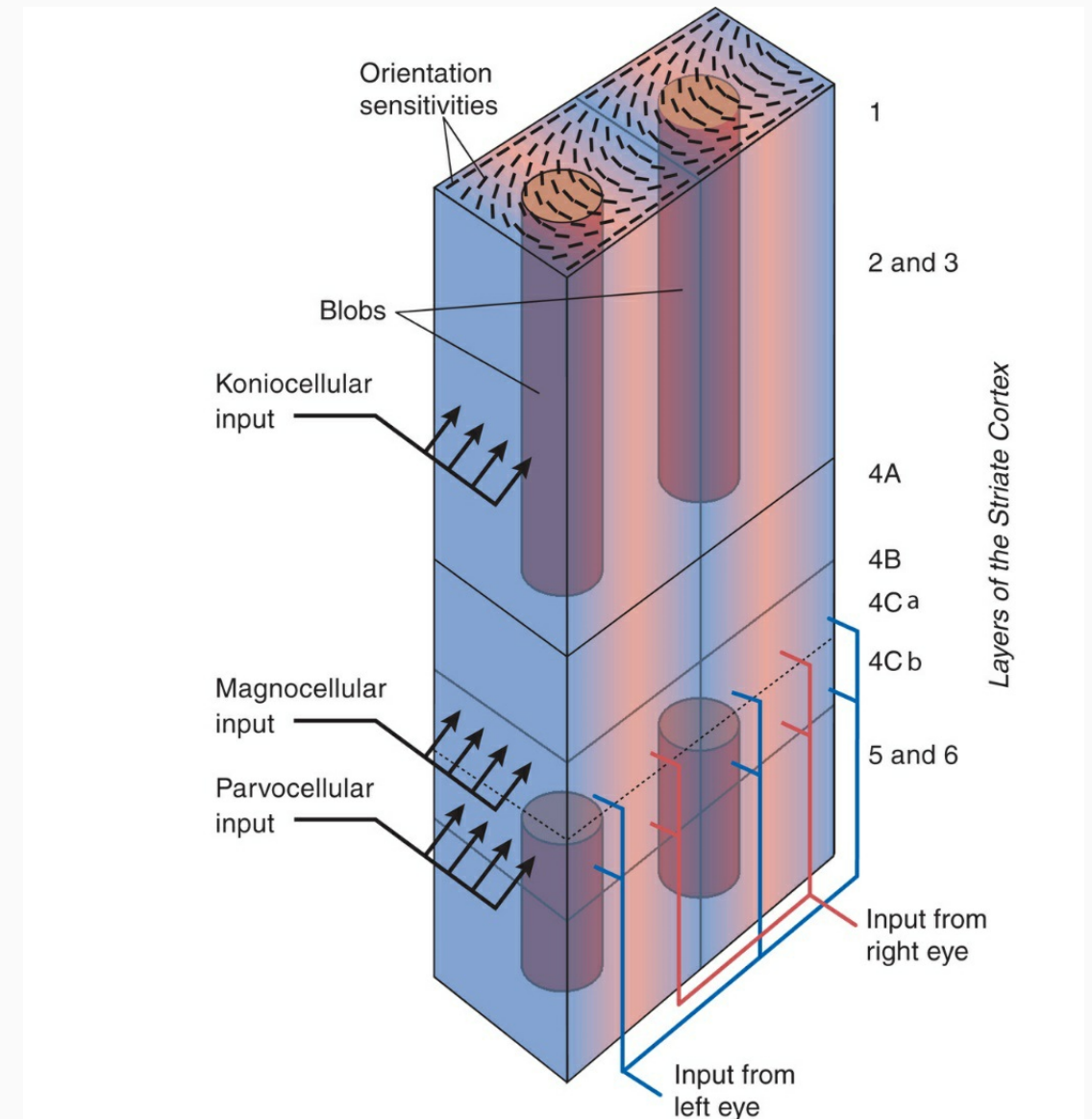
- colour-sensitive cells in CO blobs of V1 send color input to thin stripes of V2



# The Primary Visual Cortex

## Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Ocular Dominance.

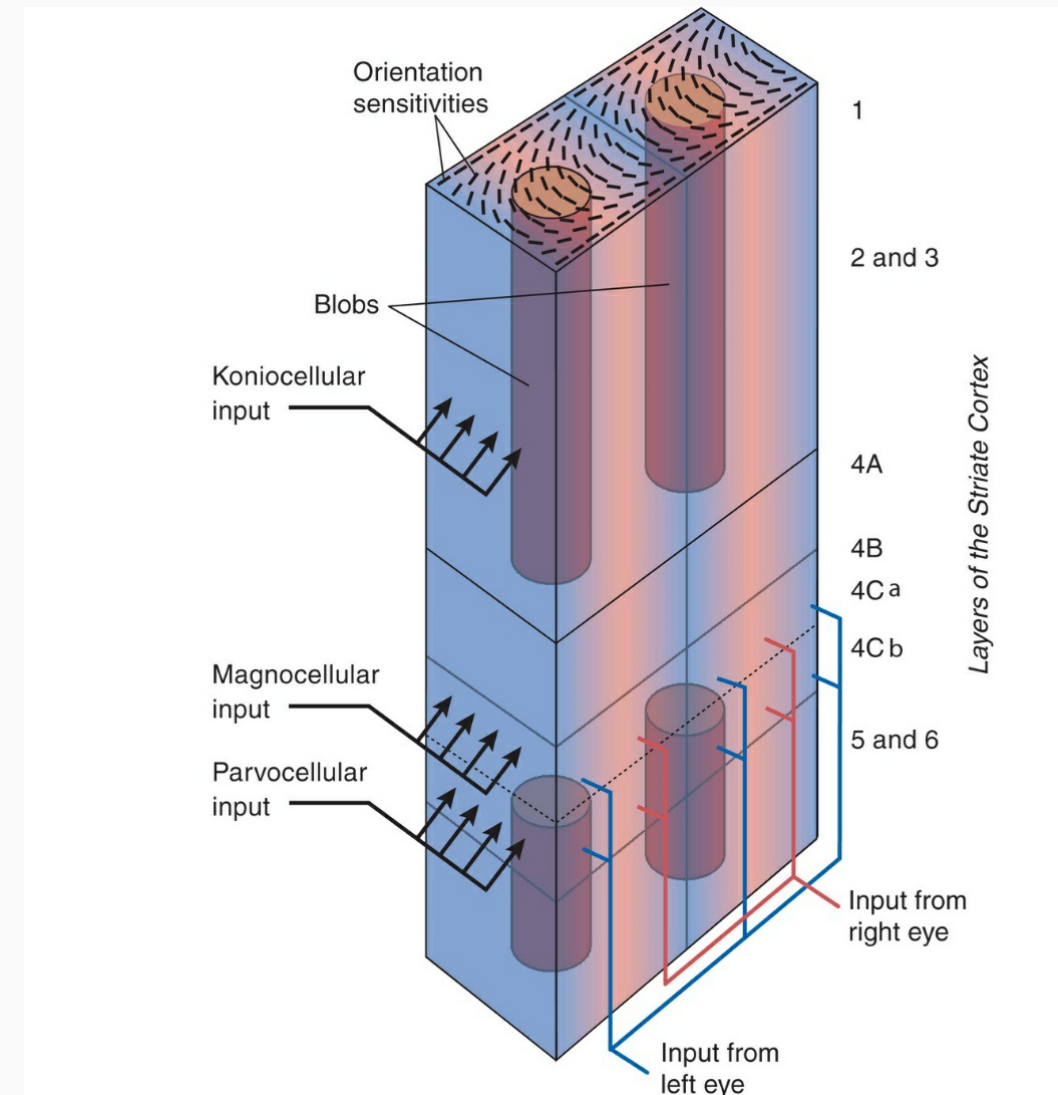
- most PVC cells are binocular, but respond more for one eye's input relative to the other
- if electrode advanced through interblob column, all neurons will have same ocular dominance
- if electrode advanced tangentially, ocular dominance switches back and forth



# The Primary Visual Cortex

## Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Orientation.

- most PVC cells are spatially tuned to respond best to stimulation in a particular orientation
- if electrode advanced through interblob column, neurons will have same similar orientation tuning
- if electrode advanced tangentially, orientation changes systematically

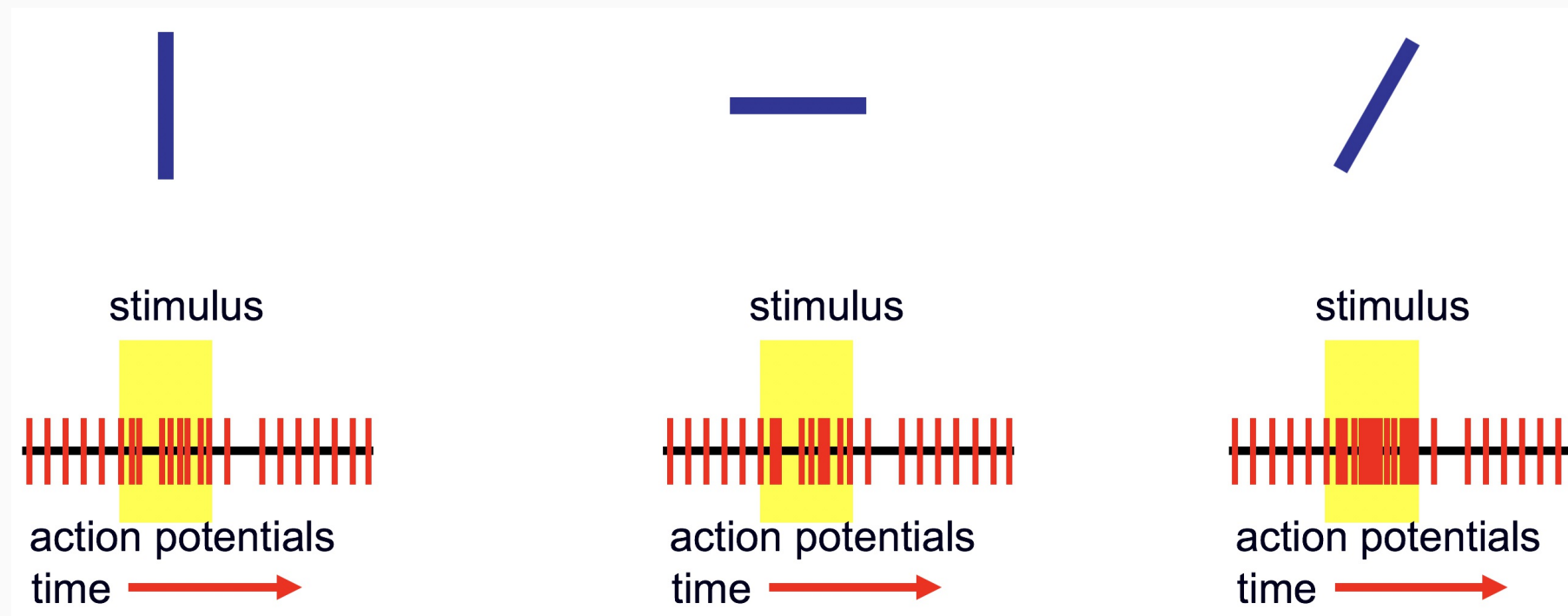




# The Primary Visual Cortex

## Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Orientation.

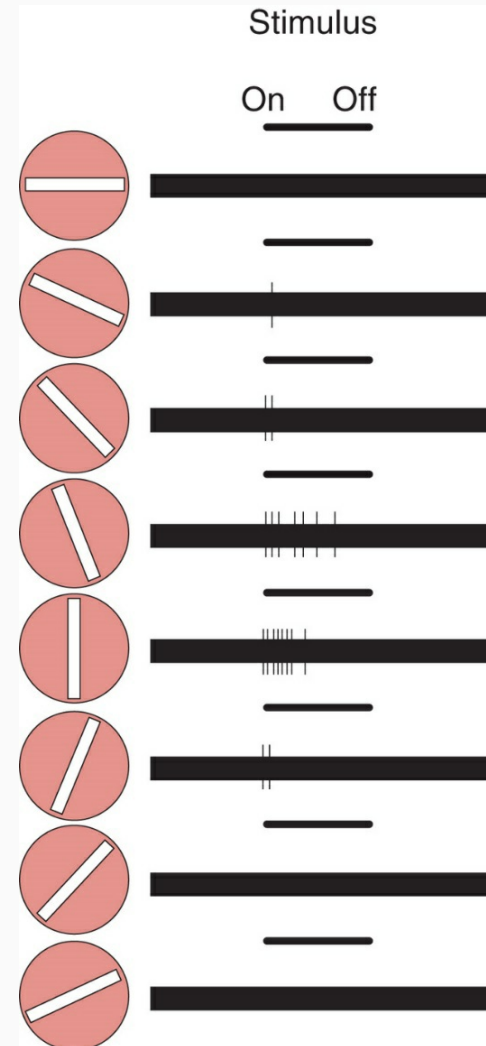
- magnocellular inputs to area V1
- if line is in simple cortical cell's RF, and rotated around its center, the cell will only respond when the line is in a particular range of orientation



# The Primary Visual Cortex

## Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Orientation.

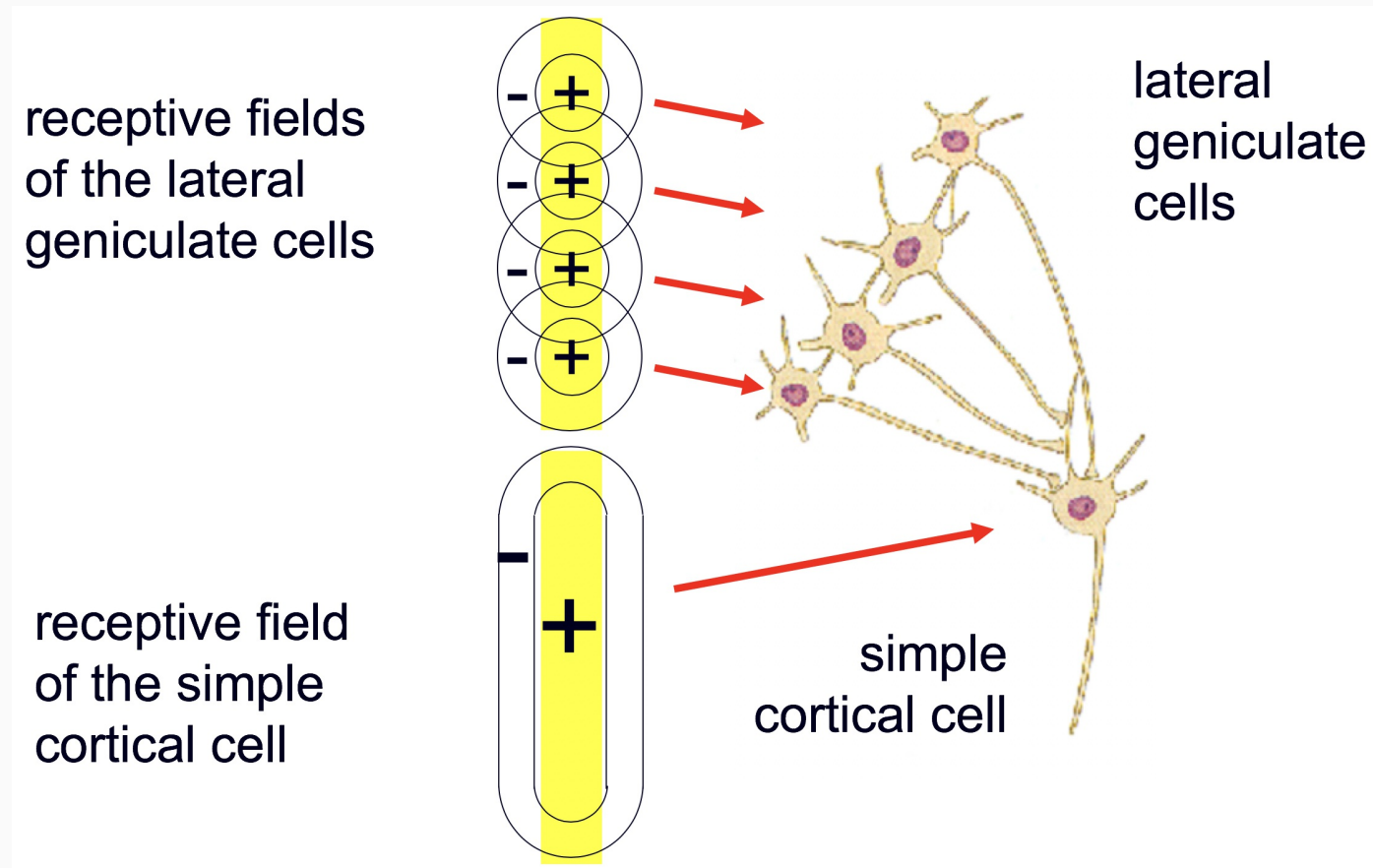
- all simple cells exhibit tuning curves



# The Primary Visual Cortex

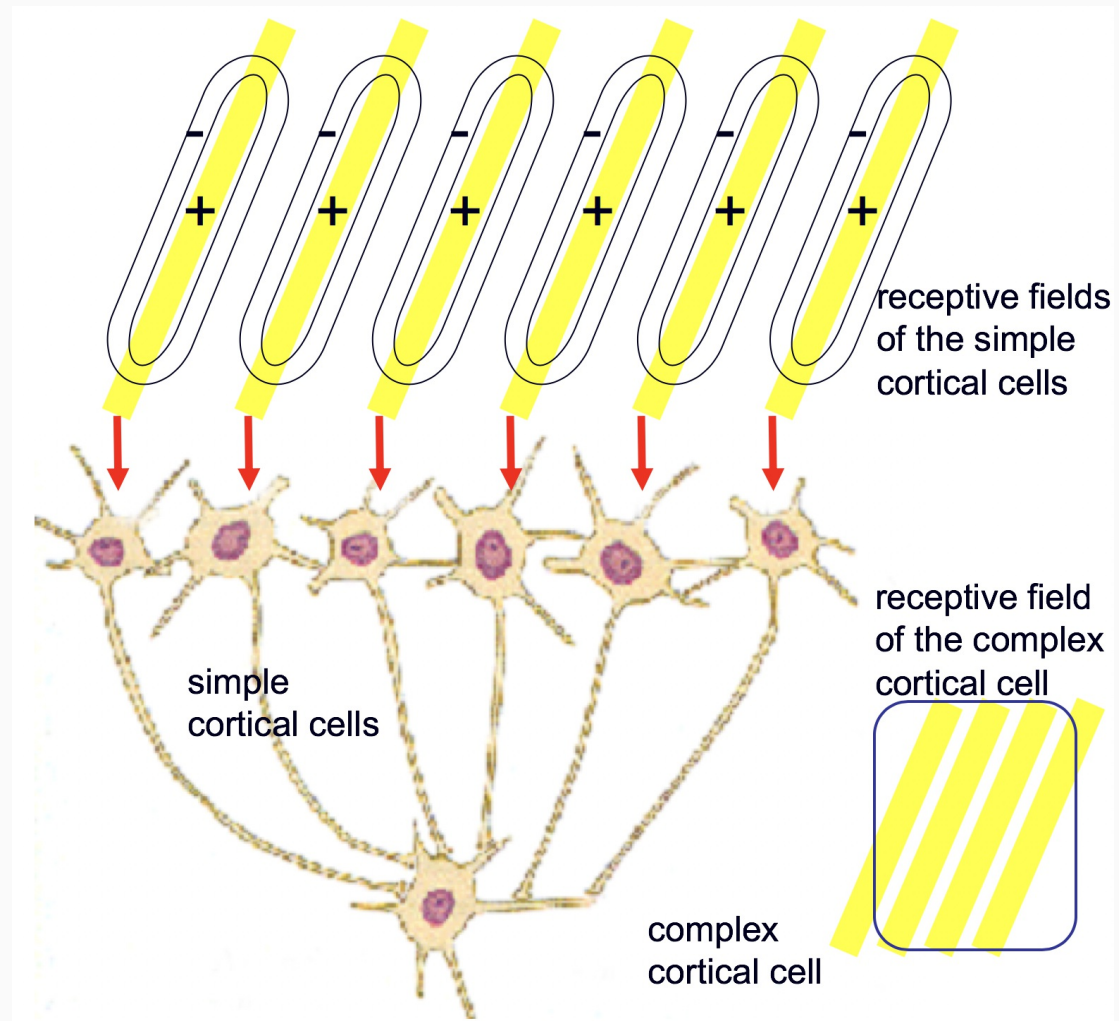
## Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Orientation.

- LGN cell's concentric receptive fields input to V1 simple cells to determine orientation selectivity



# The Primary Visual Cortex

Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Orientation.

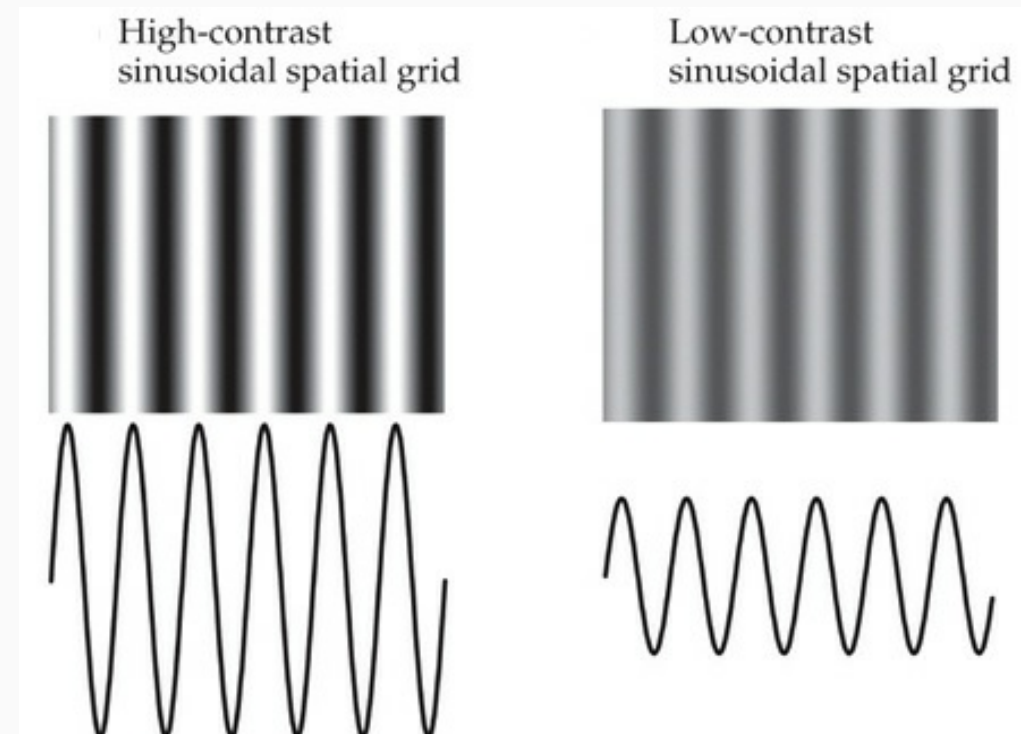




# The Primary Visual Cortex

## Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Orientation.

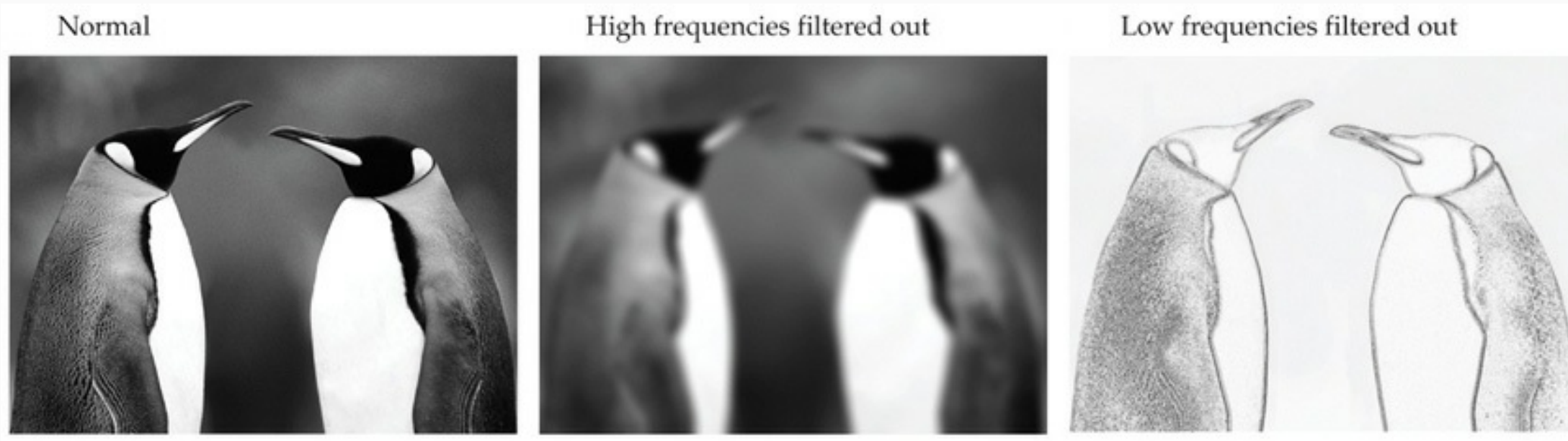
- Eyes are in constant motion
  - even when fixed on object
- - contrast between lighter and darker parts of stimulus
  - yields patterns of high or low contrast grids



# The Primary Visual Cortex

## Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Orientation.

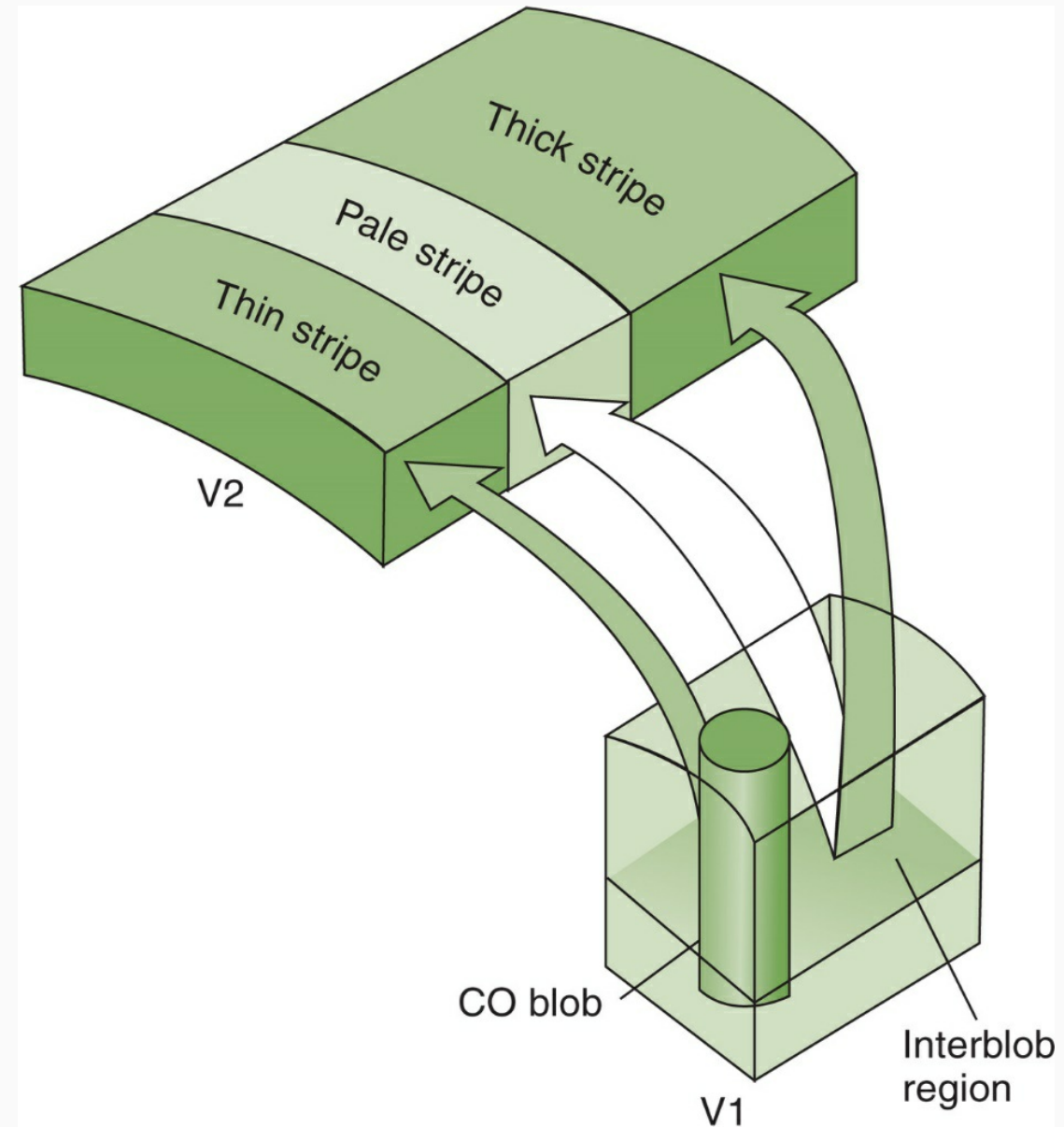
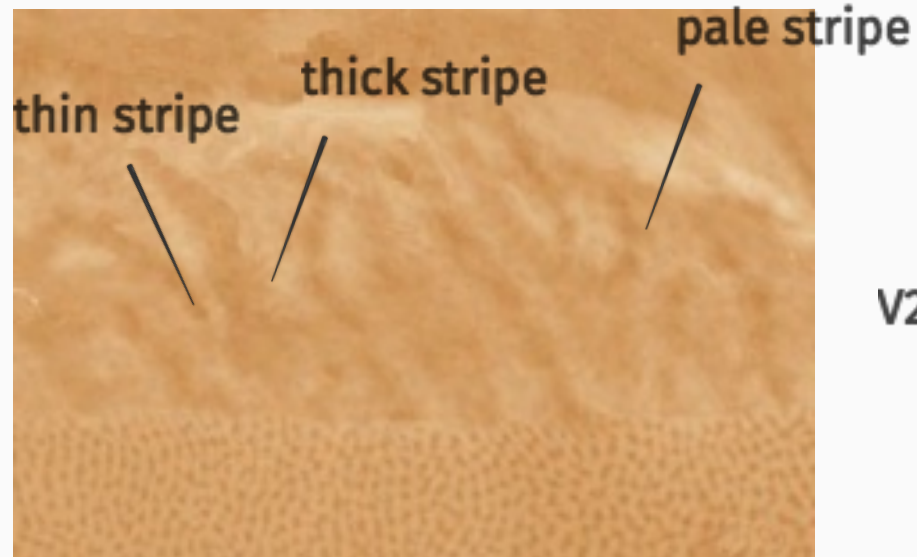
- simple cells tuned to specific frequencies at correct angle of orientation
- contributes to feature detection



# The Primary Visual Cortex

Primary Visual Cortex Represents Four Aspects of Visual Stimulus - Ocular Dominance and Orientation.

- interblob regions of V1 input to thick stripes and pale stripes to provide information about:
  - ocular dominance,
  - orientation,
  - movement...



# Image Credits

- slide 1: [http://www.dgward.com/physo101/sm06\\_pages/labs/Peripheral Vision and Visual Pathways\\_files/image003.jpg](http://www.dgward.com/physo101/sm06_pages/labs/Peripheral_Vision_and_Visual_Pathways_files/image003.jpg)
- slide 2: [http://upload.wikimedia.org/wikipedia/commons/a/ae/Occipital\\_lobe\\_-\\_animation.gif](http://upload.wikimedia.org/wikipedia/commons/a/ae/Occipital_lobe_-_animation.gif) <http://rocio.jimenez.tripod.com/blog/image021.jpg>
- slide 3: [https://www.physics.ohio-state.edu/~kagan/AS1138/Lectures/17\\_LGNs.gif](https://www.physics.ohio-state.edu/~kagan/AS1138/Lectures/17_LGNs.gif) [http://columbiaspectator.com/sites/default/files/migrate-photos\\_6F6DC7DF-28FE-433F-9AED-2CB301F35C4B.jpg](http://columbiaspectator.com/sites/default/files/migrate-photos_6F6DC7DF-28FE-433F-9AED-2CB301F35C4B.jpg)
- slide 4: [http://columbiaspectator.com/sites/default/files/migrate-photos\\_6F6DC7DF-28FE-433F-9AED-2CB301F35C4B.jpg](http://columbiaspectator.com/sites/default/files/migrate-photos_6F6DC7DF-28FE-433F-9AED-2CB301F35C4B.jpg) Carlson, N.R. (2012). Physiology of Behavior, 11th ed. Pearson Publishing
- slide 5: [https://www.physics.ohio-state.edu/~kagan/AS1138/Lectures/17\\_LGNs.gif](https://www.physics.ohio-state.edu/~kagan/AS1138/Lectures/17_LGNs.gif) Carlson, N.R. (2012). Physiology of Behavior, 11th ed. Pearson Publishing
- slide 6-8: Carlson, N.R. (2012). Physiology of Behavior, 11th ed. Pearson Publishing
- slide 9: drawn by D.P. Devine
- slide 10: Carlson, N.R. (2012). Physiology of Behavior, 11th ed. Pearson Publishing
- slide 11-12: drawn by D.P. Devine
- slide 13-14: Breedlove, S.M., Watson, N.V. (2013). Biological Psychology: An Introduction to Behavioral, Cognitive, and Clinical Neuroscience, 7th ed. Sinauer Associates, Inc.
- slide 15: Carlson, N.R. (2012). Physiology of Behavior, 11th ed. Pearson Publishing