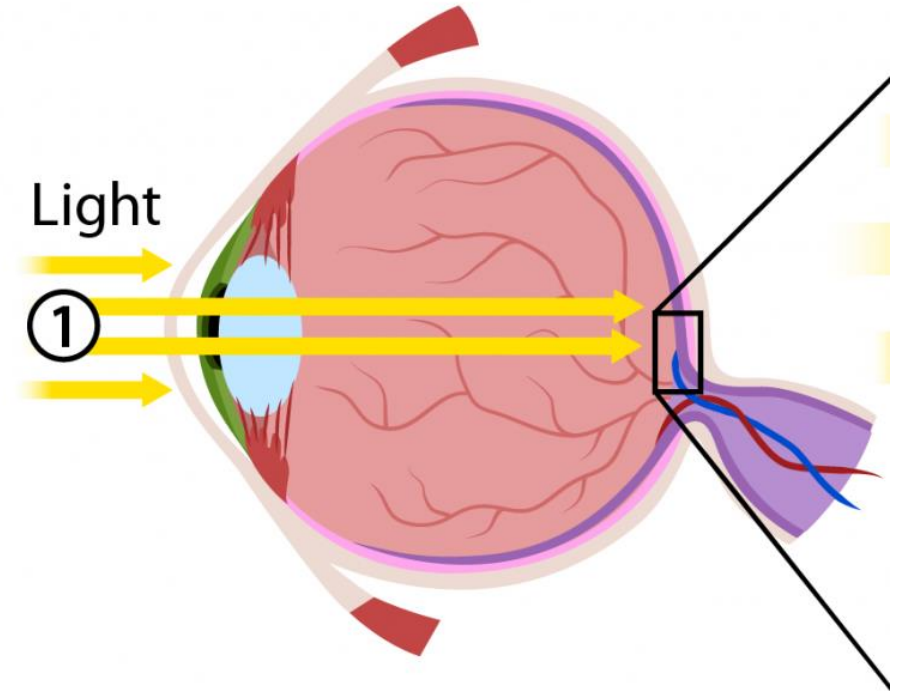


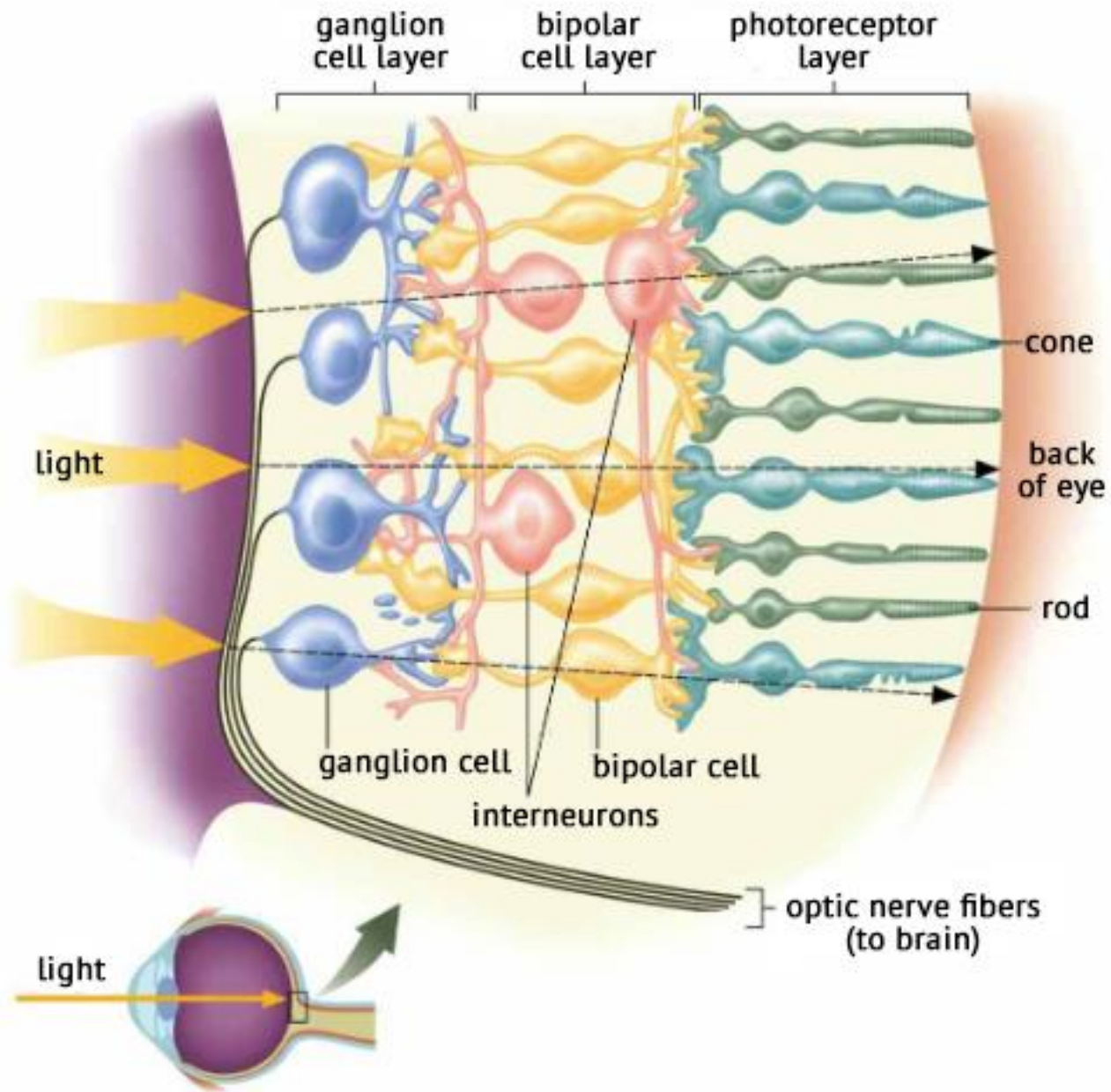
Round 3: Vision, Part 1

The Visual Pathway

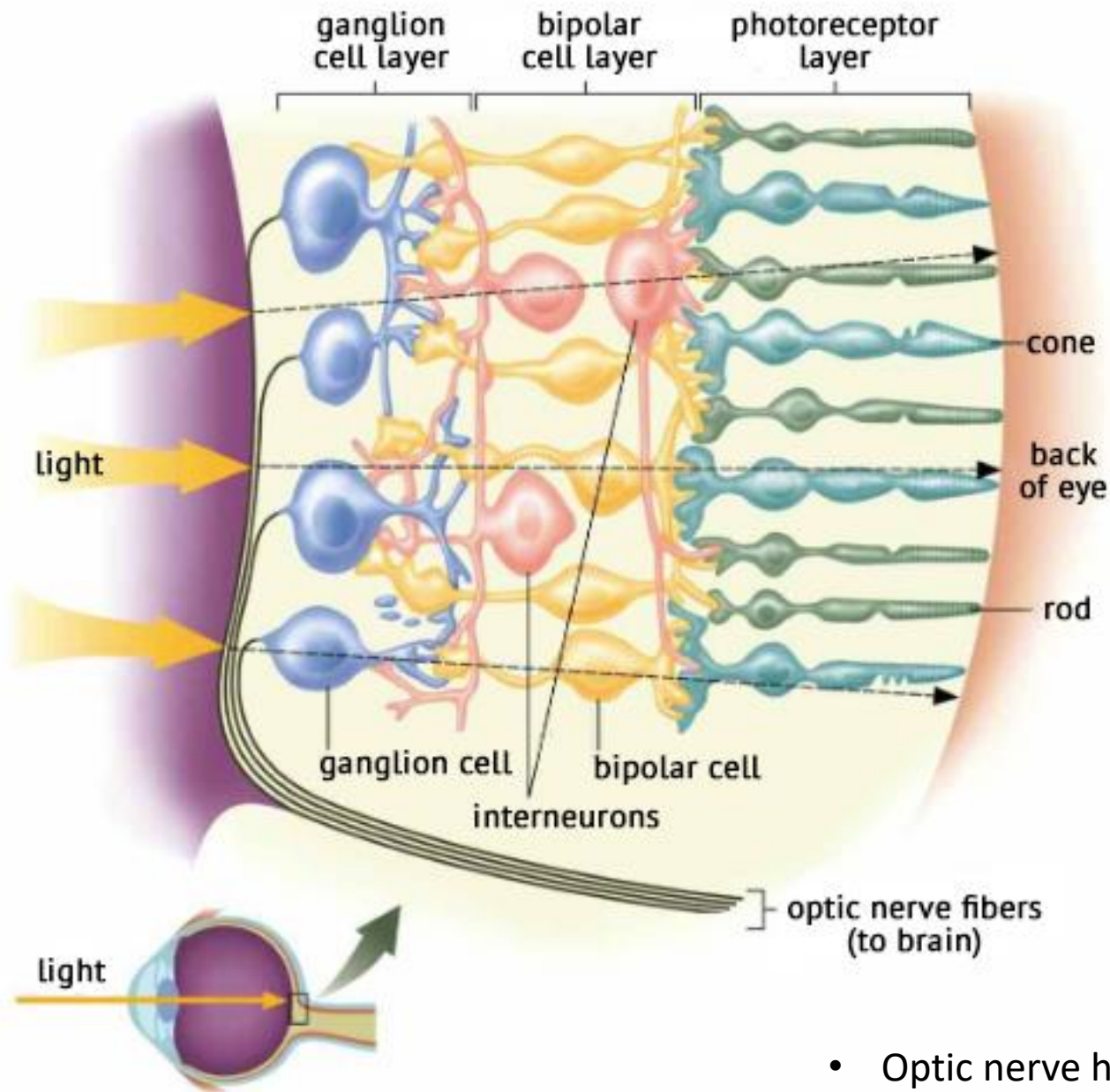
12/04/2020

Kristy Snyder Colling, PhD





Pigment Epithelium – melanin to absorb light not absorbed by photoreceptors (rods & cones)

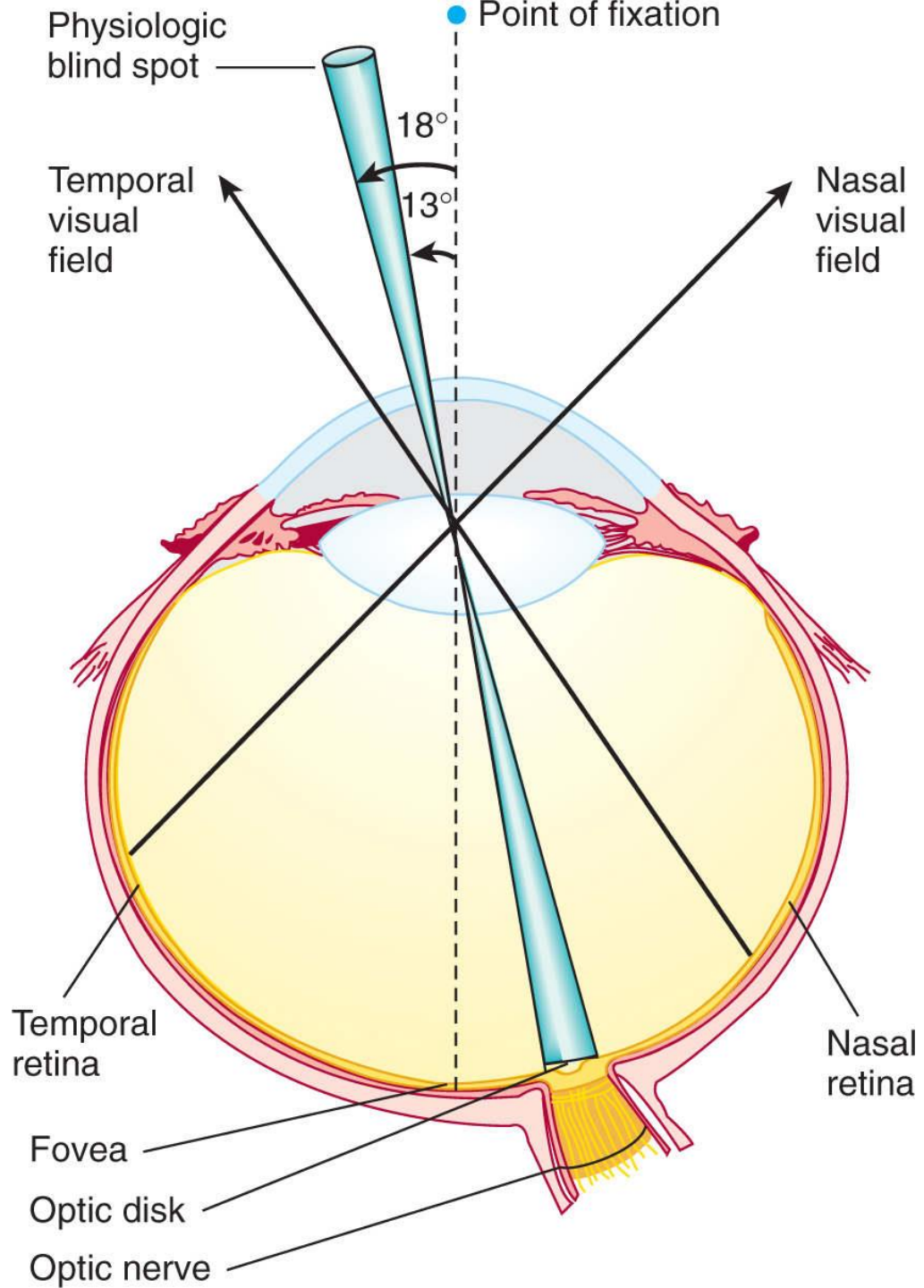


Cones - Day vision, color, more in the fovea

Rods - Night vision, variations of grey, more in periphery

- Rods outnumber cones 20-1
- Many rods synapse onto same target interneuron.
 - Increases ability to detect dim light
 - Decreases spatial acuity because signals are average together

- Optic nerve has 1 million fibers – more than all the fibers from the spinal cord

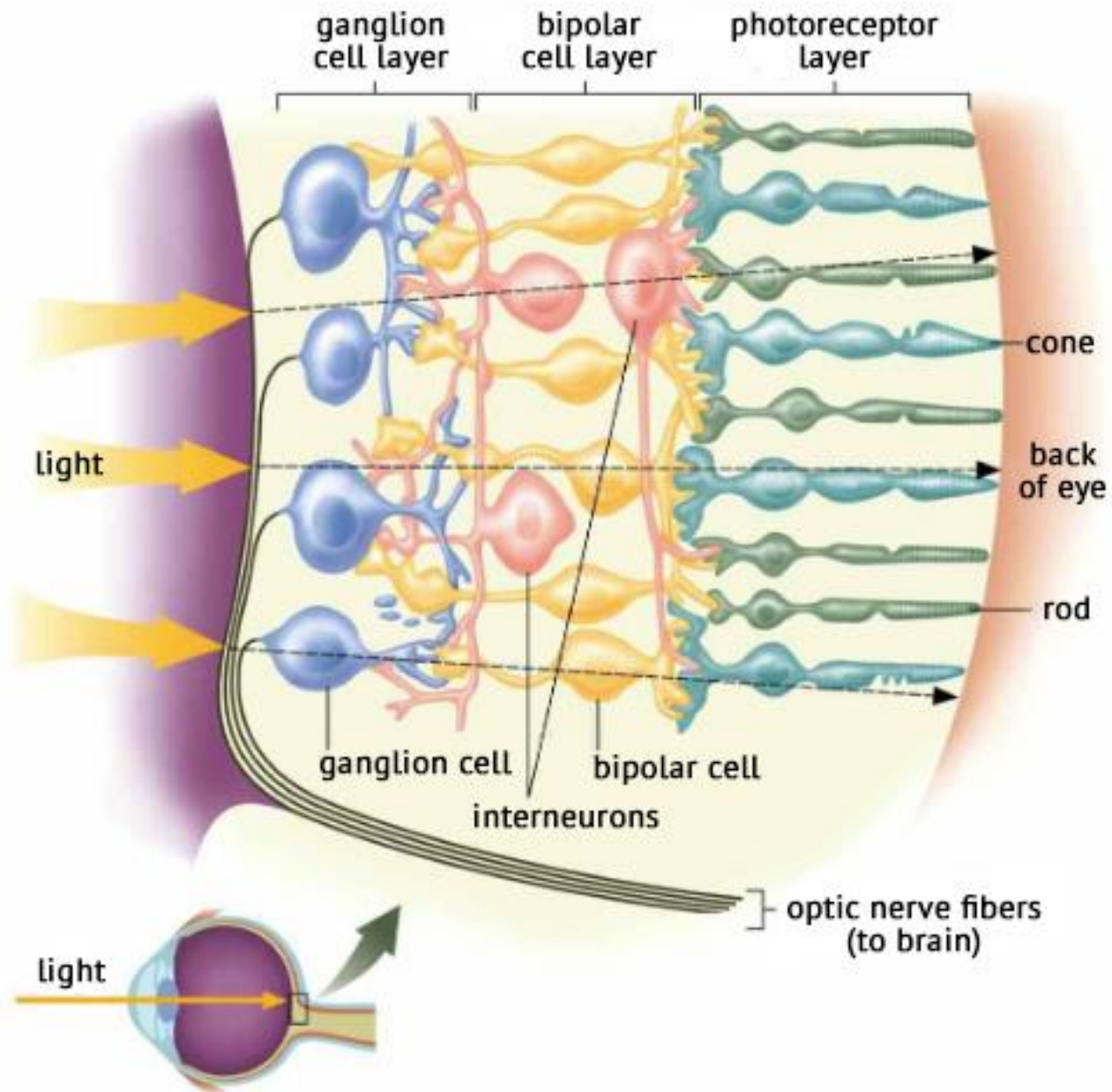


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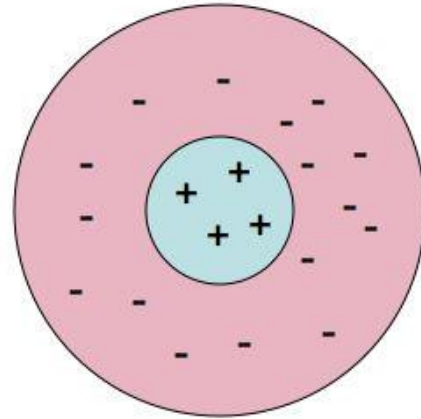
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Ganglion Cells

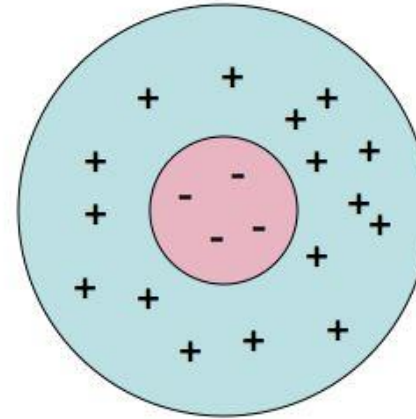
- Have a receptive field
 - Circular area of retina it receives information from
 - In fovea $\sim 1^\circ$ (.25mm), in periphery 3-5 $^\circ$
- Two kinds
 - On-center
 - Off-center

Receptive Fields



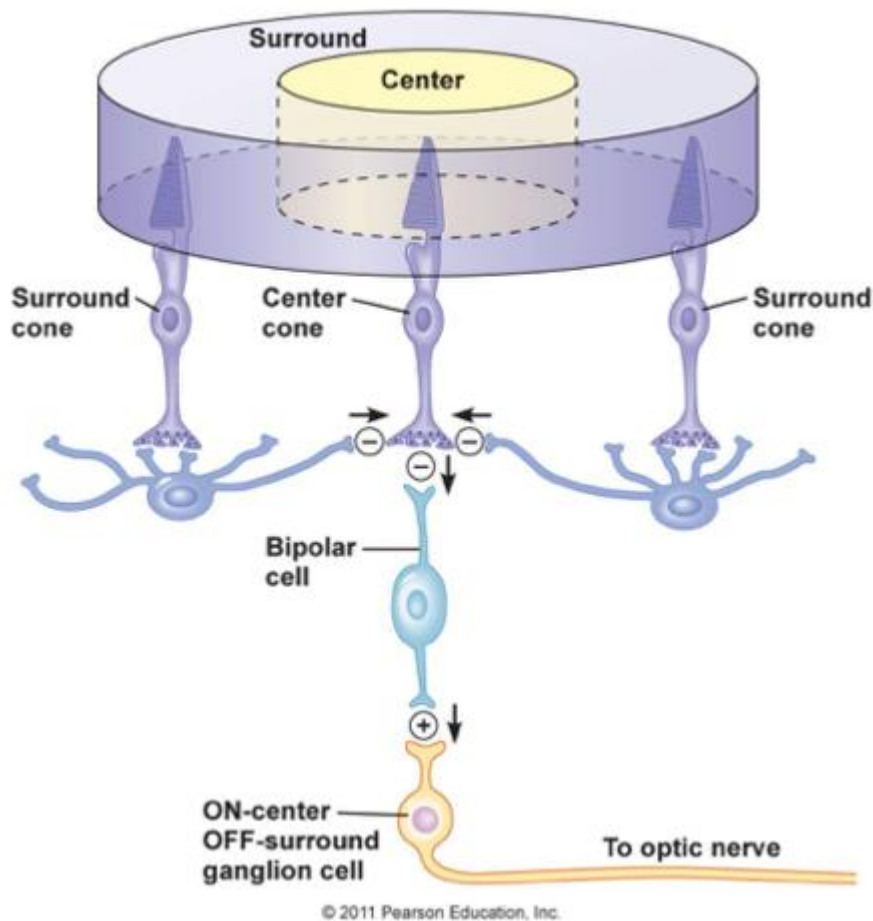
On-center, Off-surround

- Excited when light hits the center and is inhibited when light hits the surround.
- Responds to light “turning on”



Off-center, On-surround

- Inhibited when light hits the center and excited when light hits the surround.
- Responds to light “turning off”



- Information transmitted is proportional to the difference in signal contributed by photoreceptors populating the center and surround areas of the receptive field.
- If light hits both center and surround it cancels out
- Absolute intensity is uninformative. It tells more about the light source than the object you are looking at
- The purpose of this is to enhance ability to see contrasts

Retinal ganglion cells respond to edges

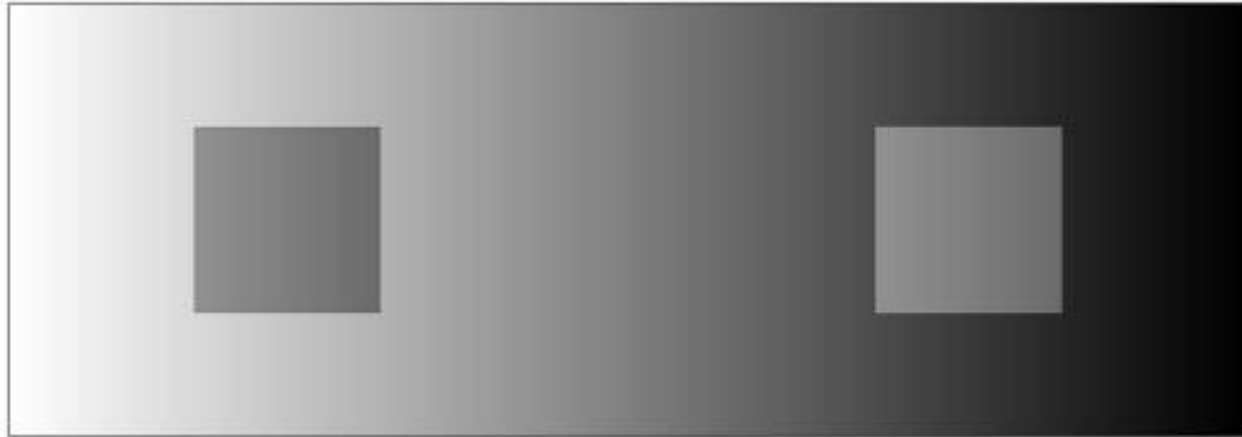
Input image
(cornea)

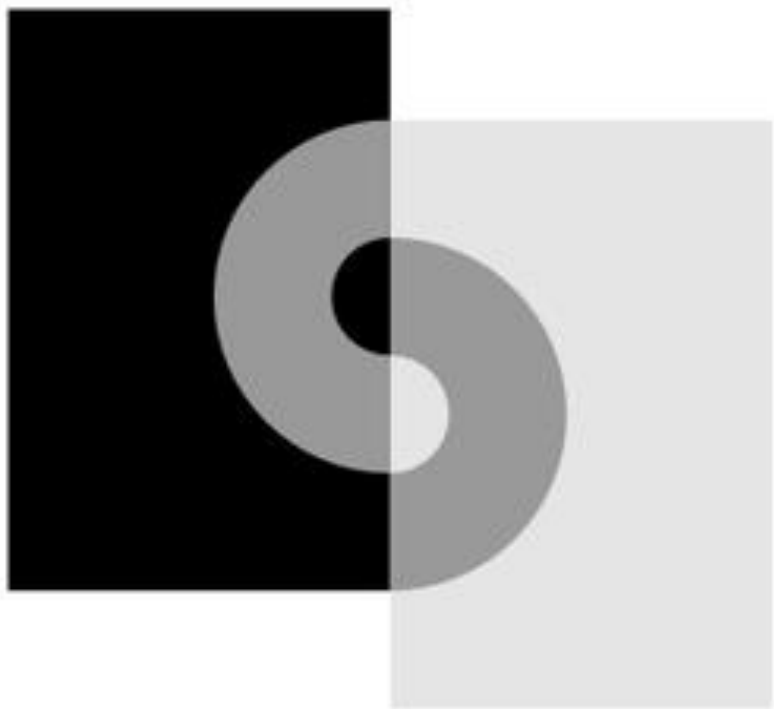
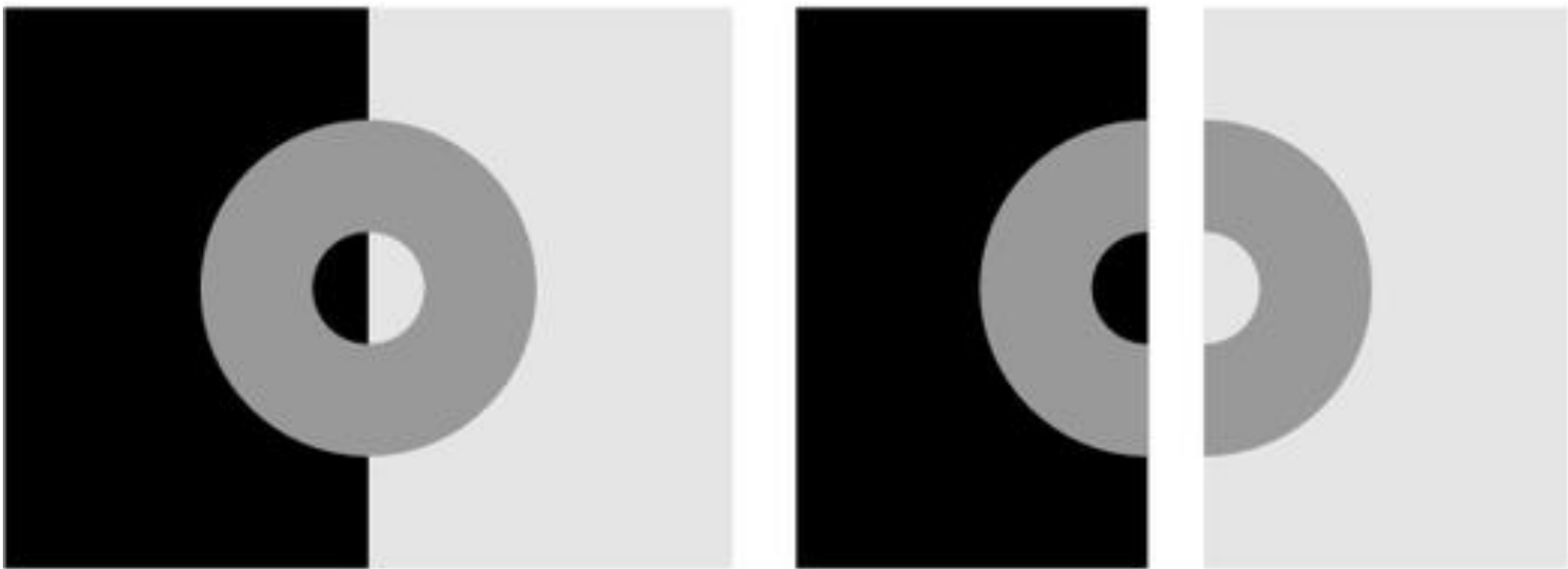


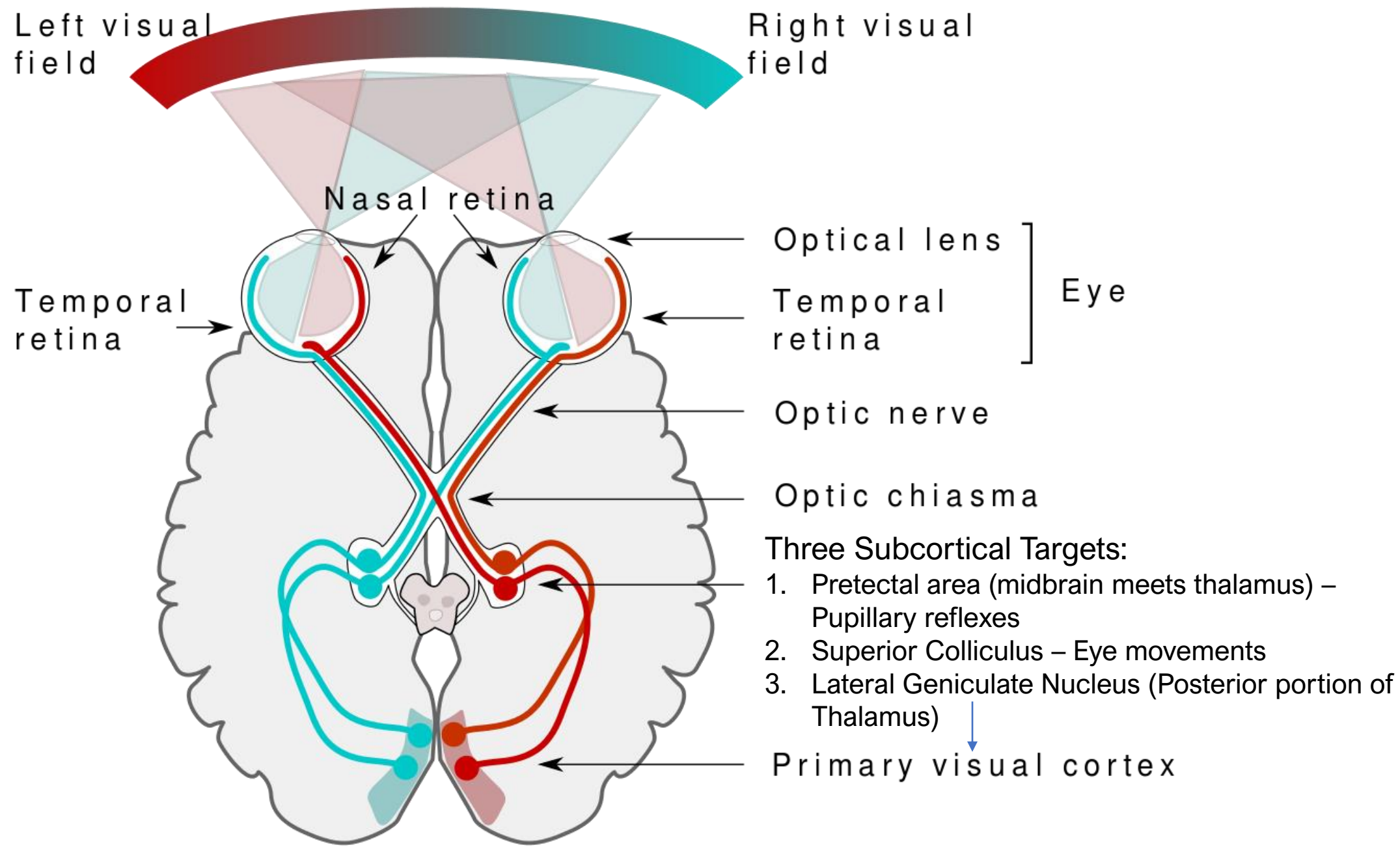
“Neural image”
(retinal ganglion cells)

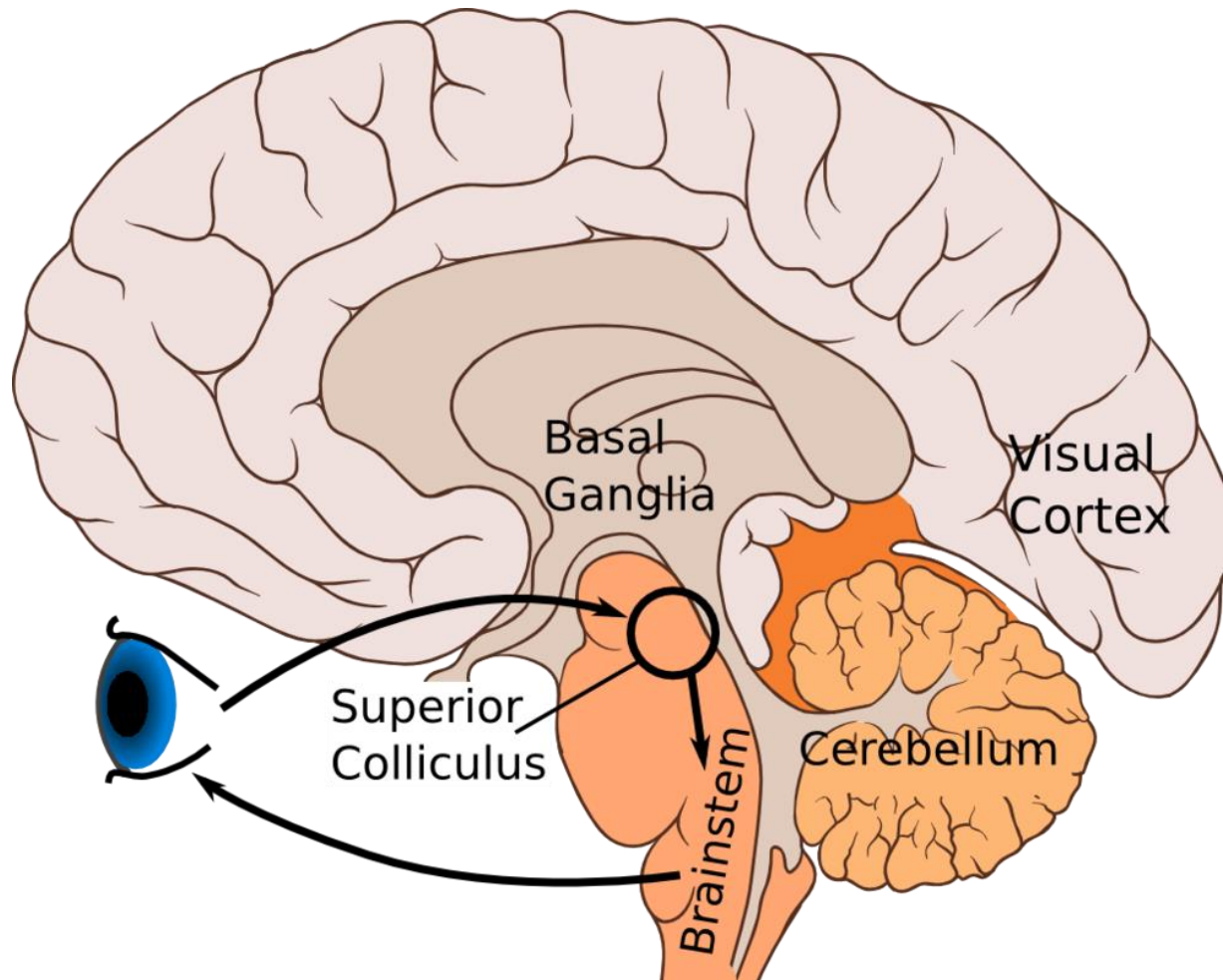


Center-surround receptive fields: emphasize edges.



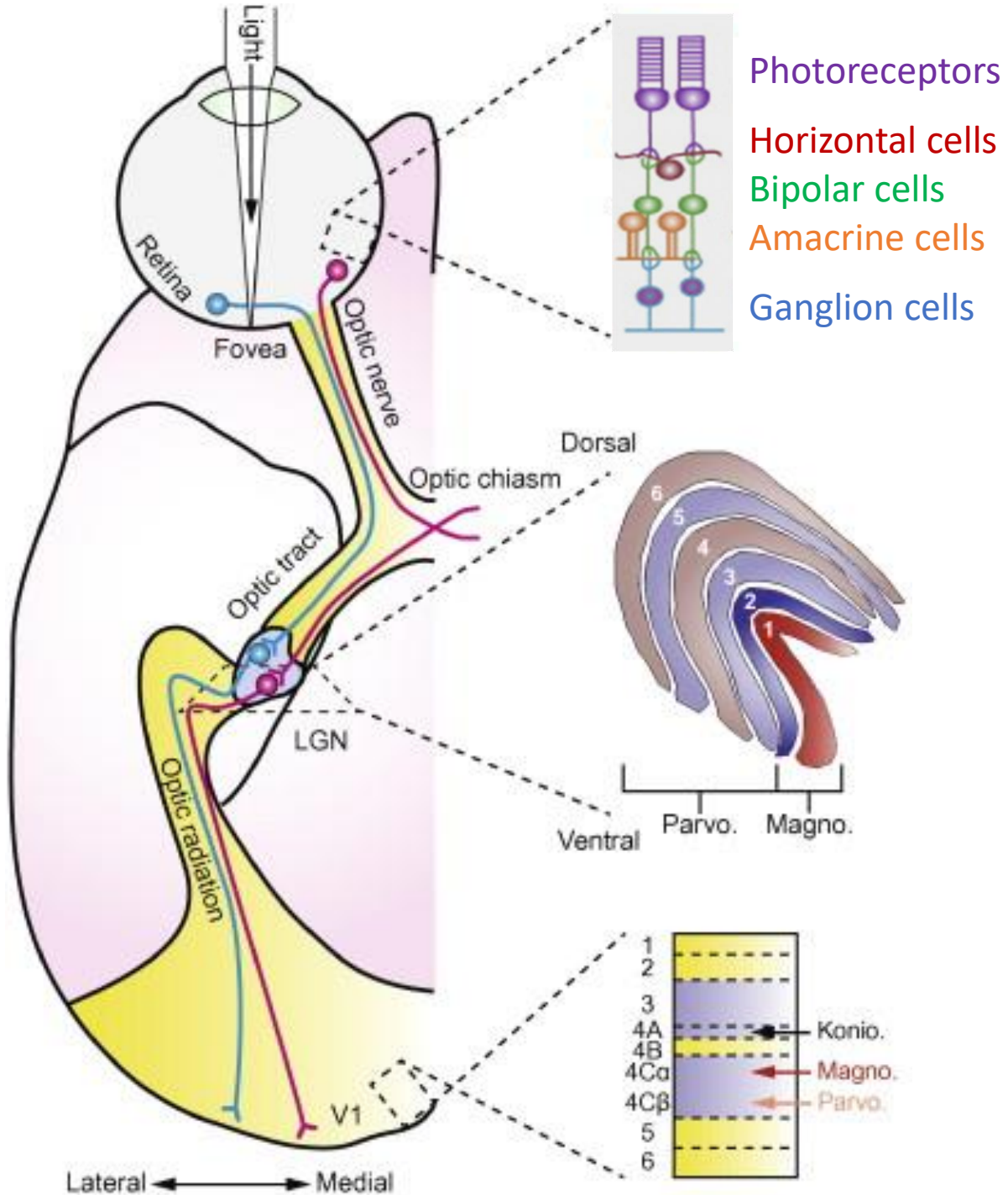






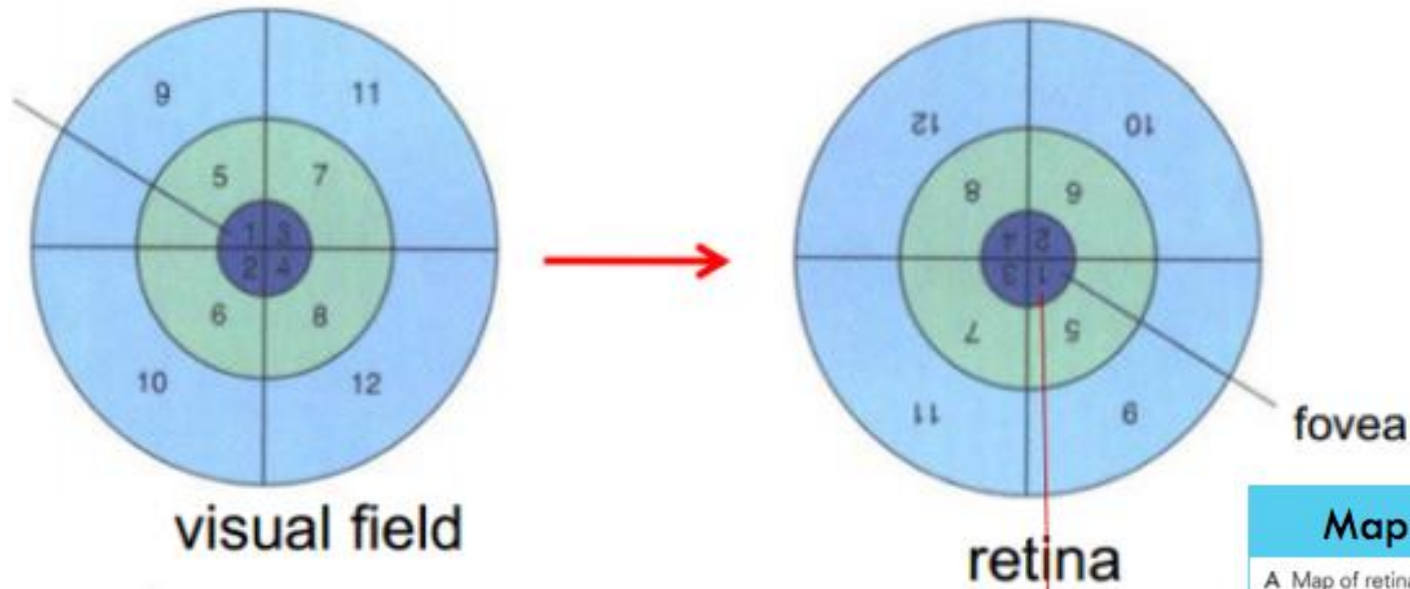
Superior Colliculus

- Coordinates visual, somatic, and auditory information to orient head and eyes toward a stimulus.
- It has 3 maps (a visual map, body surface, and sounds in space).
 - Size of representation is determined by the visual map - structures close to the eyes like nose and face have greater representation than structures further away like the fingertips
- Projects to
 - Brain stem via the tectospinal tract – reflexive head and neck movements
 - Cerebellum via tectopontine tract - relays visual information to the cerebellum for further movement coordination

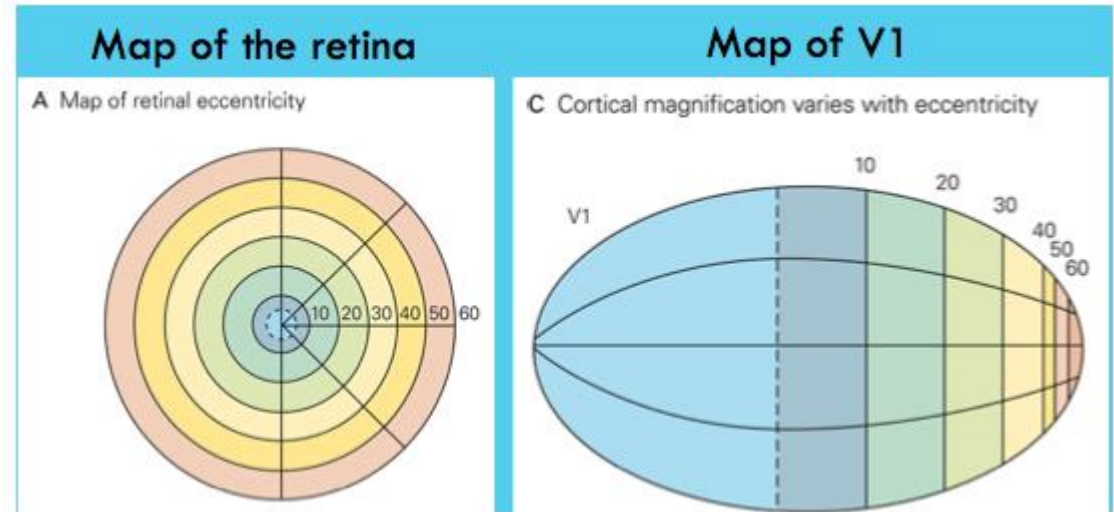
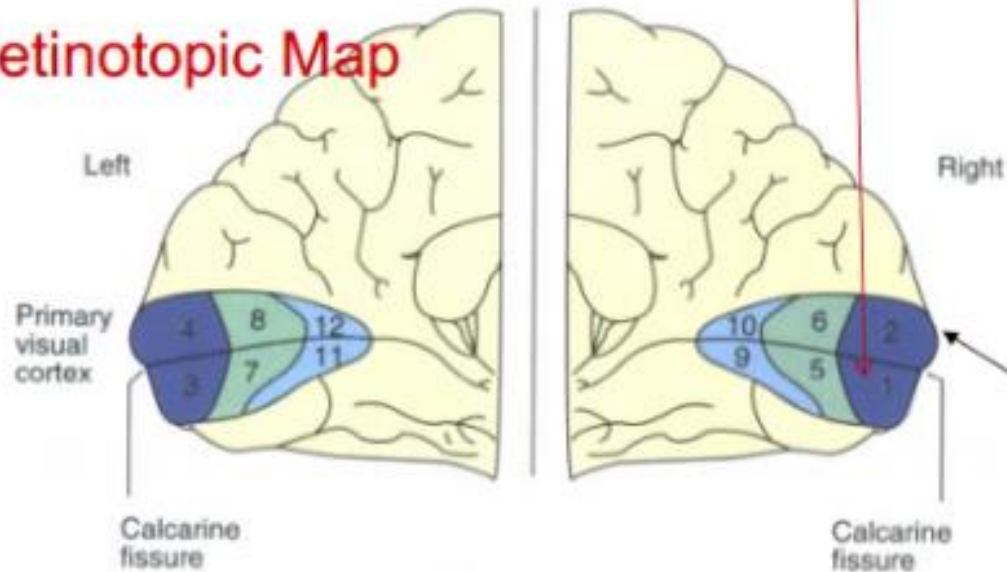


Functionally Distinct Ganglion cells begin parallel processing of visual information

M	P
Large cell bodies	Small cell bodies
Large dendritic fields	Small dendritic fields
Large receptive fields	Small receptive fields
Large/Gross features	Fine Details
Movement	Color Vision
Projects to 2 ventral layers of LGN (Magnocellular layers)	Projects to 4 dorsal layers of LGN (Parvocellular layers)
Projects to layer 4 of BA 17 around the Calcarine Fissure	
Projects to 4C α	Projects to 4C β



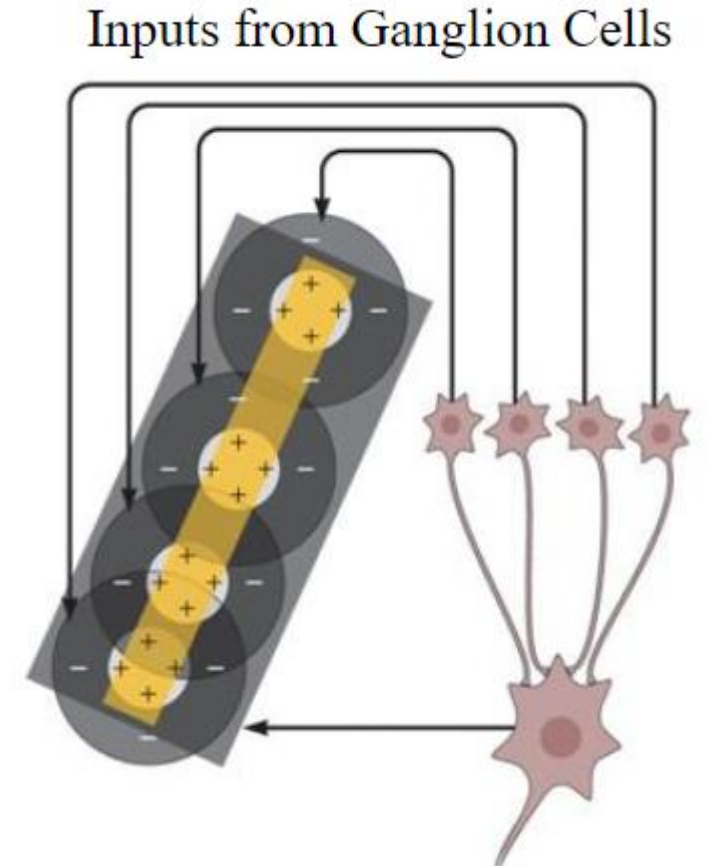
Cortical retinotopic Map



Cortical magnification

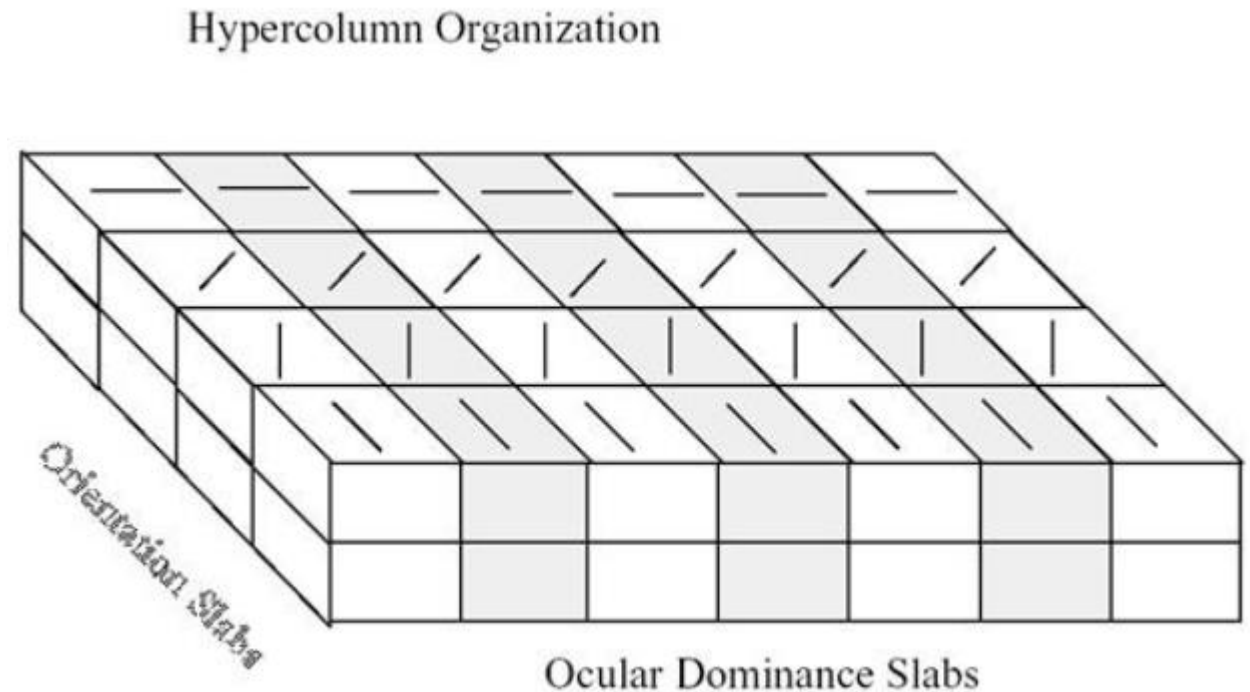
What happens in V1?

- Ganglion cells have circular receptive fields
- In V1, information from the ganglion cells that represent adjacent receptive fields are combined, resulting in rectangular receptive fields.



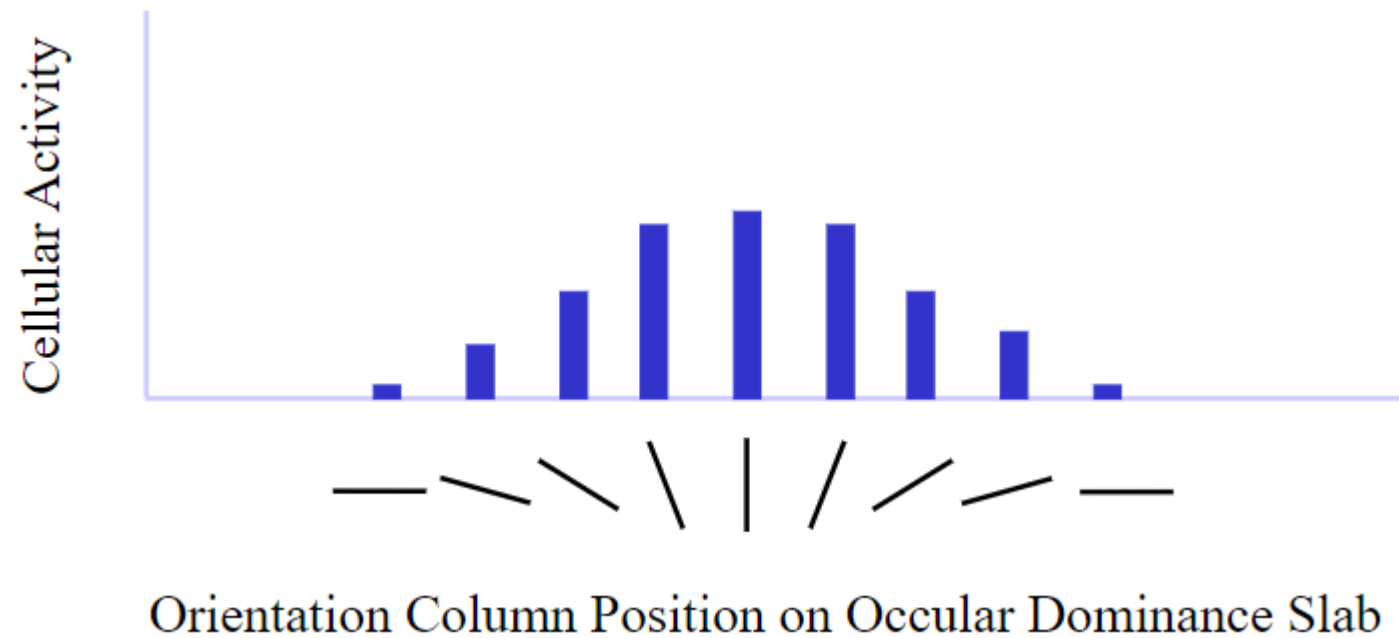
What happens in V1?

- Columns - respond to stimuli of the specific orientation from the same region of space
- Hypercolumns - combine information from both eyes
- Adjacent columns respond to $\sim 10^\circ$ shift in orientation



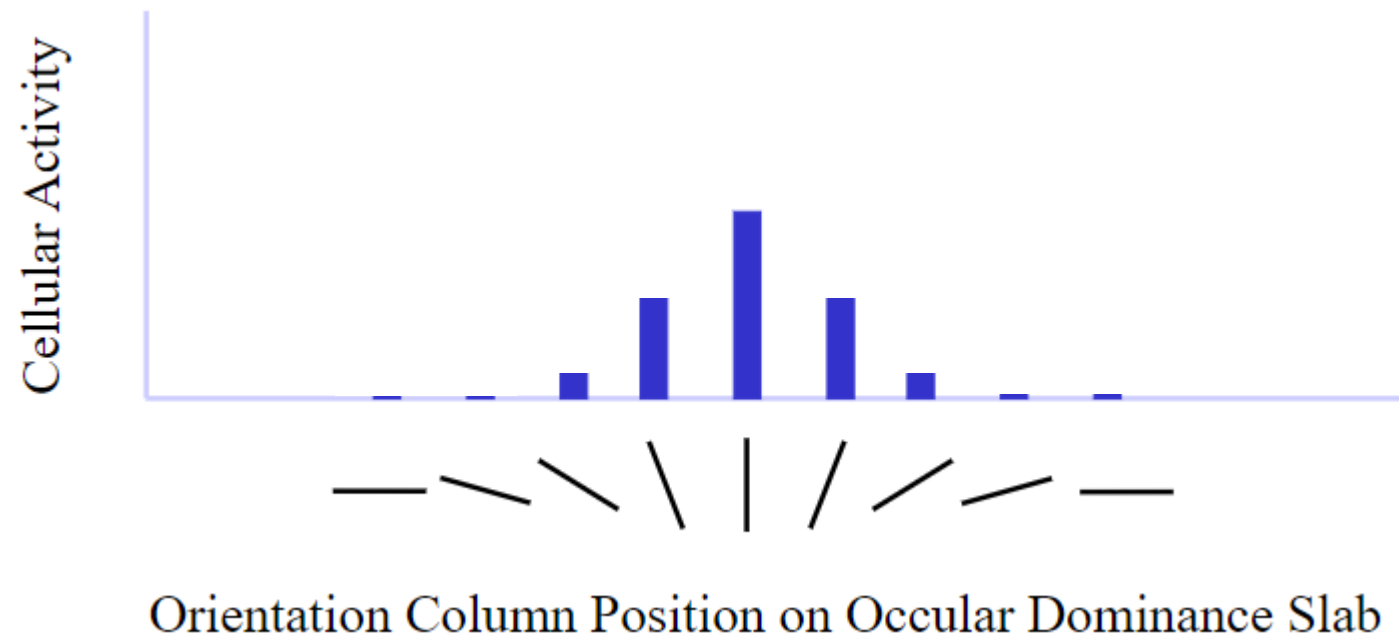
What happens in V1?

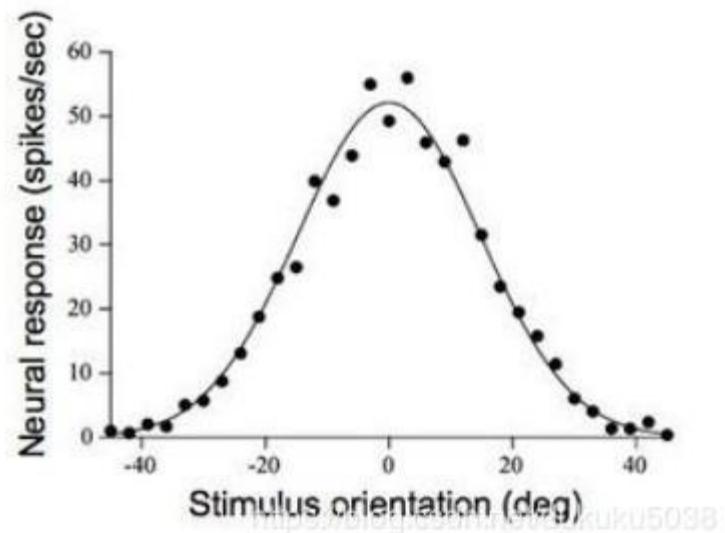
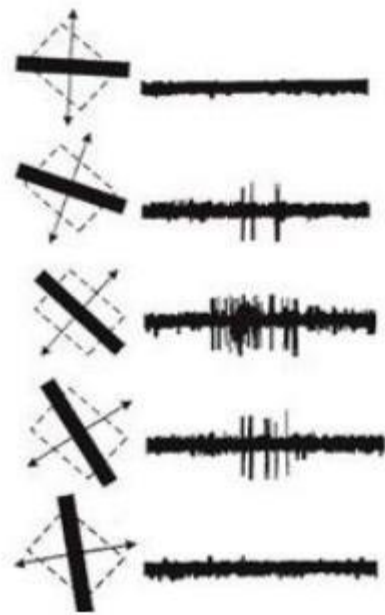
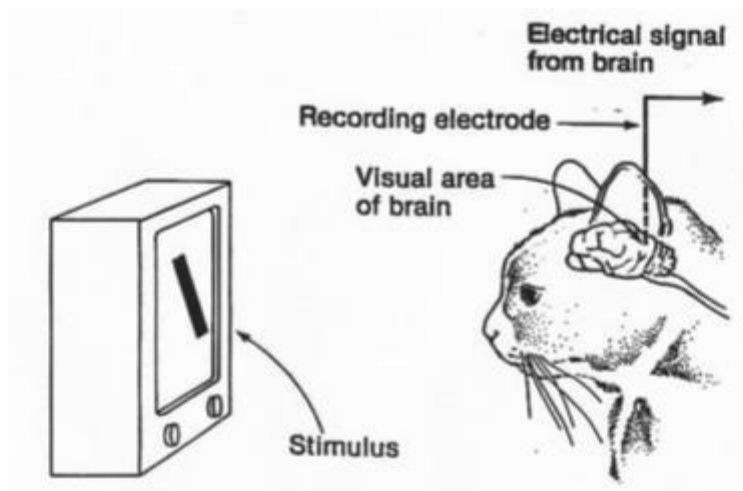
- Cell activity depends on the extent to which a stimulus matches its preferred orientation

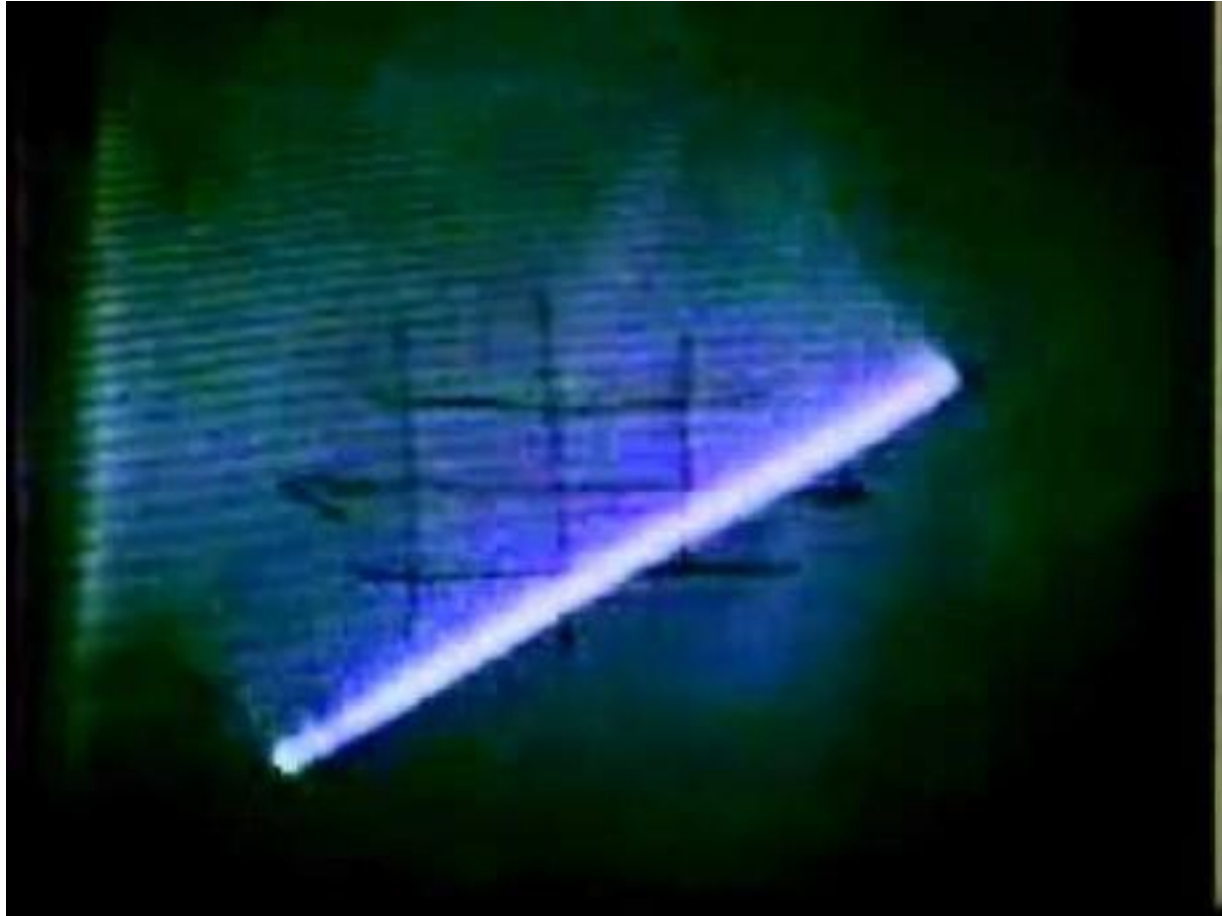


What happens in V1?

- A given cell's activity is also influenced by neighboring cells' activity via lateral inhibition







<https://www.youtube.com/watch?v=p0ugn5sHdCk&app=desktop>