

Eyes

- looking at far away object
 - lens becomes flatter
 - ciliary muscles relax

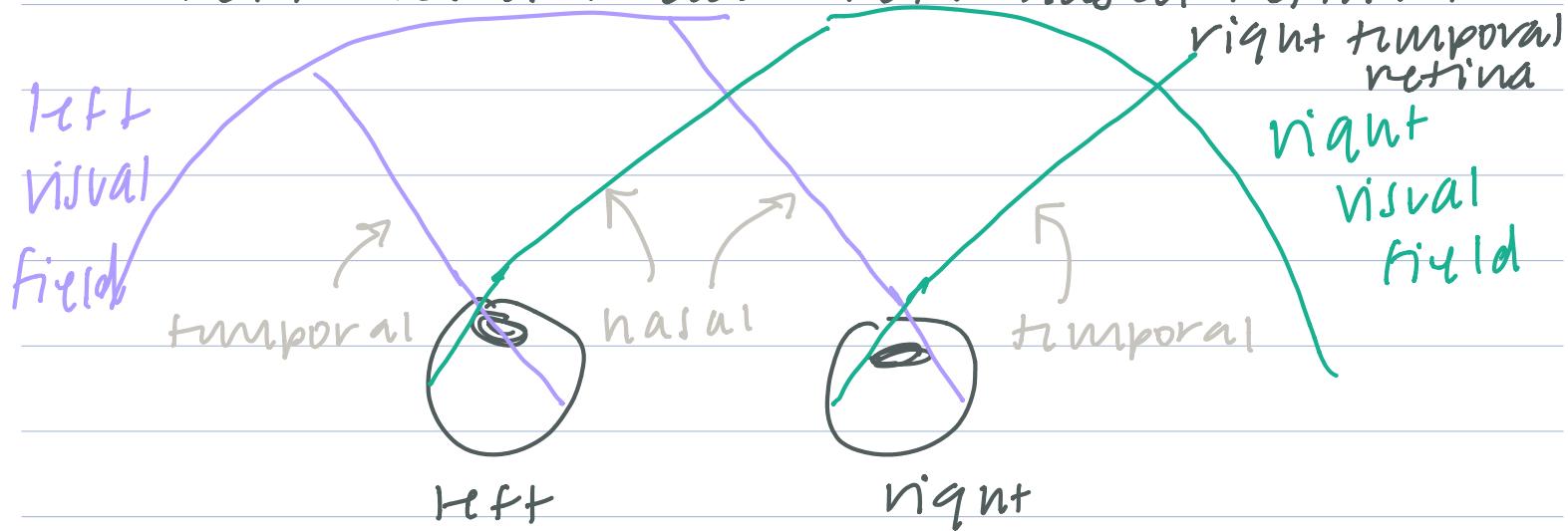
Phototransduction

- naturally in depolarizing state
- 11-cis \rightarrow 11-trans activates transducin
 - inactivates cGMP

rhodopsin kinase, A in efficiency of pathway

Visual field

- Left visual field = Left nasal retina + right temporal retina



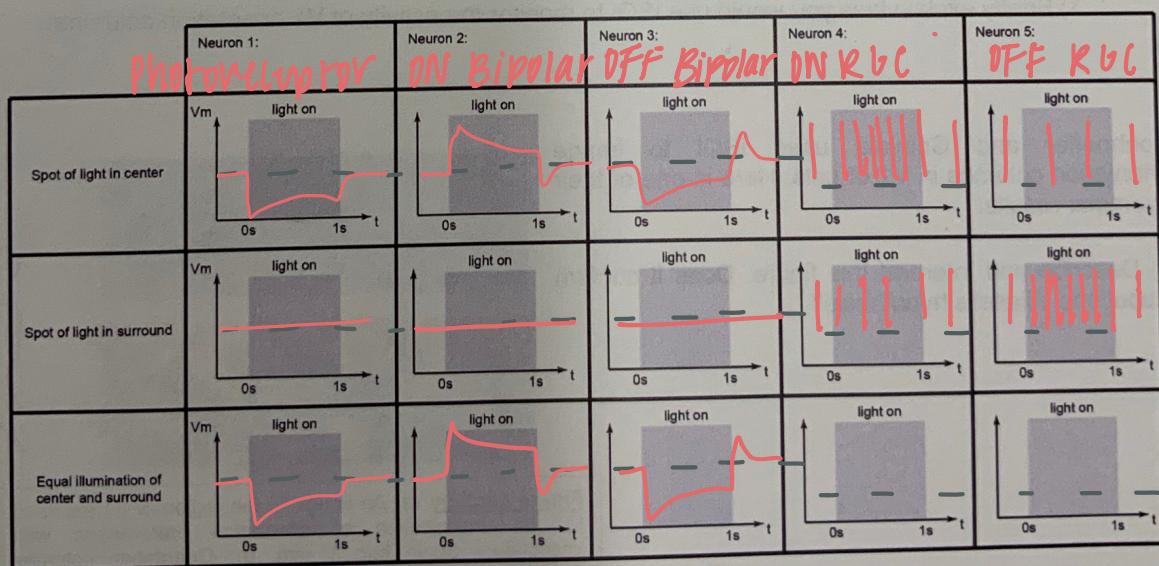
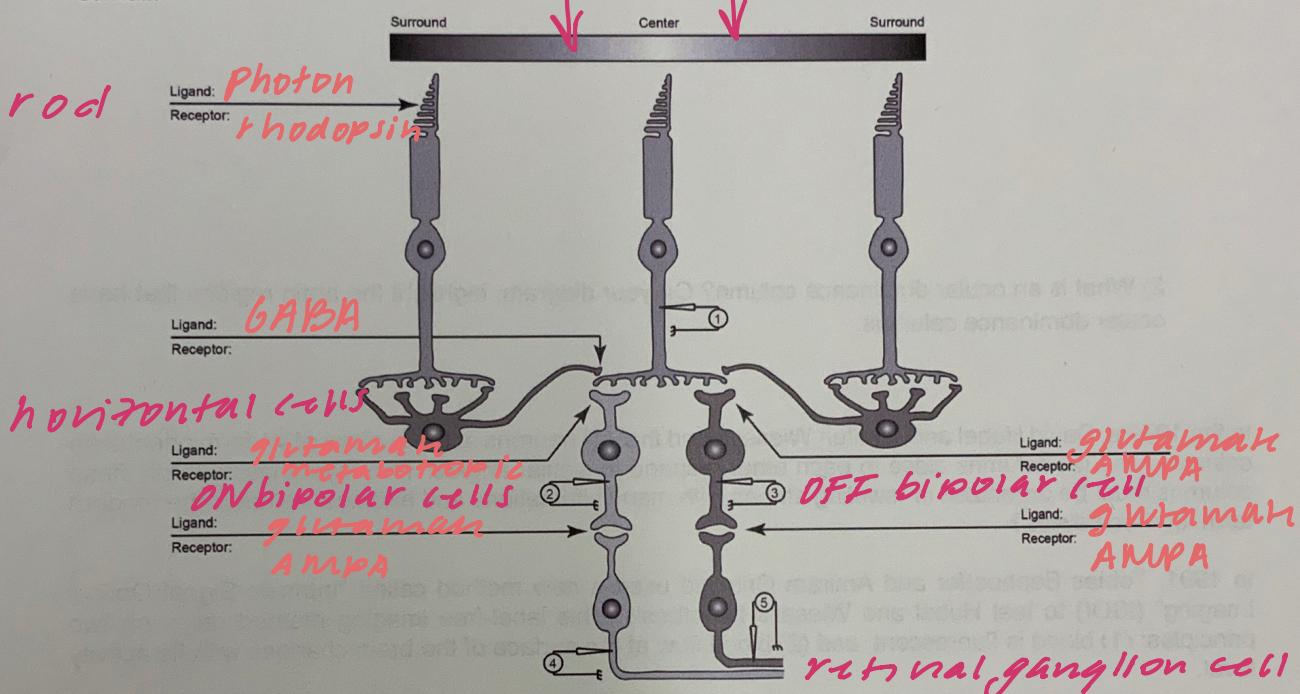
Primary viral vortex

The Retina

1) The diagram below illustrates the main neurons of the mammalian retina. With an arrow, indicate where the light is coming from, as well as the general direction of neuronal information flow.

2) Label the different neuron types, ligands, and receptors of the retina.

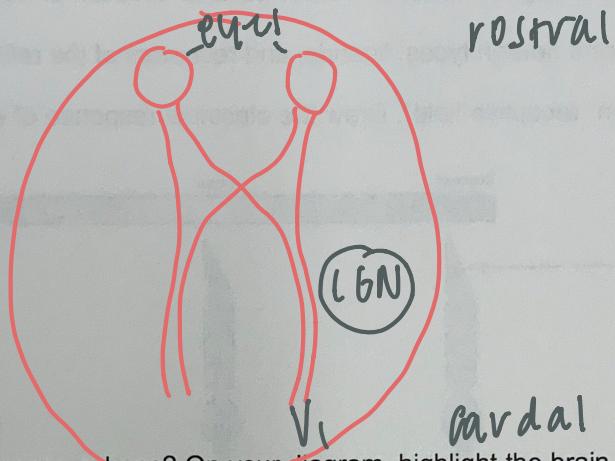
3) Define the term "receptive field". Draw the electrical response of each neuron following the specified stimuli.



Maps of the Visual System

Retinal ganglion cells send their axons to the lateral geniculate nucleus (LGN) of the thalamus. The LGN then sends visual information to the primary visual cortex (V1).

- 1) Make a diagram of the visual system from the retina to V1. Your diagram should contain: the two eyes, the LGNs, and V1 from each hemisphere, as well as brain axes (rostral, caudal, etc.)



- 2) What is an ocular dominance column? On your diagram, highlight the brain regions that have ocular dominance columns.

In the 1970's, David Hubel and Torsten Wiesel found that (1) neurons at the surface of V1 form orientation columns, and (2) columns close to each other respond to similar angles. They hypothesized that these columns must be organized in "swirling stripes with many bifurcations and endings". What is the modern term for these swirls?

In 1991, Tobias Bonhoeffer and Amiram Grinvald used a new method called "Intrinsic Signal Optical Imaging" (ISOI) to test Hubel and Wiesel's hypothesis. This label-free imaging method relies on two principles: (1) blood is fluorescent, and (2) blood flow at the surface of the brain changes with its activity level.

- 3) Briefly explain how you would use ISOI to monitor the activity of V1 orientation columns.

Bonhoeffer and Grinvald used ISOI to image orientation columns in V1 of cats. Here is one of their exemplar results:

- 4) Describe and interpret this figure. Does it confirm Hubel and Wiesel's hypothesis?

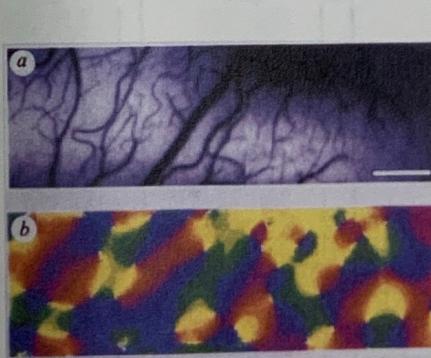


Figure caption: (a) An image of the region of V1 explored for its organization of orientation preferences with vasculature Scale bar: 1 mm. (b) Orientation columns