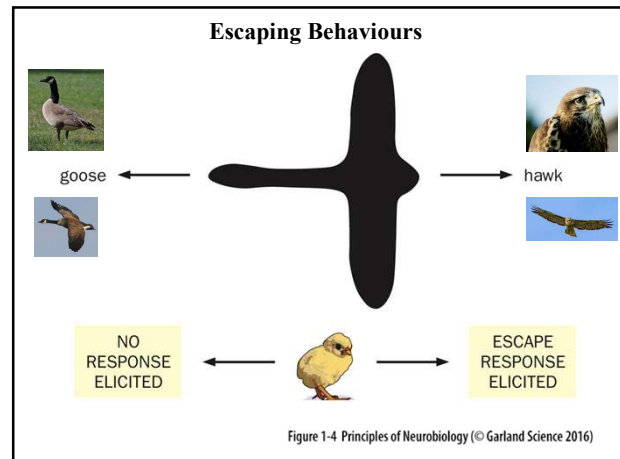


2021 Fall "Physiology"

Making Sense of Vision

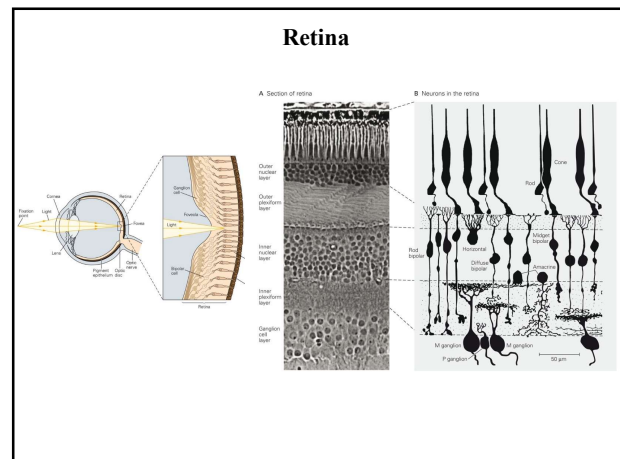
Dong-Gen LUO

College of Life Sciences
Peking University

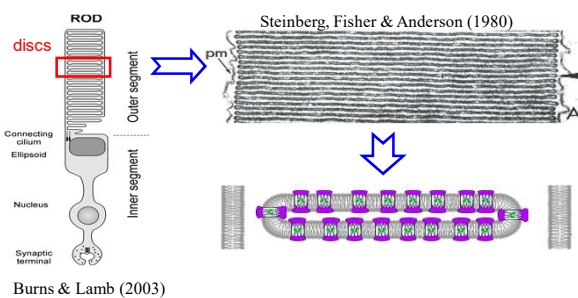


Outline of the Lecture

1. Organization of the retina;
2. Photoreceptors and phototransduction;
3. Signal transformation in the retina;
4. Visual pathways;
5. Signal processing in visual cortex.

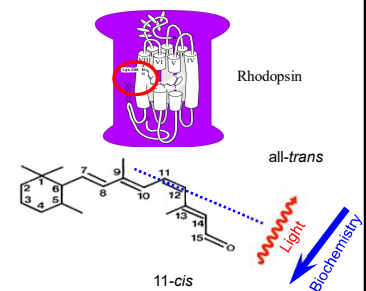
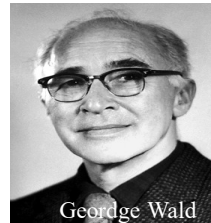


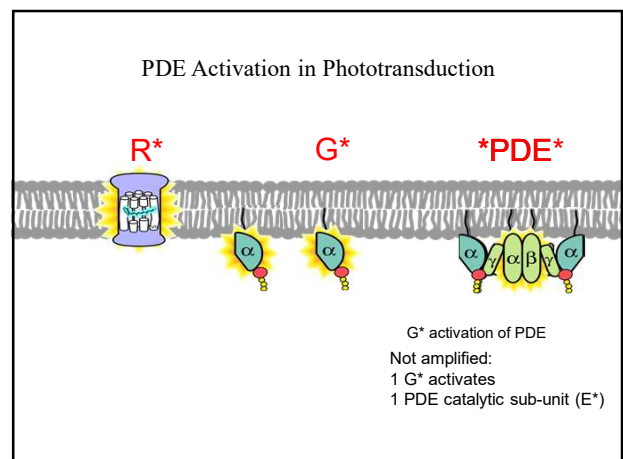
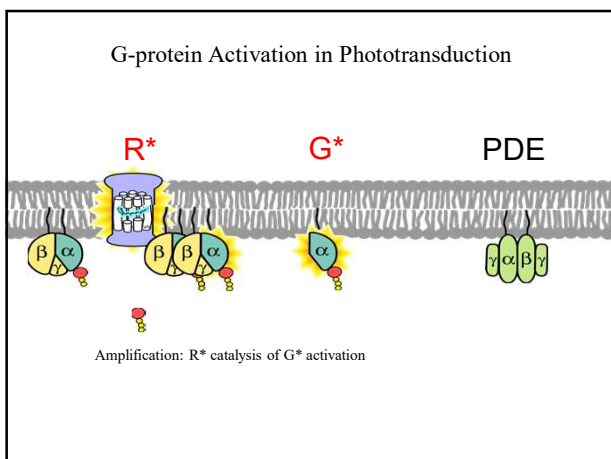
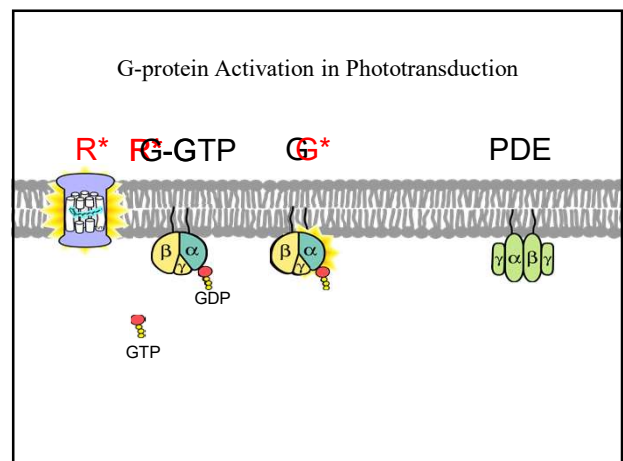
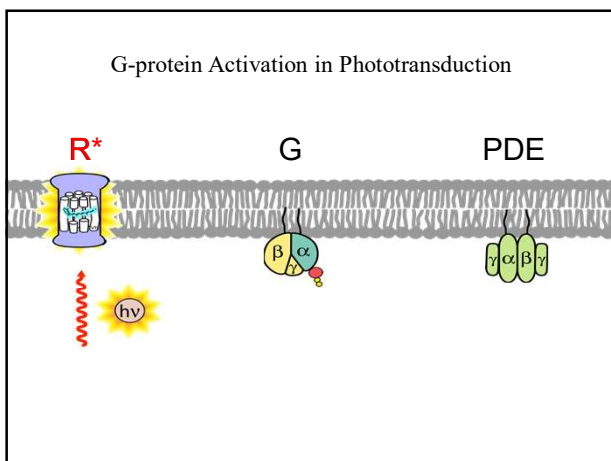
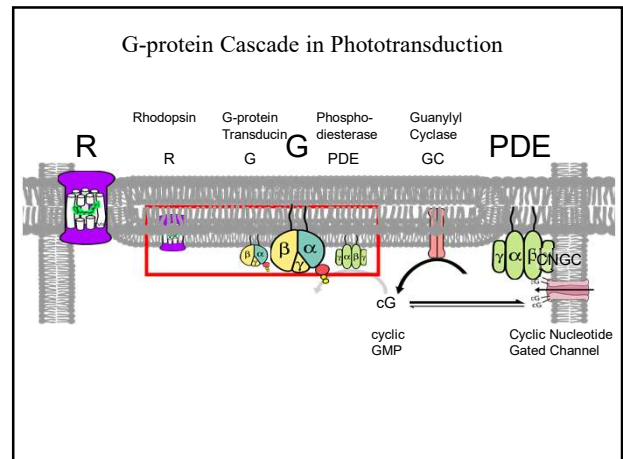
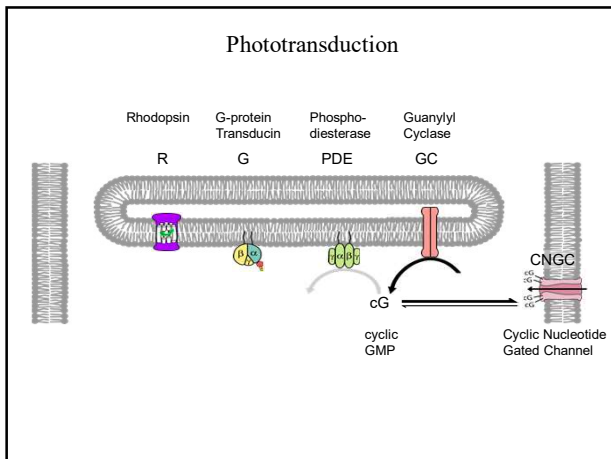
Photoreceptor Structure



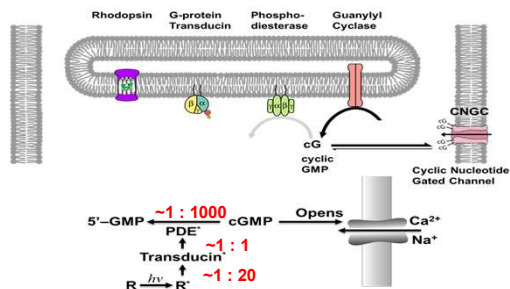
Photoisomerization

1967 Nobel Prize
in Physiology and Medicine

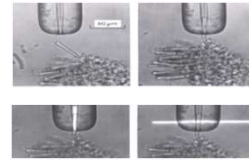




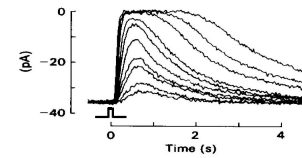
Amplification Steps in Phototransduction



Phototransduction: High Amplification and Slow Kinetics



Suction-pipette Recording



Baylor, Yau, and Lamb, (1979) *J. Physiol.*

Retinal Physiology

Haldan Keffer Hartline
(1903-1983)



Nobel prize (1967)
in Physiology or Medicine

Visual Receptors and Retinal Interaction

Retinal Ganglion Cells

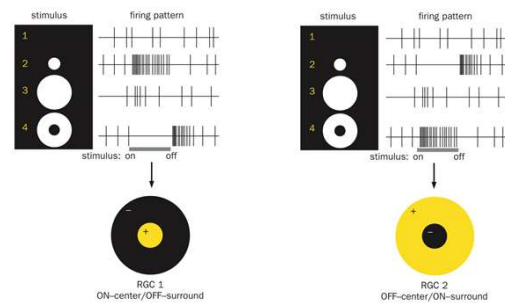
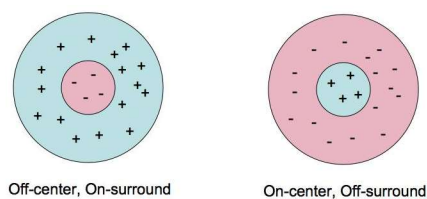
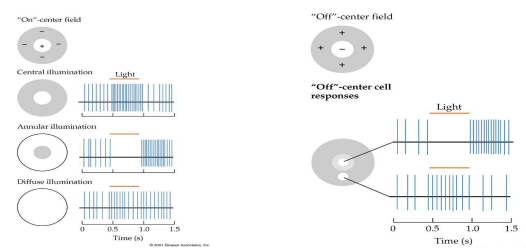


Figure 4-24 Principles of Neurobiology (© Garland Science 2016)

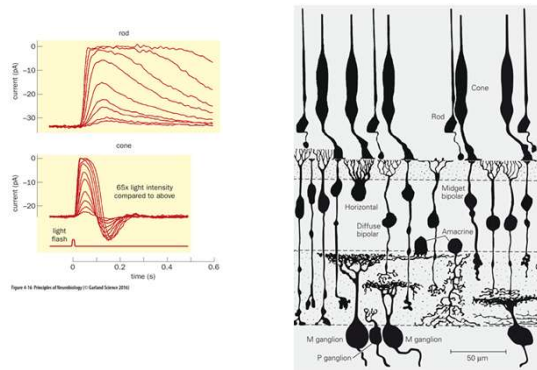
Center-Surround Receptive Field



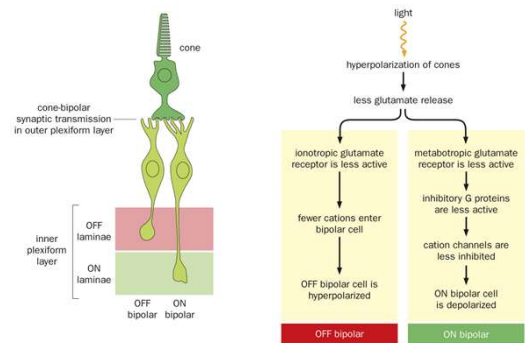
Center-Surround Receptive Field



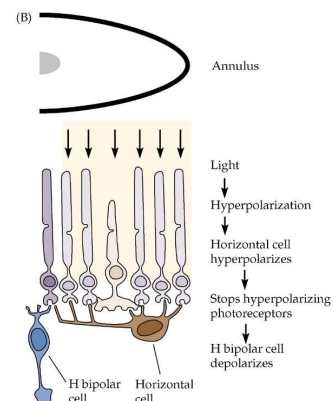
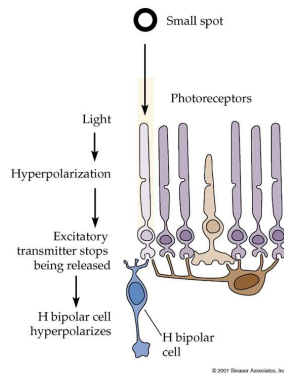
Signal Transfer from Photoreceptors to RGCs



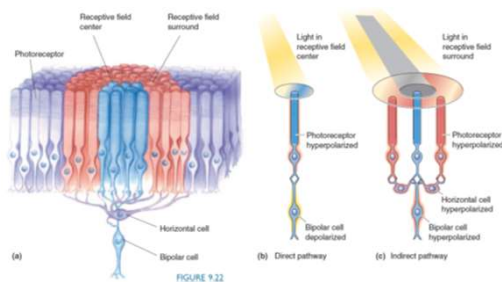
ON-OFF Channels: Bipolar Cells



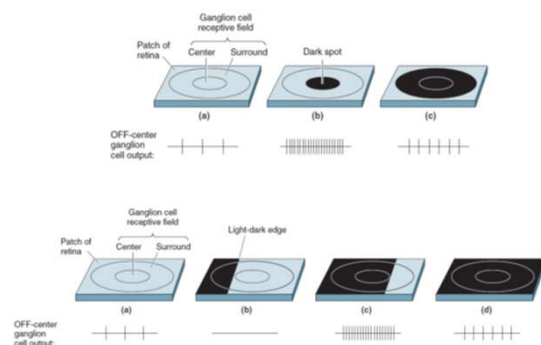
Center-Surround Receptive Field



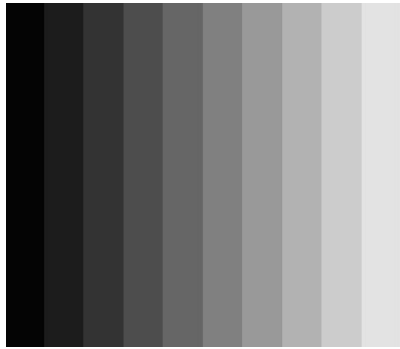
Center-Surround Receptive Field



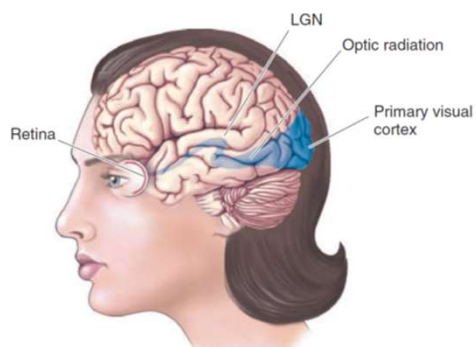
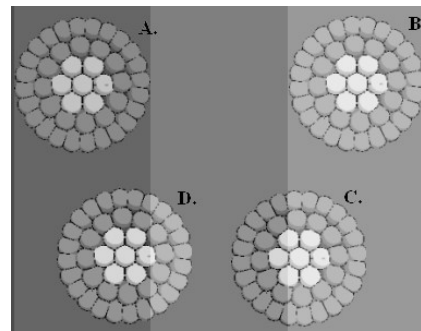
Center-Surround Receptive Field



The Mach Band



The Mach Band Explained

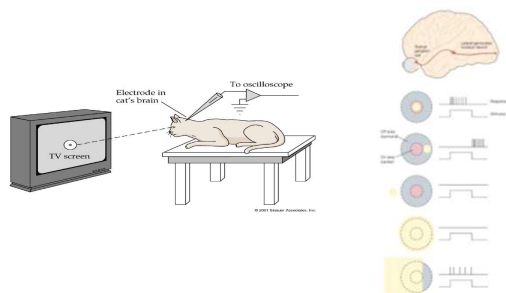


David Hunter Hubel and Torsten Wiesel

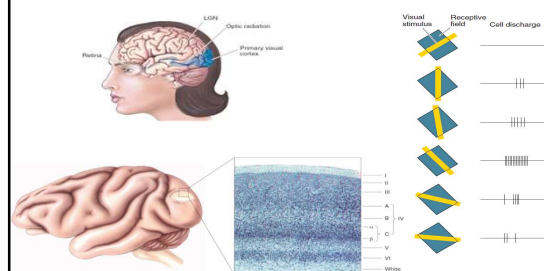


1981 Nobel Prize in Physiology or Medicine
for their discoveries concerning information processing in the visual system.

Center-Surround Receptive Field in LGN



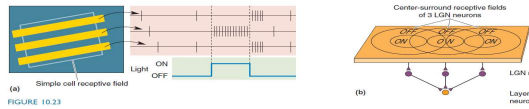
Light Responses in Visual Cortex



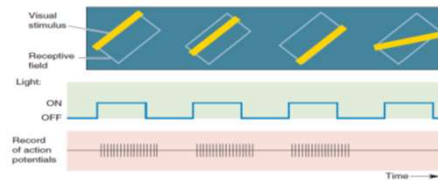
Simple Cells

Simple Cells: V1 layers 4 and 6.

- 1: Excitatory and inhibitory regions;
- 2: Linearity of spatial summation;
- 3: Antagonism between excitatory and inhibitory regions.

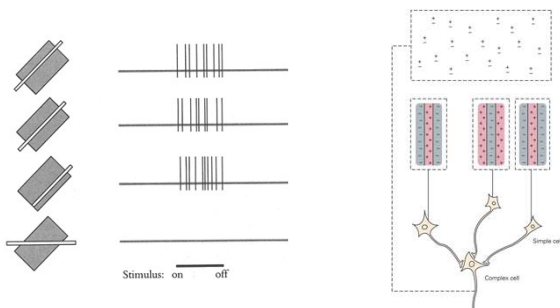


Complex Cells

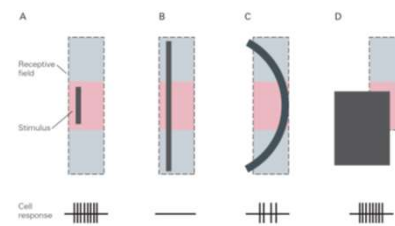


Complex Cells: V1 layers 2, 3 and 5.

- 1: No clear excitatory and inhibitory regions;
- 2: A bar about one third to one half of the RF evokes maximal response;
- 3: A stimulus covering the entire RF evokes no response.



End-Inhibited Receptive Fields



Escaping Behaviours

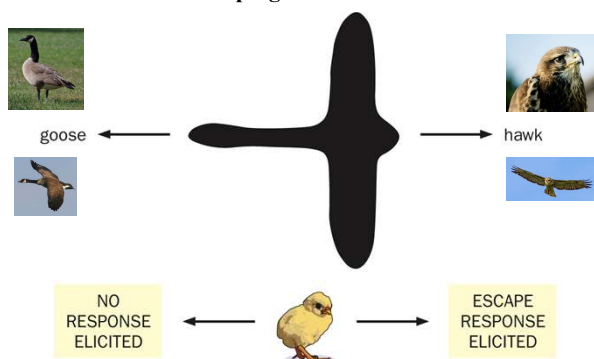


Figure 1-4 Principles of Neurobiology (© Garland Science 2016)

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