9.01 Introduction to Neuroscience
Fall 2007

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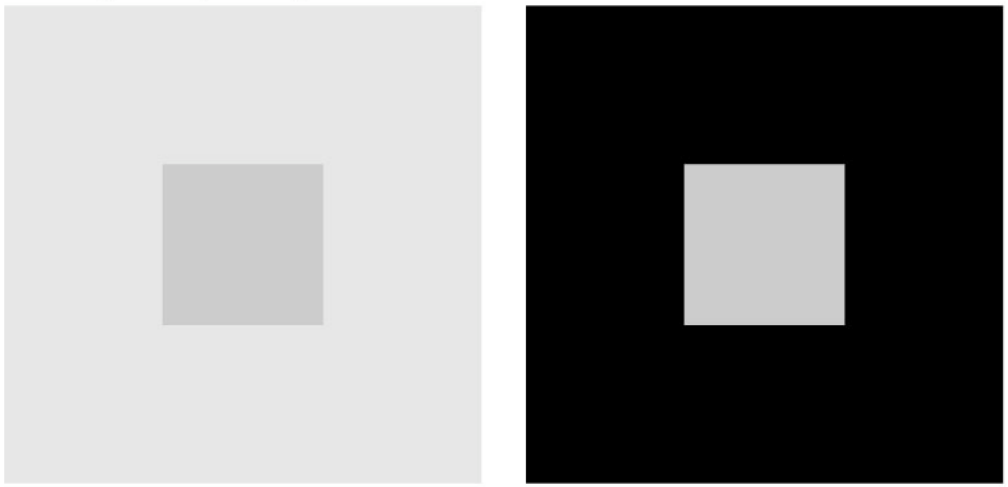
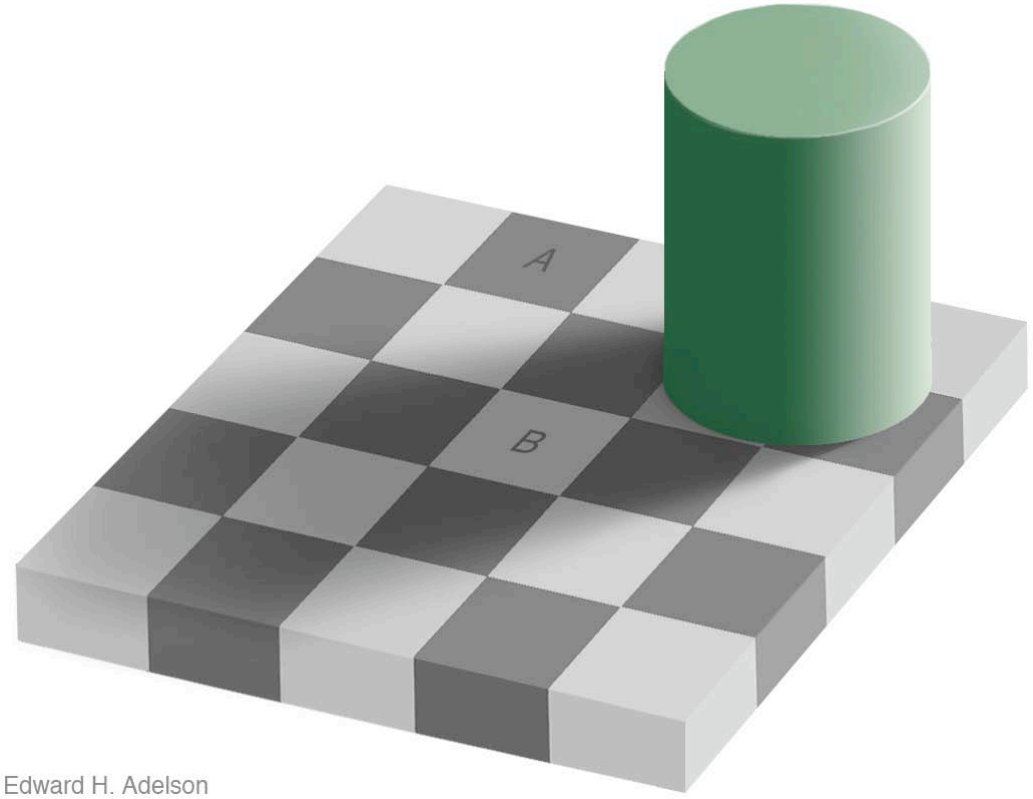
Text and graphics of Box 4.6, Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. "The Eclectic Electric Behavior of Neurons." In *Neuroscience: Exploring the Brain*. 3rd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2007. ISBN: 9780781760034.

Simultaneous contrast illusion

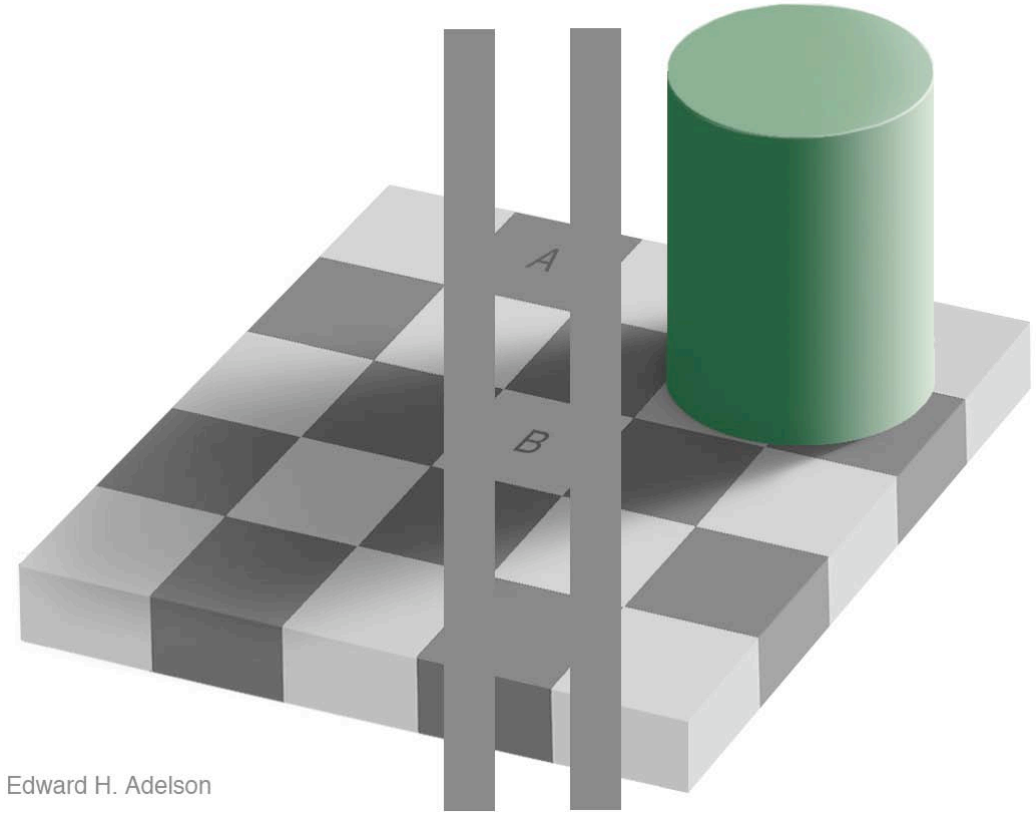


Checker-shadow illusion



Courtesy of Edward Adelson. Used with permission.

Checker-shadow illusion



Courtesy of Edward Adelson. Used with permission.

Reflectance

- luminance = incident light × reflectance
- reflectance is a property of the perceived object, not the illumination
- context must be used

Light is composed of frequency components

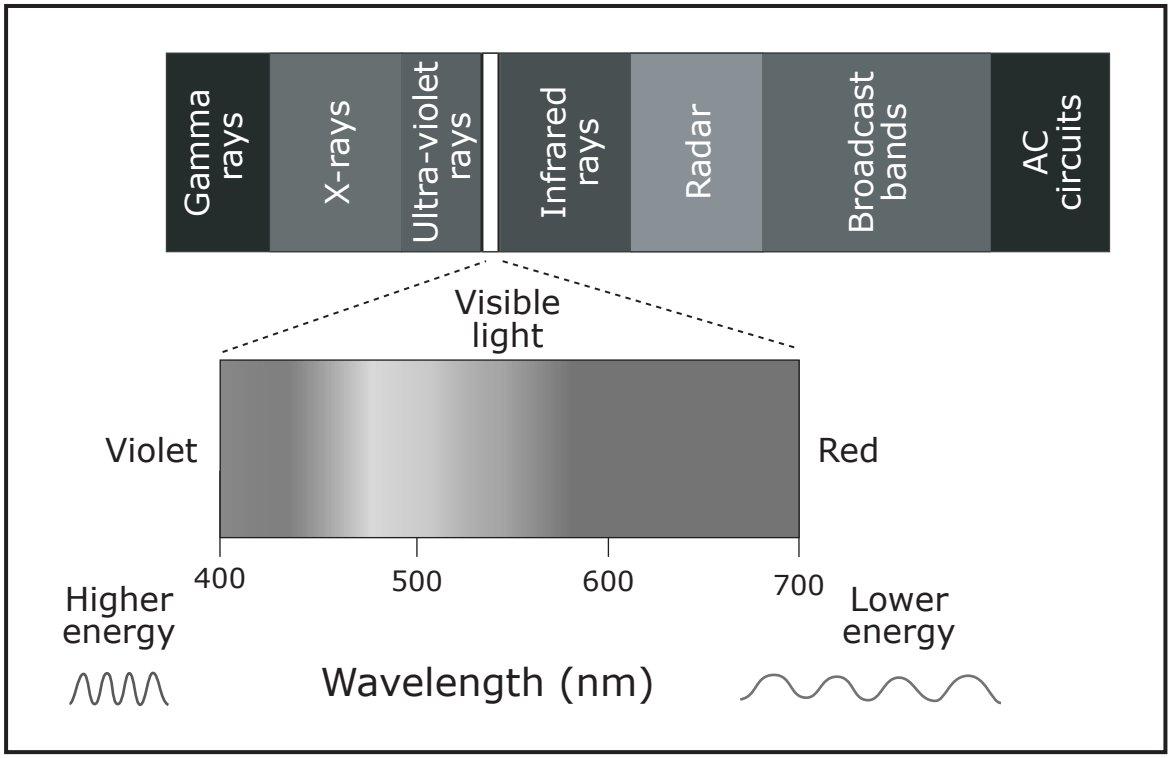


Figure by MIT OpenCourseWare.

Color space is 3d

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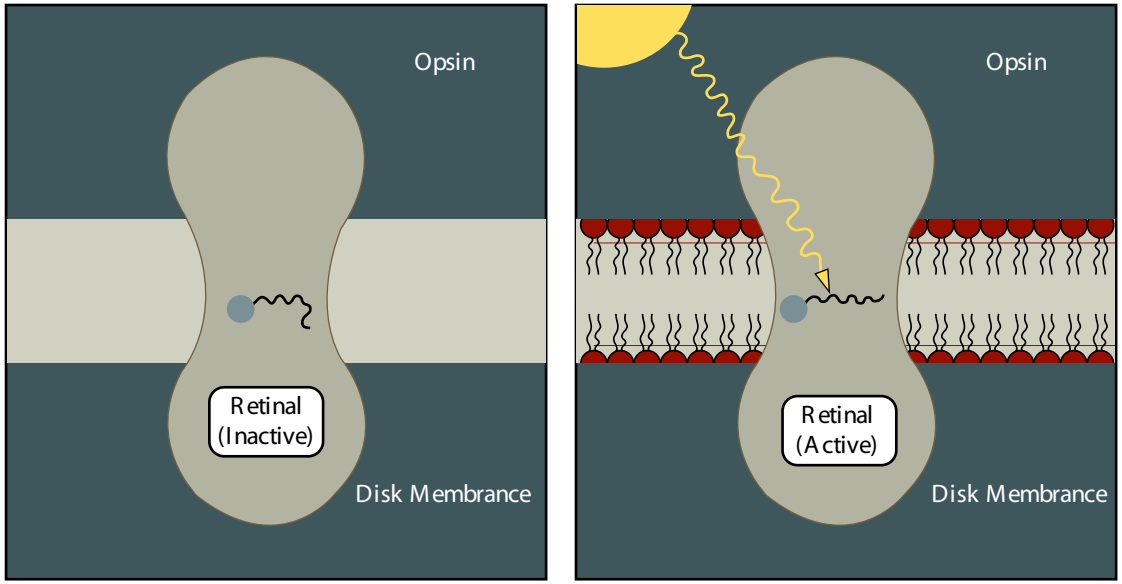
- Any color can be synthesized by mixing three primary colors.
- Young-Helmholtz trichromacy theory

Figure 9-21, Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. "Mixing colored lights," In *Neuroscience: Exploring the Brain*. 3rd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2007. ISBN: 9780781760034.

Rhodopsin photoactivation



Opsin has seven transmembrane alpha helices, like other GPCRs

Figure by MIT OpenCourseWare. After figure 9.18 in Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience: Exploring the Brain*. 2nd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2001. ISBN: 9780781760034.

Phototransduction signaling cascade

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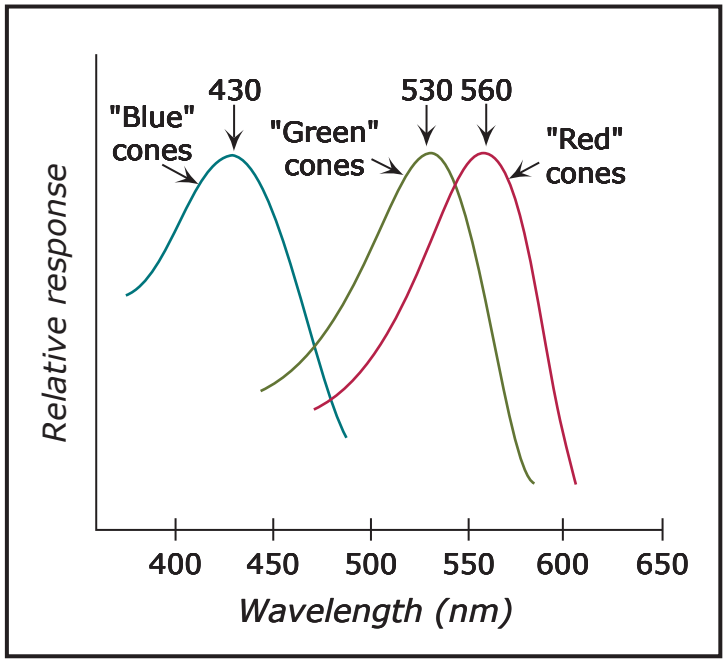
Figure 9-19, Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. "The Light-activated Biochemical Cascade in a Photoreceptor," In *Neuroscience: Exploring the Brain*. 3rd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2007. ISBN: 9780781760034.

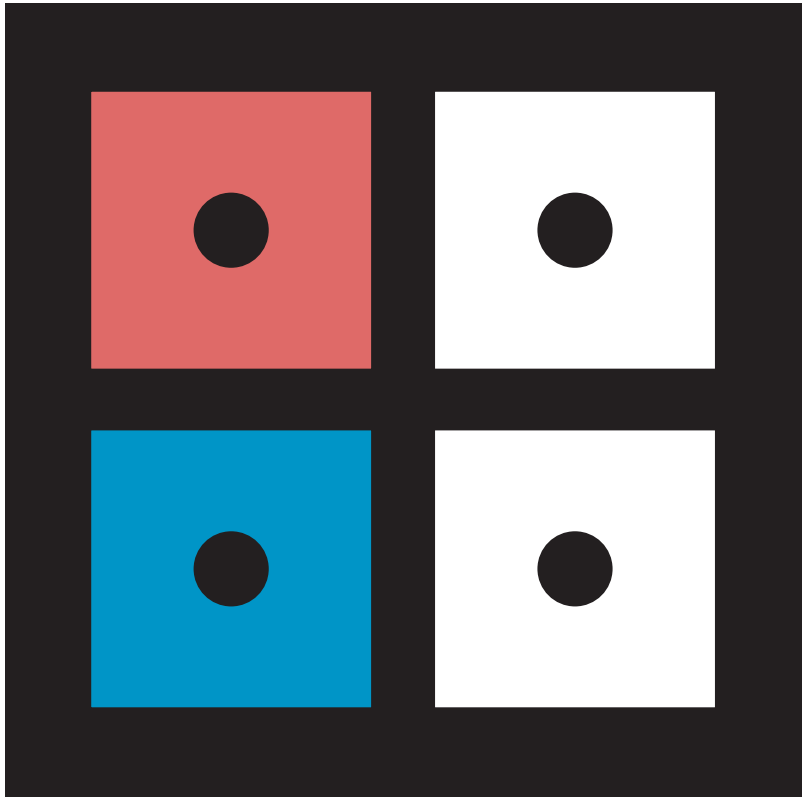
Spectral sensitivity of cones



- three types of opsins
- color blindness is caused by lack of one or more cone types

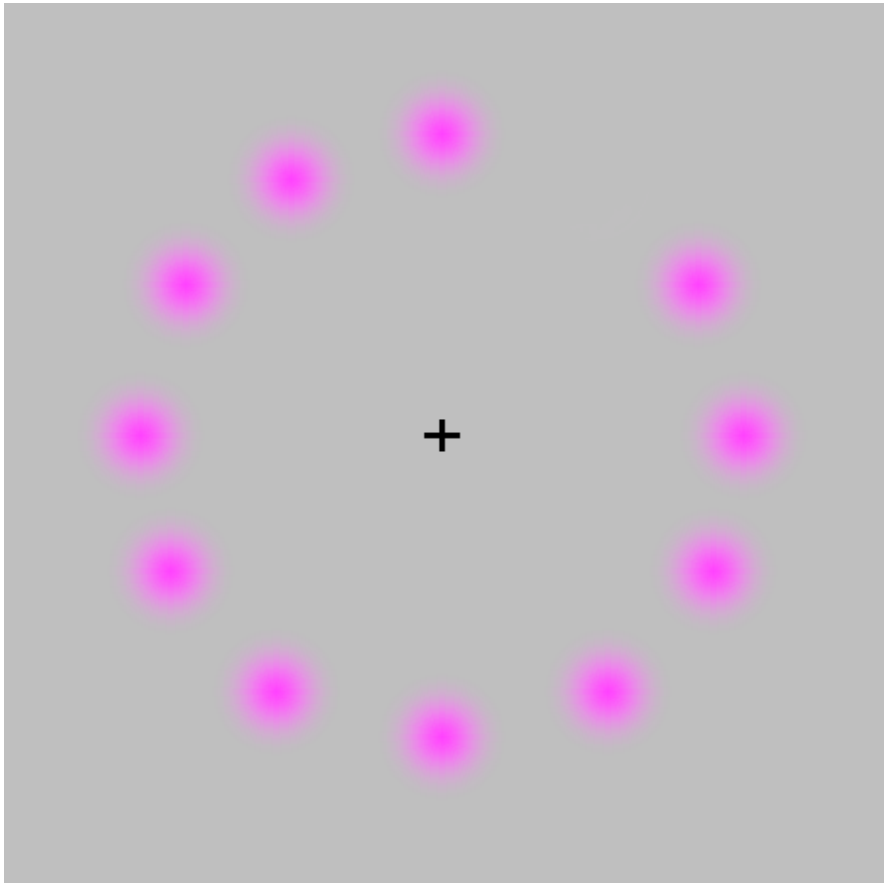
Figure by MIT OpenCourseWare. After figure 9.20 in Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience: Exploring the Brain*. 2nd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2001. ISBN: 9780781760034.

Color aftereffect



- Psychological evidence of red-green and blue-yellow opponency
- Hering's opponent process theory

Figure by MIT OpenCourseWare. After figure 9.29 in Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience: Exploring the Brain*. 2nd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2001. ISBN: 9780781760034.



Color opponency

- Retinal ganglion cells
- P cells: red-green
- nonM-nonP cells: blue-yellow

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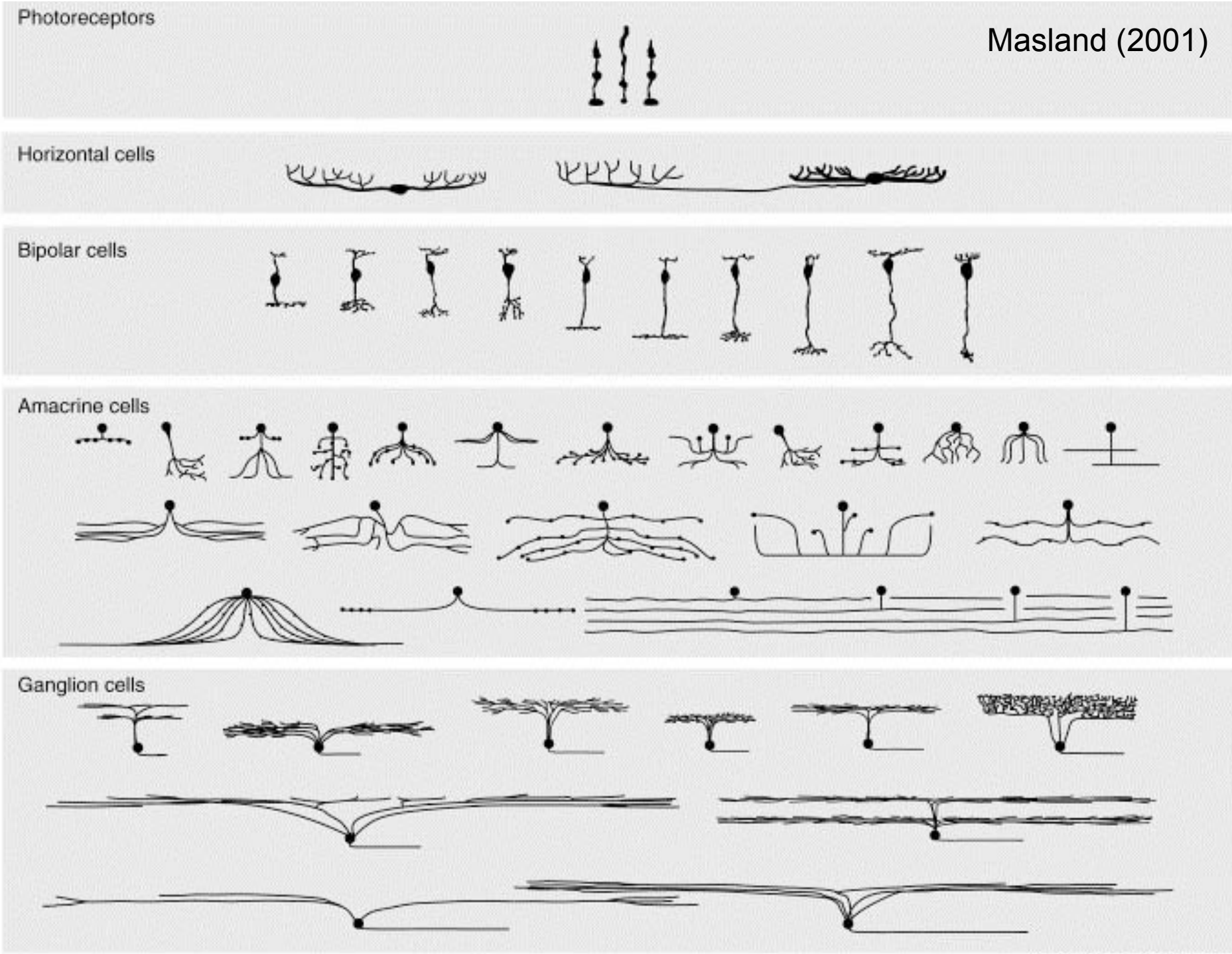
Figure 9-28, Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. "A Color-opponent Center-surround Receptive Field of a P-type Ganglion Cell." In *Neuroscience: Exploring the Brain*. 3rd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2007. ISBN: 9780781760034.

Dual process theory

- Resolution of the debate with a hybrid theory
- Photoreceptors
  - Young-Helmholtz trichromacy
- Ganglion cells
  - Hering color opponency

Further reading: S. E. Palmer, *Vision Science*, MIT Press (1999).



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Kevin Briggman and Winfried Denk

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Viren Jain, Srini Turaga, and Joe Murray

Retina → LGN → V1

- Pathway for “conscious” visual perception

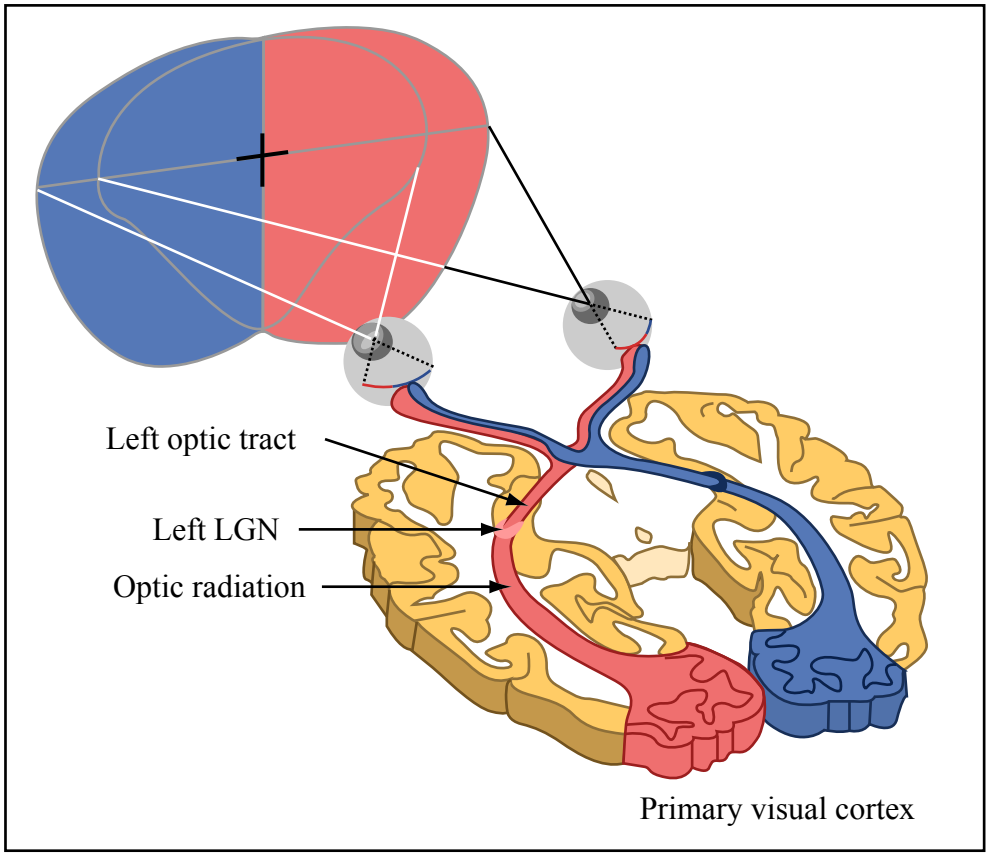
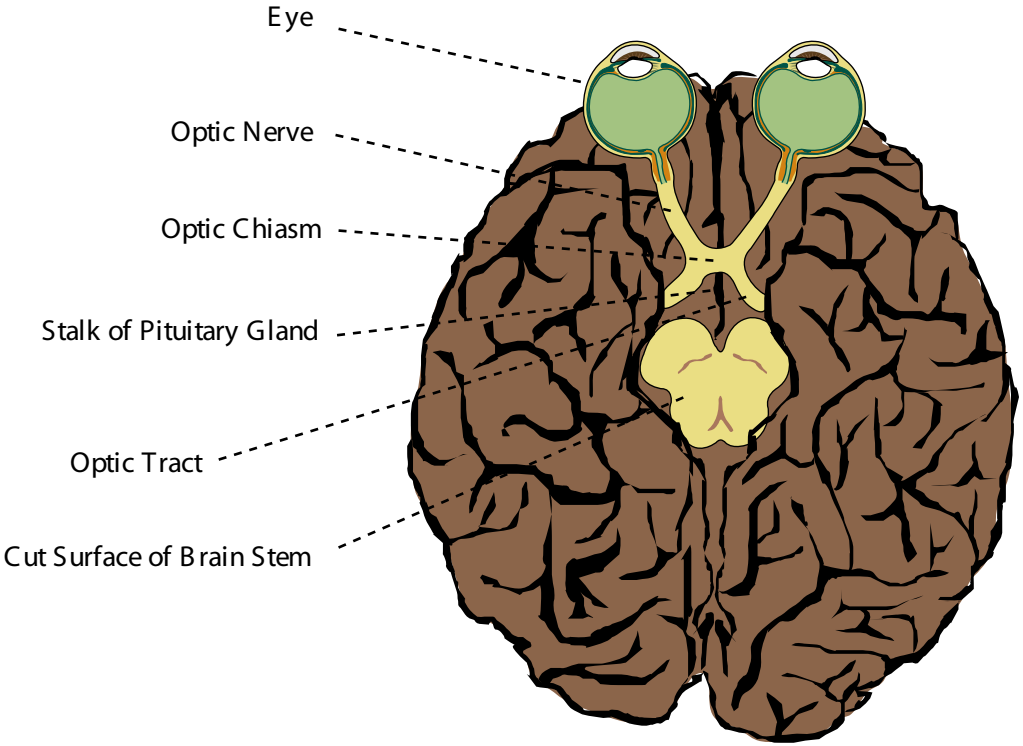


Figure by MIT OpenCourseWare. After Figure 10-4b in Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience: Exploring the Brain*. 3rd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2007. ISBN: 9780781760034.

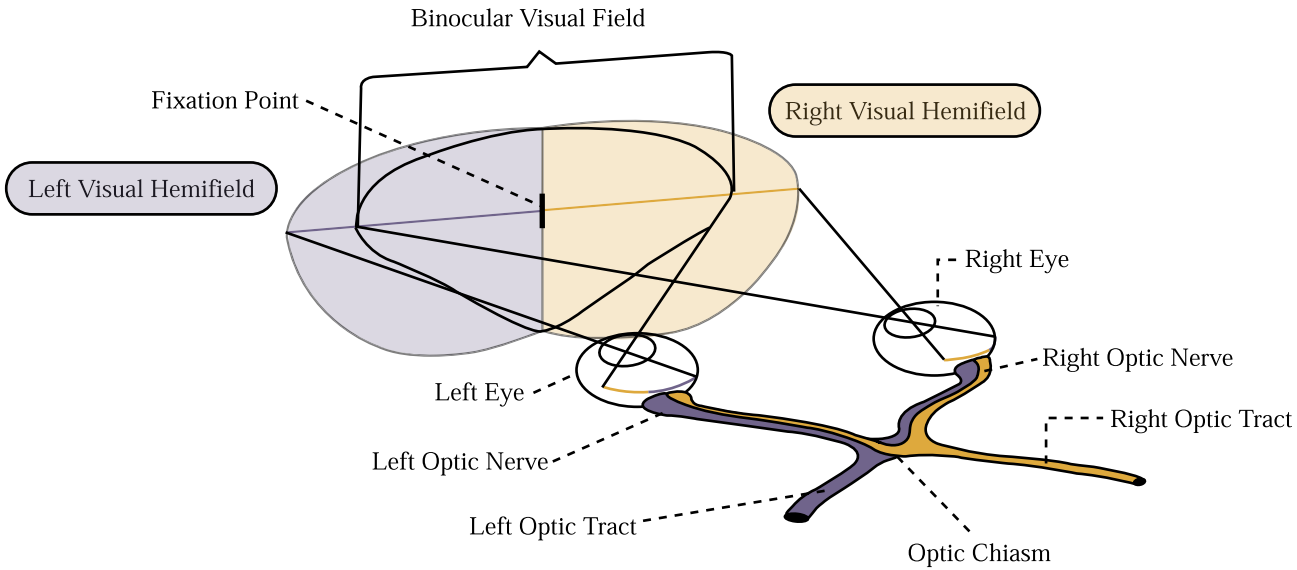
Retinofugal projection



"partial decussation"

Figure by MIT OpenCourseWare. After figure 10.2 in Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience: Exploring the Brain.* 2nd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2001. ISBN: 9780683305968.

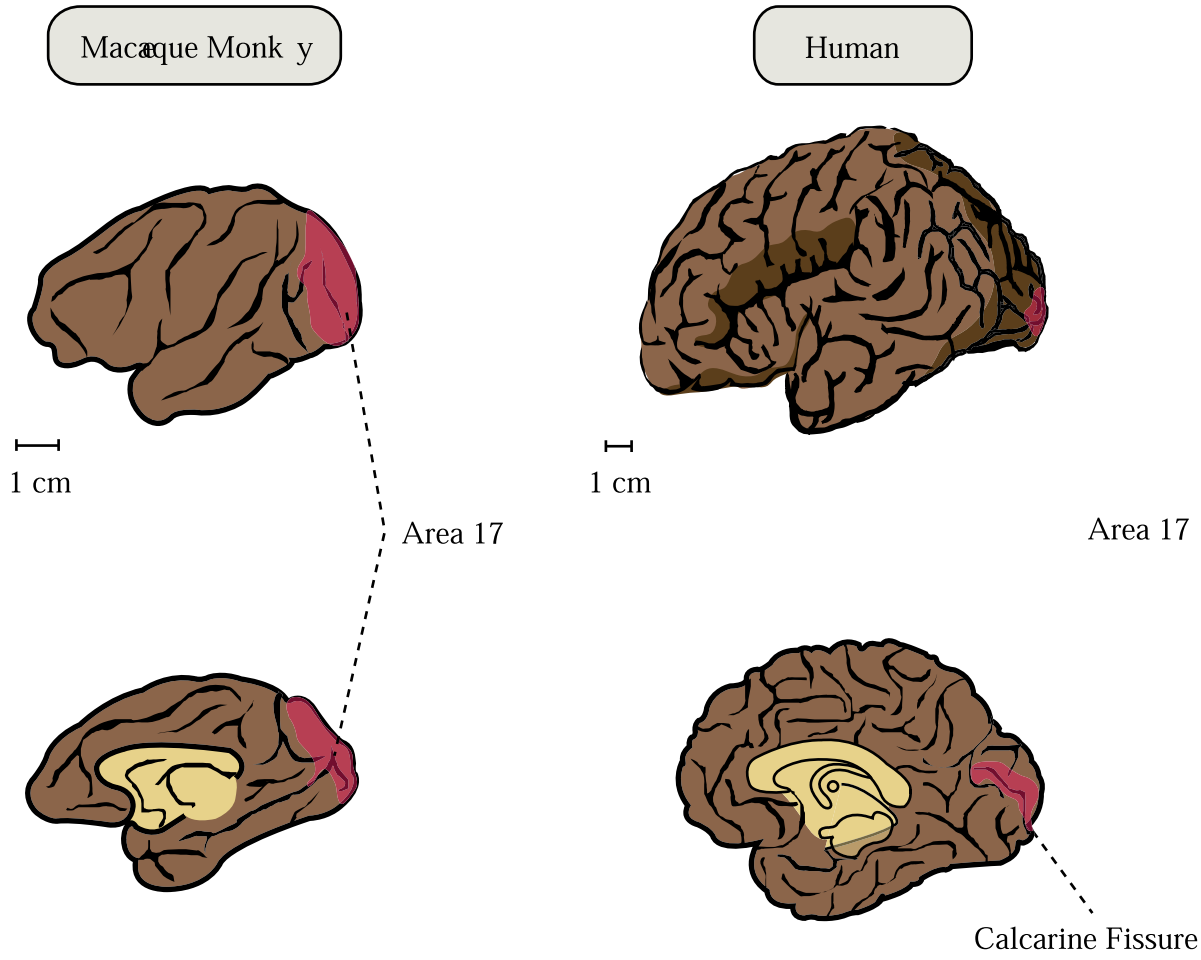
Right and left visual hemifields



- The left visual hemifield is “viewed” by the right hemisphere, and vice versa.

Figure by MIT OpenCourseWare. After figure 10.3 in Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience: Exploring the Brain.* 2nd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2001. ISBN: 9780683305968.

Cortical area 17



- occipital lobe
- Brodmann area
- synonyms
  - area 17
  - primary visual cortex
  - V1
  - striate cortex

Figure by MIT OpenCourseWare. After figure 10.11 in Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience: Exploring the Brain.* 2nd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2001. ISBN: 9780683305968.

Simple cell receptive field

- elongated ON and OFF subregions
- antagonistic organization

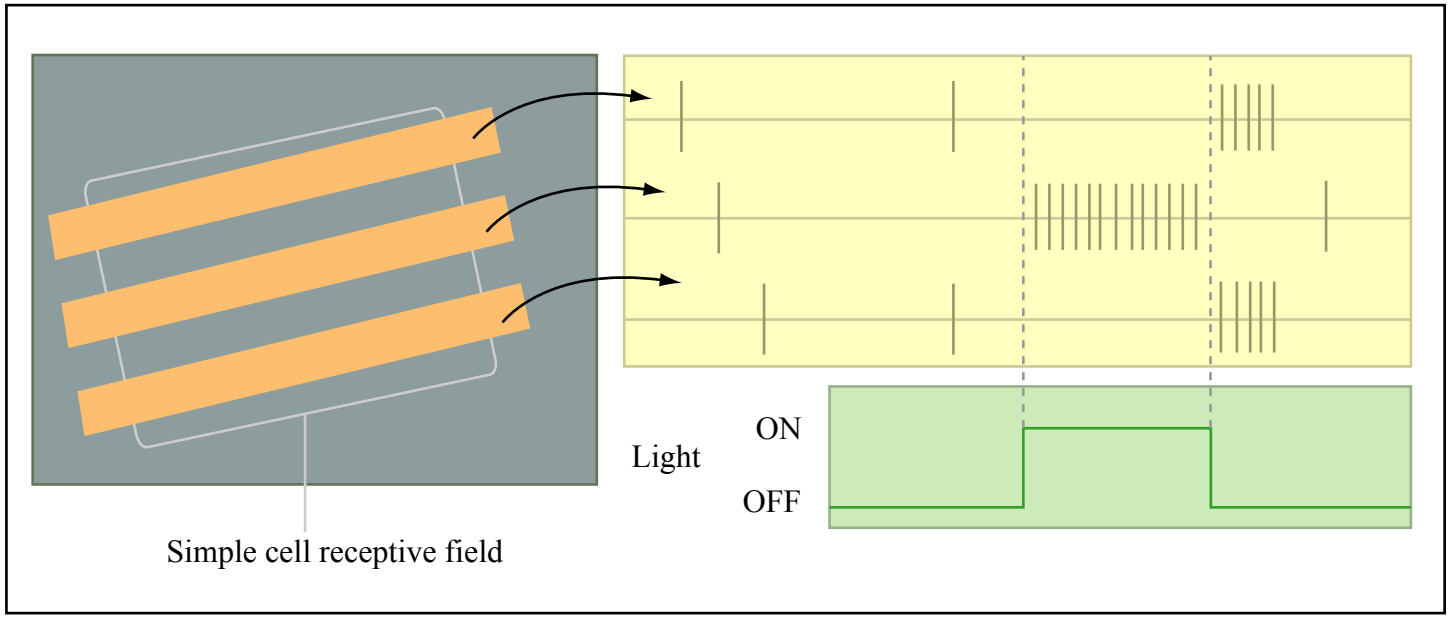


Figure by MIT OpenCourseWare. After Figure 10.23 in Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience: Exploring the Brain*. 3rd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2007.

Orientation selectivity

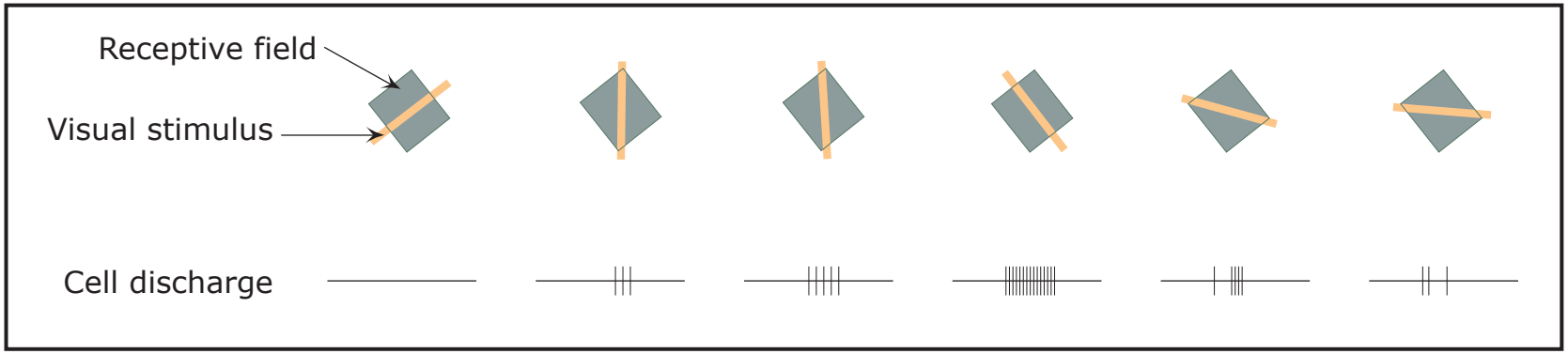


Figure by MIT OpenCourseWare. After figure 10.22 in Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience: Exploring the Brain.* 2nd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2001. ISBN: 9780683305968.

Orientation selectivity

- Stimuli orthogonal to the subregions produce no response
- “Preferred stimulus” is parallel to the subregions.

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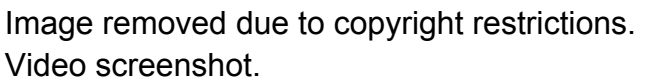
Video screenshot.

Center-surround cell

- Response is independent of orientation.
- The receptive field is rotationally symmetric.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