The Electromagnetic Spectrum

![Diagram showing the electromagnetic spectrum with wavelength in nanometers ranging from 400 to 700. The visible spectrum is highlighted.]
Examples of Colors with the Same Dominant Wavelength but Different Levels of Saturation and Brightness

- Increasing brightness
- Decreasing brightness
- Decreasing saturation
- Increasing saturation
The Human Eye

- Conjunctiva (merges with inside of eyelids)
- Cornea
- Iris
- Pupil (opening in iris)
- Lens
- Layers of retina
- Vitreous humor (upper half has been removed)
- Optic nerve
- Blood vessels
- Sclera
Test for the Blind Spot
Details of Retinal Circuitry

Photoreceptor Layer
- Photoreceptors
  - Cone
  - Rod

Bipolar Cell Layer
- Bipolar cell
- Horizontal cell
- Amacrine cell

Ganglion Cell Layer
- Ganglion cell

Source: Adapted from Dowling, J.E., and Boycott, B.B. Proceedings of the Royal Society of London, B., 1966, 166, 80-111
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Transduction

1. Light strikes rhodopsin
2. Rhodopsin molecule splits, retinal binds with and activates transducin
3. Transducin activates phosphodiesterase
4. Phosphodiesterase destroys cyclic GMP, closes ion channel
5. Cations no longer enter, membrane hyperpolarizes

Cyclic GMP holds ion channel open

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Neural Circuitry in the Retina


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A Photomicrograph of a Section Through the Right Lateral Geniculate Nucleus of a Rhesus Monkey

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The Primary Visual Pathway

- Region of overlap of two visual fields
- Visual field of right eye
- Visual field of left eye
- Optic chiasm
- Information from left half of visual field (green)
- Optic nerve
- Lateral geniculate nucleus
- Information from right half of visual field (yellow)
- Primary visual cortex
Central vs. Peripheral Acuity

- Receptive field in center of retina (fovea)
- Photoreceptors
- Bipolar cells
- Ganglion cells

Receptive field in periphery of retina

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Responses of ON and OFF Ganglion Cells to Stimuli Presented in the Center or the Surround of the Receptive Field

Relative Absorbance of Light of Various Wavelengths by Rods and the Three Types of Cones in the Human Retina

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Color Coding in the Retina

(a) Red light stimulates "red" cone
Red-green ganglion cell is excited; signals red

(b) Green light stimulates "green" cone
Red-green ganglion cell is inhibited; signals green

(c) Yellow light stimulates "red" and "green" cones equally
Yellow-blue ganglion cell is excited; signals yellow
Excitation and inhibition cancel each other; no change in signal

(d) Blue light stimulates "blue" cone
Yellow-blue ganglion cell is inhibited; signals blue
A Photomicrograph of a Small Section of Striate Cortex

Orientation Sensitivity

Stimulus
On    Off

Response Characteristics of Neurons to Orientation in the Primary Visual Cortex

(a) Simple Cell
(b) Complex Cell
(c) Hypercomplex Cell
Concepts of Visual Angle and Spatial Frequency
One of the Modules of the Primary Visual Cortex
The Human Visual System

- Second level of visual association cortex in parietal lobe
- Dorsal lateral geniculate nucleus
- Thalamus
- Dorsal Stream
- Striate cortex (primary visual cortex)
- Extra striate cortex
- Ventral Stream
- Inferior temporal cortex: Second level of visual association cortex
- Eye
- Optic nerve

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Areas of Visual Cortex in the Rhesus Monkey Brain

Source: Adapted from Zeki, S.M. Journal of Physiology, 1978, 277, 227–244. Copyright © 2001 by Allyn & Bacon
Interconnections of Areas of Visual Cortex in the Rhesus Monkey Brain
Responses to Objects and Location