Light

- Visible range: 390-700nm
- Luminance has a large dynamic range:
  - 0.00003 -- Moonless overcast night sky
  - 30 -- Sky on overcast day
  - 3000 -- Sky on clear day
  - 16,000 -- Snowy ground in full sunlight
- Actual colors result from spectral curves
  - dominant wavelength, hue
  - brightness, lightness
  - purity, saturation
Physiology: Eye

- Cornea
- Iris
- Lens
- Retina
- Optic nerve

Physiology: Receptors

- Rods
  - active at low light levels (scotopic vision)
  - only one wavelength sensitivity function
- Cones
  - active at normal light levels
  - three types: sensitivity functions with different peaks
Cone Sensitivity Functions

- Glassner '95, p. 16.
Wavelength (nm)

Spectral sensitivity

M
L

R(M) R(L)

R(S)

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7

400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700

Number of rods vs. cones per mm²

Elliptical spot

Rods

Cones

Fovea

Peripheral vision

Neural processing

Visual activity
Physiology: Ganglia

- Transform incoming SML into opponent color responses
  - G - R
  - Y - B (Y = R+G)  
  - W (W ≅ R+G)

- Characteristics
  - concentric receptive fields
  - logarithmic response of receptors
  - adaption

Center-surround Receptive Fields
Physiology: Brain

- Lateral geniculate nuclei
  - assemble data for single side of visual field
  - 2 monochromatic layers => magnocellular path
  - 4 chromatic layers => parvocellular path

- Visual cortex
  - orientation
  - end-stopped
  - ocular dominance
  - spatial frequency

- Feedback from cognitive levels to earlier stages
Magnocellular Division

• Role in vision
  – identify objects and boundaries
  – depth perception
  – motion perception

• Characteristics
  – color: achromatic
  – acuity: large RF centers
  – speed: fast, transient response
Parvocellular Division

• Role in vision
  – discrimination of fine detail
  – color

• Characteristics
  – color: sensitive to wavelength variations
  – acuity: small RF centers
  – speed: relatively slow response

Human Visual Characteristics

• Contrast sensitivity influenced by spatial frequency
• Adaption
• Communication between neighboring receptors
• Illusions
Communication between Receptors

• Edge completion: subjective contours
• Relative judgements
  – intensity
  – size
  – slope
• Constancy
  – lightness
  – simultaneous contrast
• Tolerance of noise
Illusions

- Feedback from higher visual processes
- 3D interpretation of 2D drawings
- Expectations from experience