VISUAL SYSTEM

1) The Stimulus (Light)

   a) Wavelength

   b) Intensity

      i) Illuminance

      ii) Luminance

   c) Perceptual dimensions

      i) Color

      ii) Intensity

2) Visual System Overview

   a) Pathways

      i) Eyes

      ii) Lateral Geniculate Nucleus (LGN) of thalamus

      iii) Visual receiving area (striate cortex)

      iv) Extra-striate cortex
3) The Eye

a) Overview/Parts

i) Sclera

ii) Cornea

iii) Choroids

iv) Iris

v) Lens

vi) Pupil

vii) Whytt’s reflex

viii) Pupilometry: Aside on pupil diameter & task difficulty
ix) The Retina

(1) Rods
(2) Cones
(3) Fovea
(4) Note: the eye is “backwards”
(5) Bipolar cells
(6) Ganglion cells
(7) Horizontal cells
(8) Amacrine cells
(9) Note: lateral inhibition
(10) Sensitivity
(11) Spatial summation
(12) Acuity

x) Blind spot
4) Eye Movement

  a) Occulomotor muscles
  
  b) Convergence
  
  c) Accommodation of lens

   i) Refractive errors due to failures of accommodation

     (1) Presbyopia

     (2) Hyperopia

     (3) Myopia

     (4) Question: Can too much TV hurt your vision?

   ii) Refractive errors due to lens shape

     (1) Spherical aberration

     (2) Chromatic aberration

     (3) Astigmatism
5) Receptive Fields (in the Cortex)

a) Ganglion cells

b) Center-surround field

i) ON cell

ii) OFF cell

iii) ON/OFF cell

c) P-cells vs. M-cells

i) Parvocellular

ii) Magnocellular
6) Visual Pathways

a) Eye

b) Optic nerve

c) Optic chiasm

i) Visual fields

d) Superior colliculus

i) 1/5 of projections
e) Lateral Geniculate Nucleus (LGN) of thalamus

i) 4/5 of projections

ii) Retinotopic arrangement of ganglion projections

iii) 6 layers, 3 per eye

iv) Cell types:
   1) Magnocellular (inner 2 layers)
   2) Parvocellular (outer 4 layers)
   3) Koniocellular (on all layers)

f) Visual Cortex (Striate Cortex)

i) Occipital lobe

ii) Simple feature detectors

iii) Organized in modules (~2500), each with 150,000 neurons

g) Extra-striate cortex
7) Striate Cortex (visual area, V1)

   i) Occipital lobe

   ii) Retinotopic layout (contralateral half of visual field)

   iii) Simple feature detection

b) Six layers (plus several sublayers)

c) Feature detection

   i) Orientation and movement

   (1) Simple cells

   (2) Complex cells

   (3) Hyper complex cells
ii) Spatial frequency

(1) Note: uses of spatial frequency information:

(a) Long-range vision uses low spatial frequency

(b) Near, details uses high spatial frequency

iii) Texture

iv) Retinal disparity

v) Color

(1) Parvocellular and koniocellular ganglion cells

(2) CO (cytochrome oxidase) blobs

(3) Regions of cortex respond best to different cone input

d) Organization of striate cortex

i) Modules

ii) CO blobs – color

iii) Outside blobs – feature detectors

(1) Column

(2) Hypercolumn
8) Extrastriate Pathway

a) Ventral system

i) “What” pathway

ii) V1 to temporal lobe via V2, TEO, TE

iii) Perception of objects and form

iv) Damage leads to visual agnosias

b) Dorsal system

i) “Where” or “How” pathway

ii) From V1 to posterior parietal cortex via V5 (MT)

iii) Perception of movement, location, orientation

c) Blindsight (“Cortical blindness”)

i) Blind people with ability to look at, point at, and be influenced by objects they cannot see

ii) Optical pathway is still intact

iii) Likely due to redundant pathways to extrastriate cortex via:

   (1) Superior colliculus (SC)

   (2) Dorsal lateral geniculate nucleus (LGN)