"If the world were a logical place, men would ride side-saddle.
- Rita Mae Brown (1944 - )

Assignments
Read chapters 12, 13, 14 and 15 in Course Pack. Make a note of anything that you don’t understand and ask about it in class.

Work on Study Guide 3.

Exam 2 is on Monday, November 9. It will cover the somatosensory system and as much of the visual system as we have completed.

The Central Visual Pathways
- A side view of the brain shows the thalamocortical visual pathway. The optic nerve also sends branches directly to the suprachiasmatic nuclei and the superior colliculus.

The LGN is a layered structure
- Each eye projects to one magnocellular (M) layer and two parvocellular (P) layers.

Each layer of the LGN contains its own representation of the visual field
- This means that there are 6 “maps” of the visual field in the LGN.
- Information from these maps is sent to the primary visual cortex (V1).

The topographic map of the visual field is maintained at all levels.
- The retinotopic map is the fundamental organizing principle of the visual system.
The representation of the fovea occupies the largest portion of V1

- The fovea, though a very small part of the retina, has a greatly expanded representation in V1.
- Receptive fields of cells in V1 are very small, providing high acuity.
- The magnification factor for the foveal representation is large.

The ipsilateral and contralateral M and P layers of the LGN project to different areas of V1

- The segregation of projections from different layers of the LGN is the basis for forming cortical ‘hypercolumns’ made up of different functional units.
- More on this later...

Parallel and hierarchical processing in the visual system

- “Magno” and “Parvo” pathways process different sorts of information in multiple stages.

The circuitry in visual cortex is actually more complicated than the “where” and “what” diagram!

There are many different interconnected visual cortical areas and polysensory areas.

Finding explanations for common illusions: retina or CNS?

- Many illusions can be explained solely on the basis of retinal processing. Others cannot.
Receptive fields of cells in the lateral geniculate nucleus are similar to those of retinal ganglion cells.

LGN cells have concentric, center-surround receptive fields.

Receptive fields of neurons in V1 are very different from those in the LGN.

- The best stimulus is typically a bar of light, not a spot.

A bar in a particular orientation is the best stimulus.

Different V1 neurons have different preferred orientations:

- For this neuron, the vertical bar evokes the biggest response.

The majority of V1 neurons prefer vertical or horizontal bars:

- The distribution of preferred orientations corresponds roughly with the distribution of contours in the visual world.

An “orientation” illusion:

Cells in V1 can be classified according to their response properties:

- Neurons that respond best to a bar or stripe of light in a specific orientation are called simple cells.
Convergence of inputs from LGN could create simple cells’ response properties

- Neurons in LGN converge onto cells in layer 4 of V1.
- Layer 4 cells send excitatory and inhibitory inputs to the simple cell.
- The simple cell responds when the excitatory inputs are stimulated simultaneously.

Complex cells

- Neurons that respond best to a bar in a specific orientation that moves in a specific direction, at a specific speed are called complex cells.

Hypercomplex cells

- Neurons that respond best to a bar of a specific length, in a specific orientation that moves in a specific direction, at a specific speed are called hypercomplex cells.

Other cell types in extrastriate areas

- Cells in some cortical areas outside V1 (inferotemporal cortex, for example), are highly selective in their responses. This neuron “prefers” monkey and human faces.

The visual cortex is organized as an array of functional modules called hypercolumns

- Each hypercolumn receives input from the left and right eyes (ocular dominance columns).
- It also contains columns of cells sensitive to specific orientations (orientation columns).
- The “bibs” contain cells sensitive to color.

Ocular dominance columns

- Neurons in the visual cortex tend to respond best to input from either the left or the right eye.
- The dominant eye is determined by which layer of the LGN provides input to the cortical neuron.
- Neurons with the same ocular dominance characteristics are located near one another in the same column.
Orientation columns

- Within an ocular dominance column are multiple orientation columns.
- Neurons tuned to the same orientation are stacked one on top of another to form the column.

Blobs and interblob areas

- Neurons in the blob regions are very sensitive to color.
- Neurons in the interblob regions are relatively insensitive to color.

Development of the visual system: We have to learn how to see

- For example, ocular dominance columns develop postnatally.
- Visual experience with both eyes is necessary in order to establish cortical organization.
- This experience must occur within a critical period in order for it to be effective.

Closing one eye during the critical period causes abnormal development of ocular dominance columns

- Projections from the open eye invade the space normally occupied by projections from the eye that was closed.