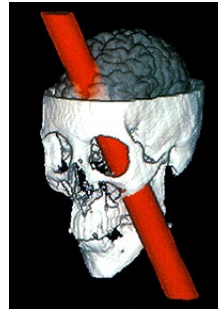


## Association cortex (Ch 25)



### Information through:

Functional Brain Imaging (fMRI, PET, etc)

Brain "damaged" persons

Cognitive tests, etc

Studying of other species

### Cerebral Cortex

Brain's most complex area with billions of neurons and trillions of synapses: the tissue responsible for mental activities

Consciousness

Perceives sensations

Commands skilled movements

Emotional awareness

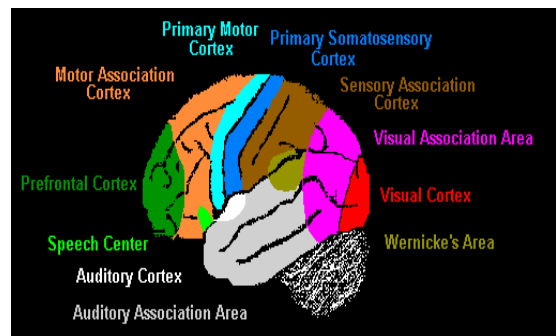
Memory, thinking, language ability

Motivation

All "higher" mental functions



### The Brain - Some repetition



### Types of Cerebral Cortex

#### Neocortex

Newest in evolution

About 90% of total

6 layers, most complex

#### Paleocortex

Associated with olfactory system, the parahippocampal gyrus, uncus

fewer than 6 layers (3 layers)

#### Archicortex

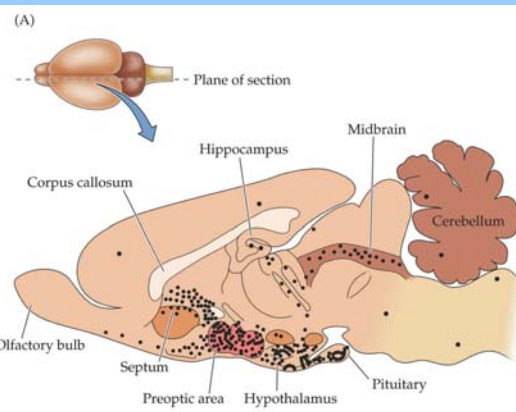
Hippocampal formation; limbic system

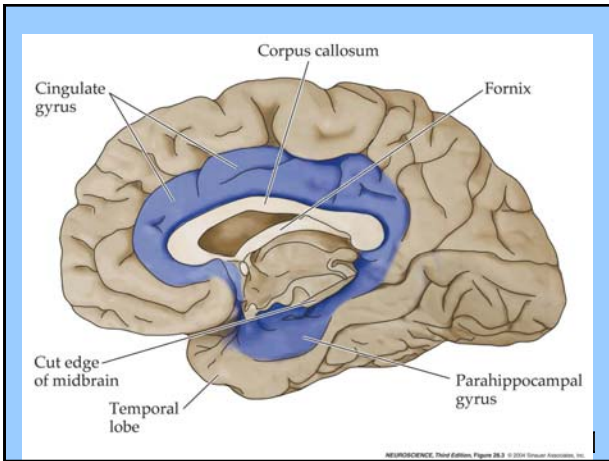
fewer than 6 layers (3-4 layers), most primitive

#### Mesocortex

Cingulate gyrus

Transitional between archicortex and neocortex





### Histology of the Cerebral Cortex

2 main cell types are pyramidal and granule cells

- Pyramidal cells have large apical dendrite and basal dendrites
- Axon projects downward into subcortical white matter
- Pyramidal cell is the primary output neuron

Granule (stellate) cells are interneurons

- Short dendrites extending in all directions
- Short axon projecting to adjacent pyramidal cells
- Granule cells are especially numerous in sensory and association cortex

Neocortex has 6 layers designated I, II, III, IV, V, VI

- Pyramidal cells predominate in layers III and V
- Granule cells in layers II and IV

### Types of Cortex

Cytoarchitecture varies in different areas

- Number and size of cells
- Thickness of layers

Figure 27.8  
Photomicrographs of Nissl-stained sections through three somesthetic areas to show differences in cytoarchitectural organization: primary somatosensory cortex (area 3), primary motor cortex (area 4), and neocortex (area 5). Notice the highly granular layers II and IV in areas 3 and 4 and large pyramidal neurons in the deep part of layer III in area 5 and in layer V of area 4.

Paleocortex  
Neocortex  
Archicortex

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PN26BA0.JPG **A More Detailed Look at Cortical Lamination**

### Brodmanns areor

(B)

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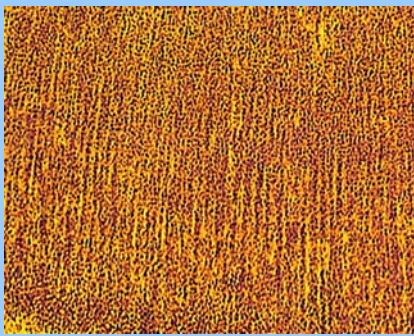
PN26022.JPG **Structure of the Human Neocortex Including Association Cortices**

### Cortical Columns (minicolumn – macro/hypercolumn)

Functional units are cortical columns

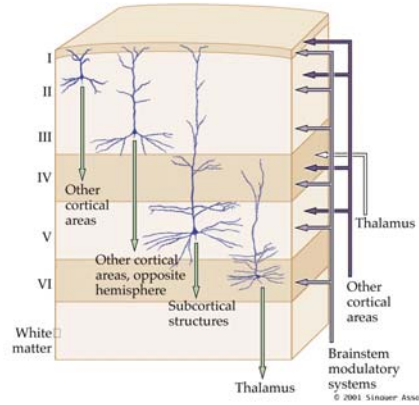
- Columns are vertically oriented groups of thousands of neurons in synaptic contact
- Main input layer is layer IV which receives thalamic input
- Thalamus is the main source of input to the cortex

Human foetal columns at ~26 gestational weeks



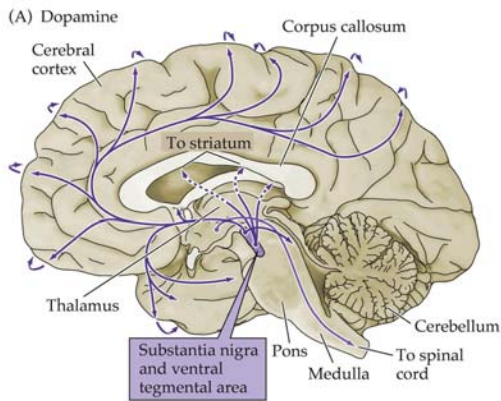
Buxhoeveden, D. P. et al. Brain 2002 125:935-951

**BRAIN**  
A journal of neurology

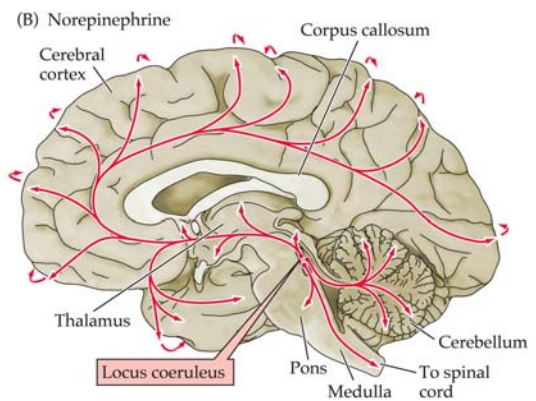


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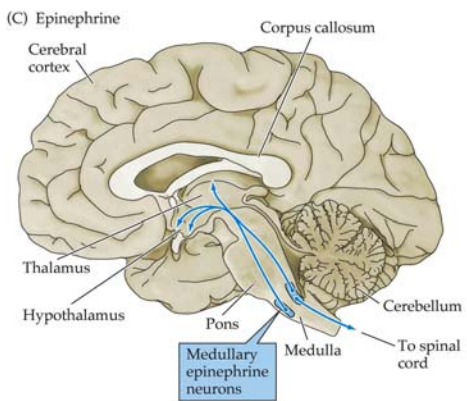
Canonical Neocortical Circuitry - 6 layers



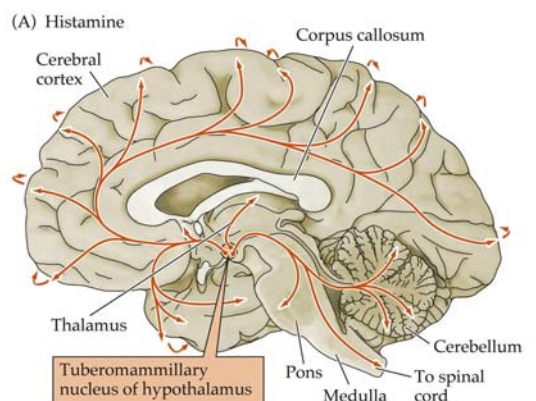
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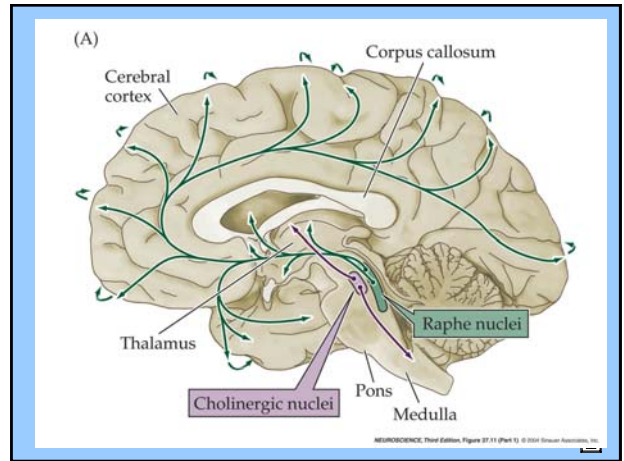
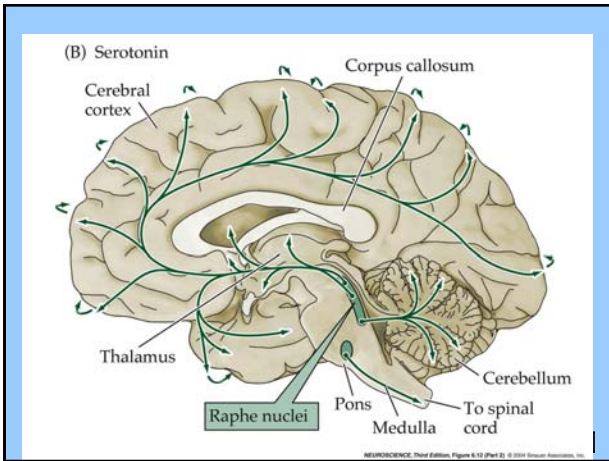
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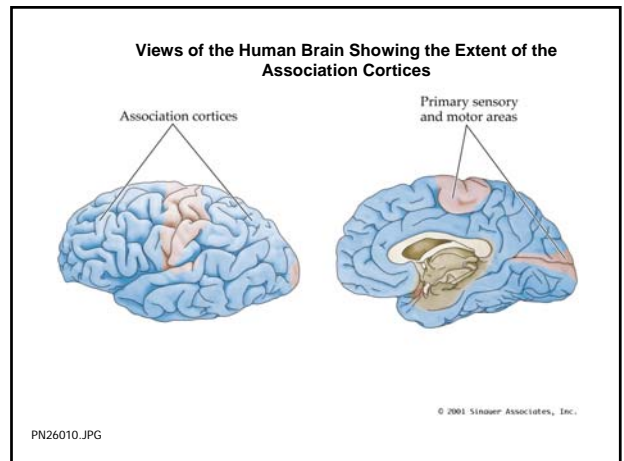
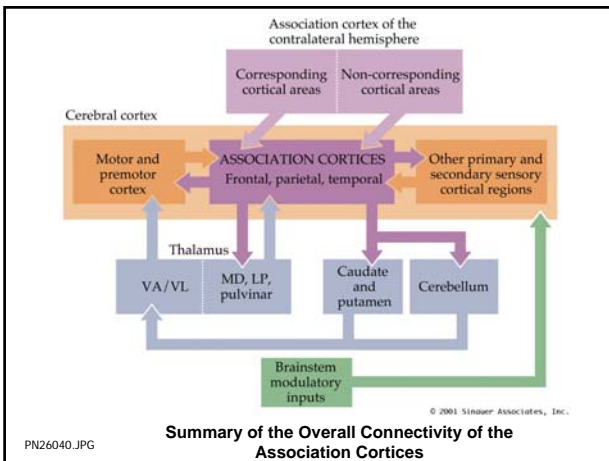
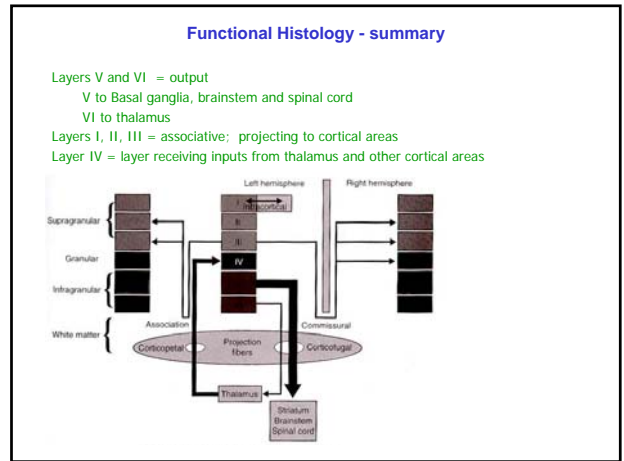
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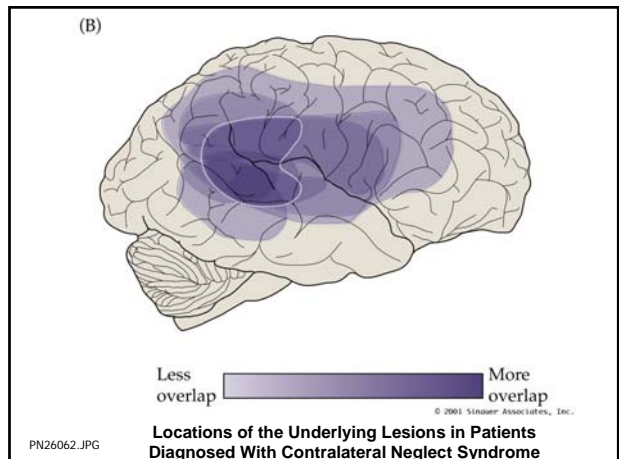
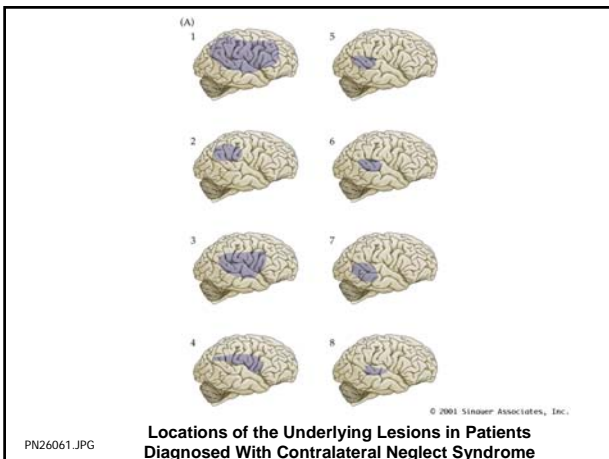
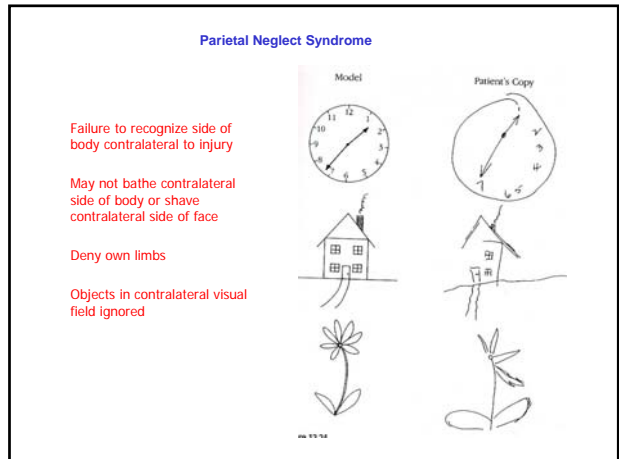
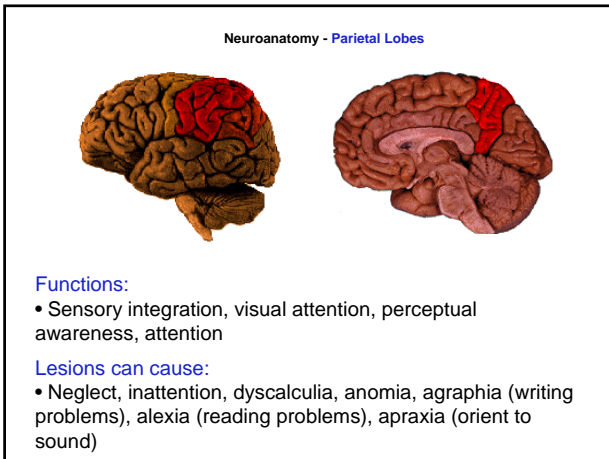
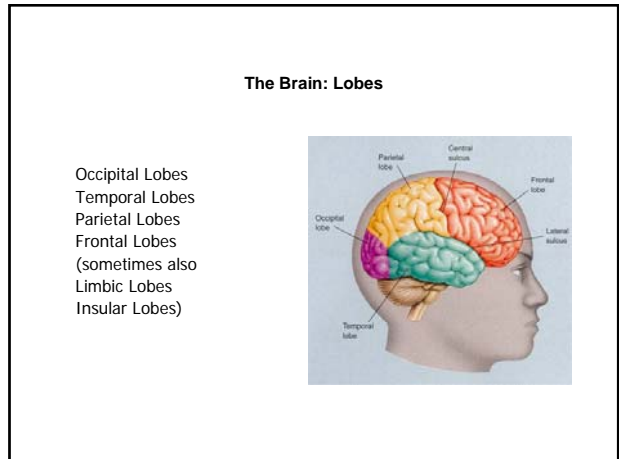
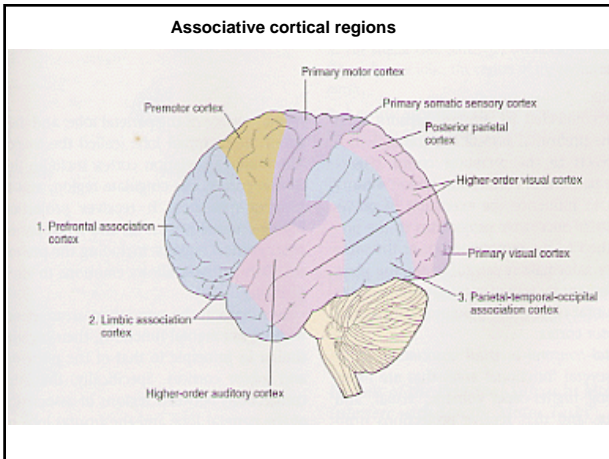


**TABLE 25.1**  
**The Major Connections of the Neocortex**

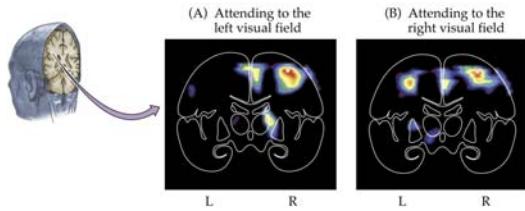
Sources of cortical input	Targets of cortical output
Other cortical regions	Other cortical regions
Hippocampal formation	Hippocampal formation
Amygdala	Amygdala
Thalamus	Thalamus
Brainstem modulatory systems	Caudate and putamen (striatum)
	Brainstem
	Spinal cord

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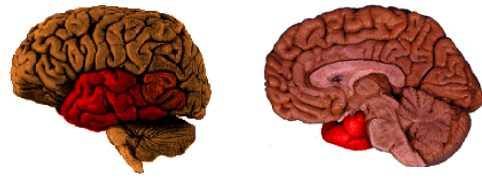
**The Right Parietal Cortex of Normal Subjects is Highly Active During Tasks Requiring Attention**



Note: "better" to damage left part

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**Neuroanatomy - Temporal Lobes**



**Functions:**

- Memory, auditory processing, object recognition and identifying, naming

**Lesions can cause:**

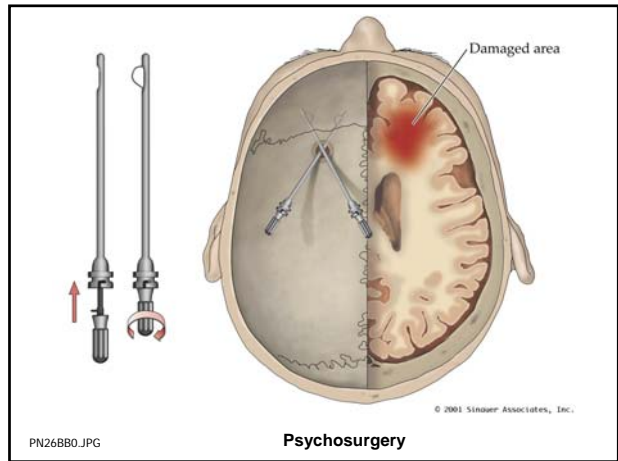
- Amnesia, Wernicke's aphasia (more if left side affected), agnosias, prosopagnosia (if right side damaged - faces not recognized), category specific deficits.

**Neuroanatomy - Frontal Lobes**



Can be divided into:

- **Motor:** Control of movement
  - weakness / paralysis
- **Premotor:** Integration of motor skills / learned action
  - uncoordinated movements / impaired motor skills / speech
- **Prefrontal:** Complex cognitive functions
  - difficulties with planning / decision making / inhibition / memory / attention / perseveration / personality changes / aphasia etc etc.

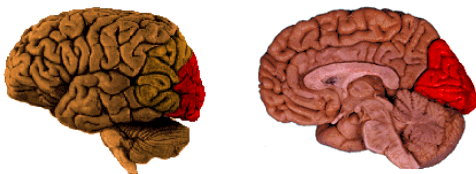


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**Psychosurgery**

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**Neuroanatomy - Occipital Lobes**



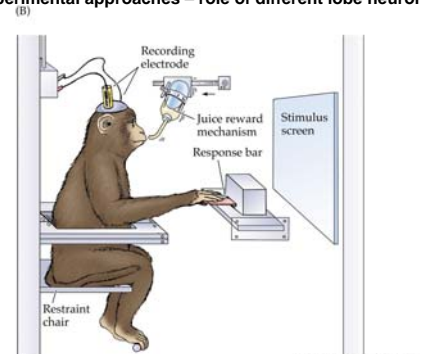
**Functions:**

- Sensory integration, visuoperception, vision

**Lesions can cause:**

- Heminopia, Blindsight, Visual Agnosia, Colour Agnosia

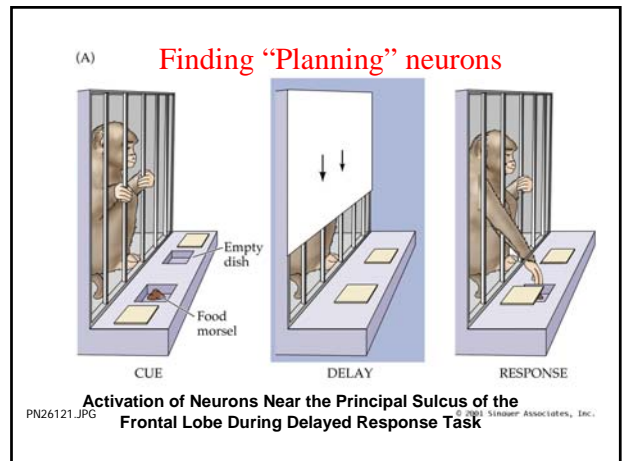
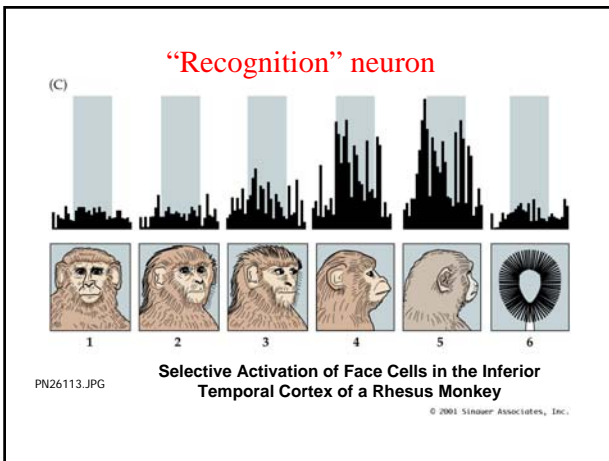
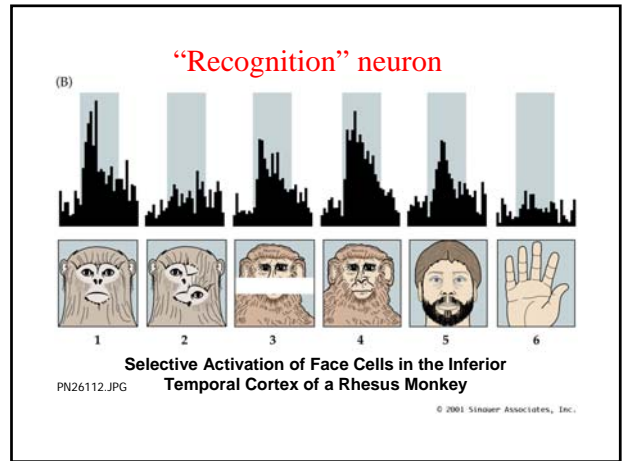
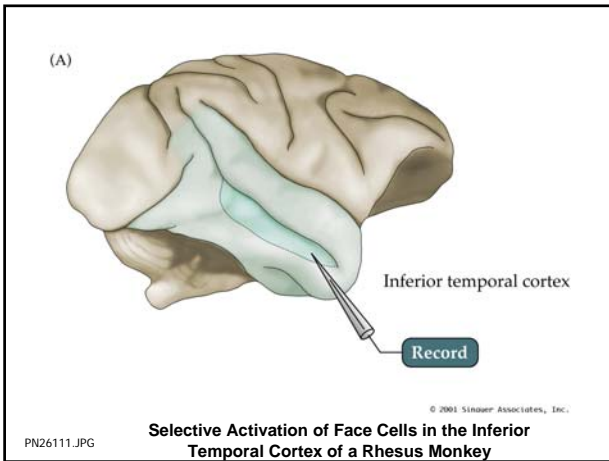
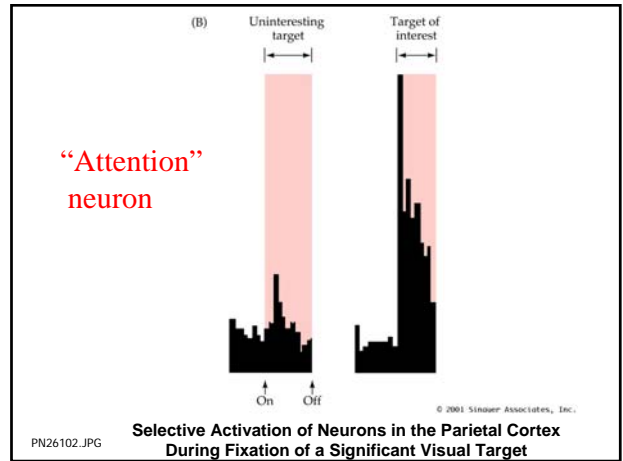
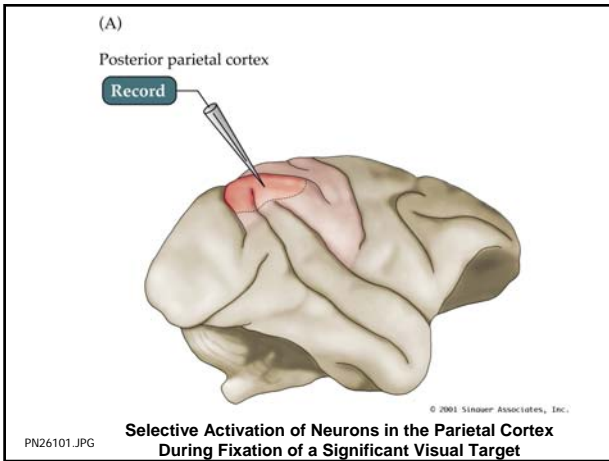
**Typical experimental approaches – role of different lobe neurons:**

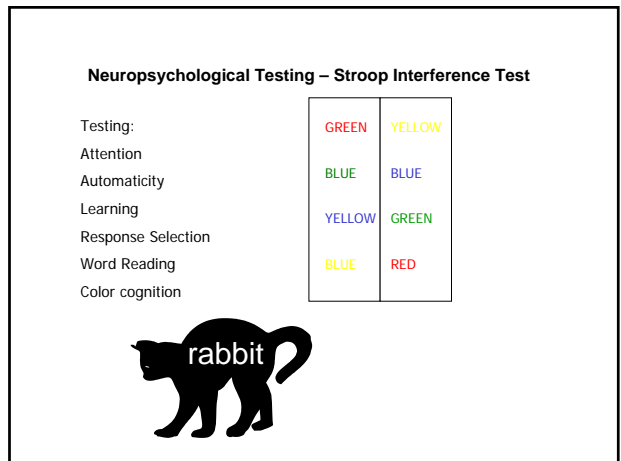
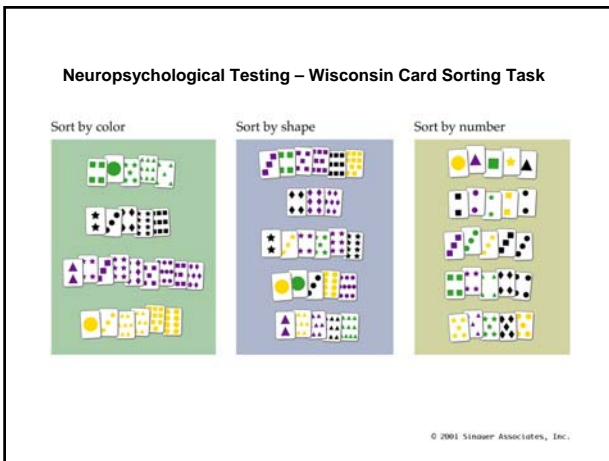
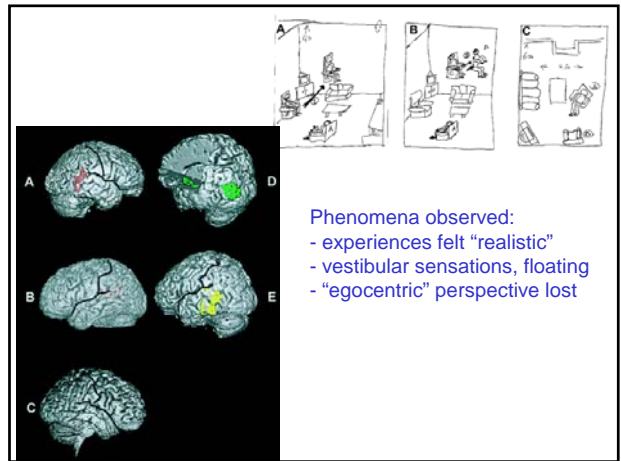
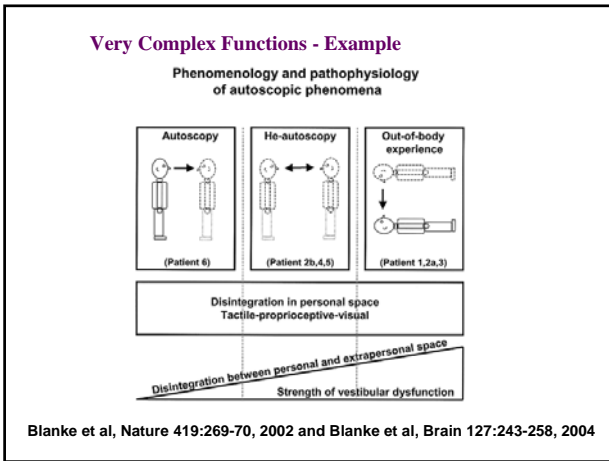
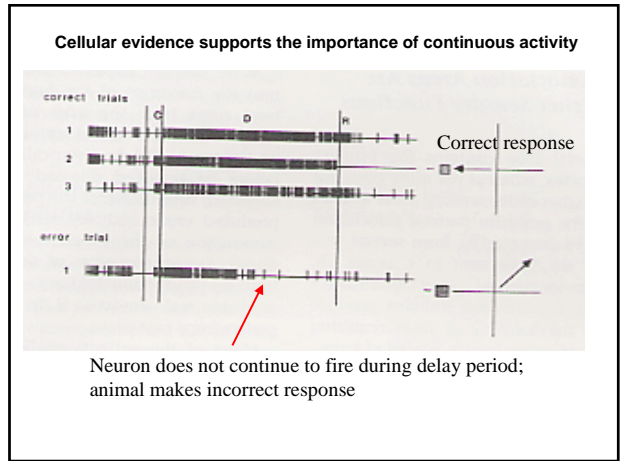
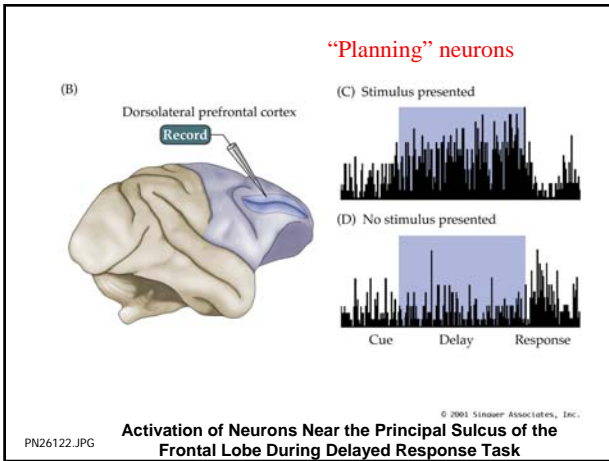


PN26092.JPG

**Recording From Single Neurons in the Brain of an Awake, Behaving Rhesus Monkey**

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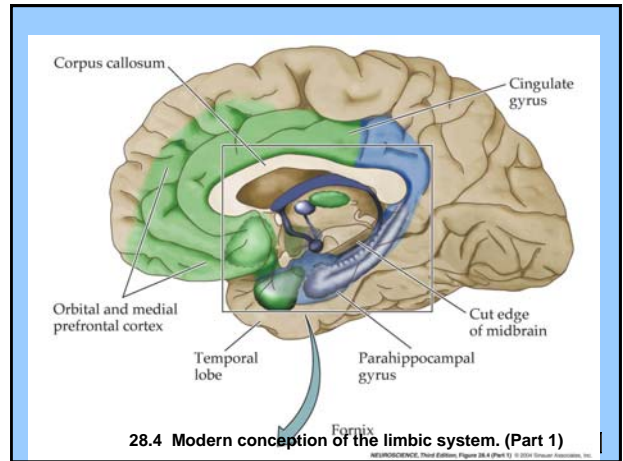
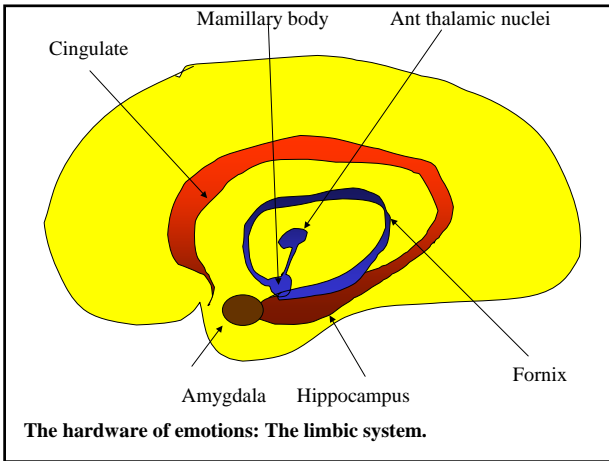
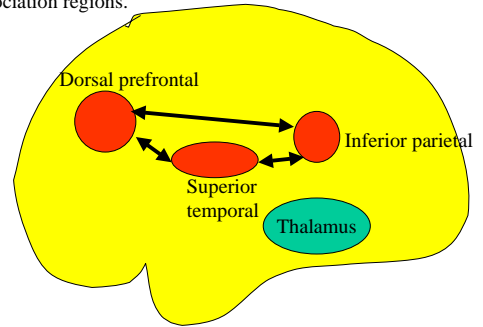




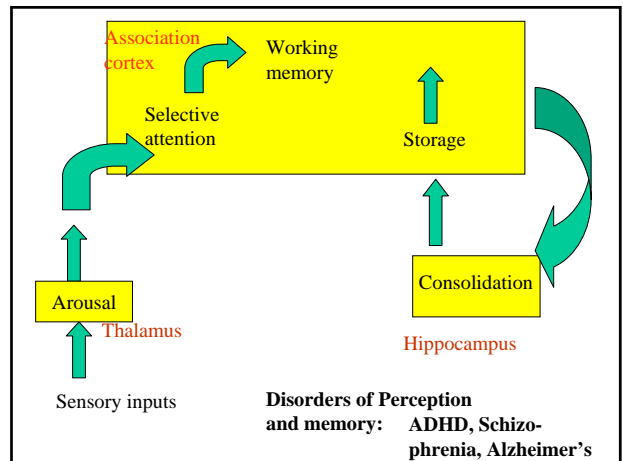
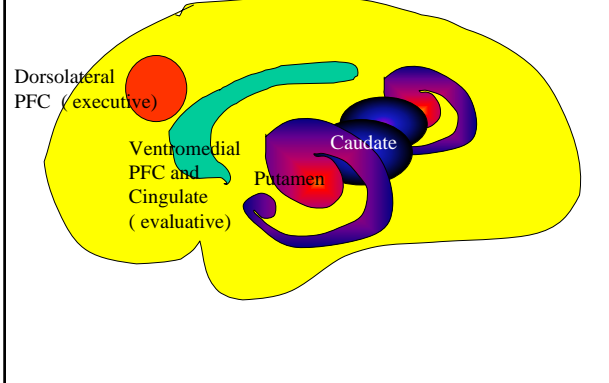
**Anatomy of the mind – more complete view**

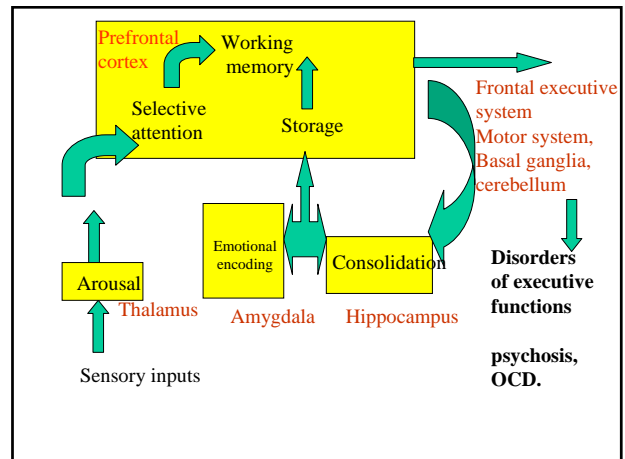
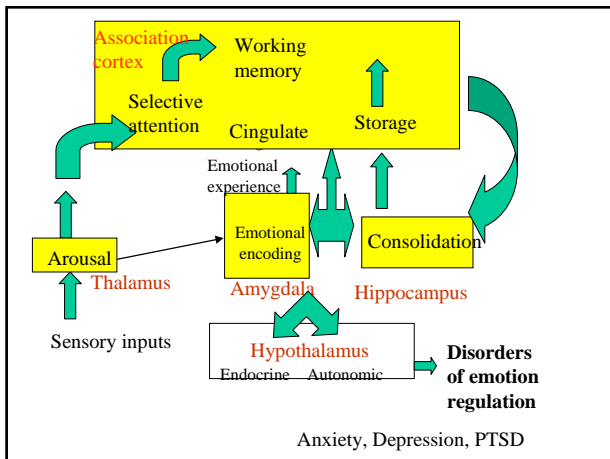
Cognition (perception and memory)	Neocortex and hippocampus
Affect (feeling and expression)	Amygdala-hippocampus and cingulate
Conation (thinking and action)	Prefrontal cortex and basal ganglia

The hardware of cognition: The neocortex association regions.



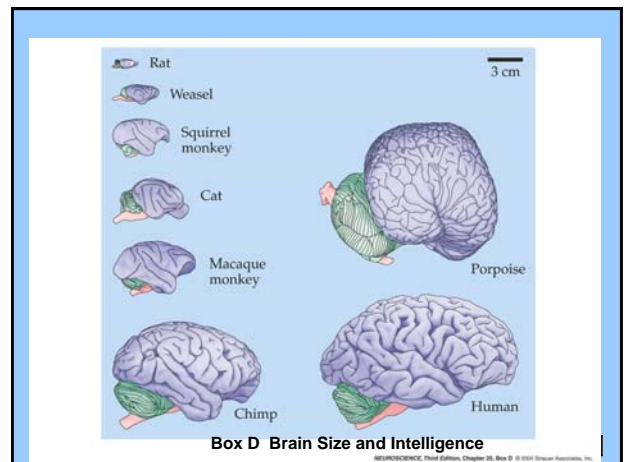
The hardware of "executive" functions:  
The corticostriatal structures





### Neurochemical systems involved

Norepinephrine	• Flight/Fight/Fright
Dopamine	• Pleasure seeking/executive
Serotonin	• Appetitive functions
Acetylcholine	• Memory, arousal
GABA	• Inhibitory
Glutamate	• Excitatory



### Study questions for *The Association Cortices*

- Describe the basic organizational features of neocortex, shared by association cortices and sensory and motor cortices.
- What features distinguish association cortices from sensory and motor cortices? Consider thalamic input and corticocortical connections.
- How did Brodmann decide where to put the boundaries between Brodmann's areas?
- What are the main function(s) of each of the following? What techniques and approaches have been used to reveal these functions?  
 parietal association cortex  
 temporal association cortex  
 frontal association cortex
- What does the study of agnosias contribute to cognitive neuroscience?
- What does contralateral neglect syndrome suggest about the neuroanatomy of attention? Why does contralateral neglect result from damage to the right, but not left, parietal lobe cortex?
- Where and what are "recognition neurons"? "planning neurons"? "attention neurons"?
- What cortical region is particularly critical for the delayed response task?
- Is brain size a good measure of intelligence?
- Other terms to know:  
 cognition  
 apraxia  
 cytoarchitectonic  
 prosopagnosia