Thus the thalamus works hand in hand with the cortex.

**Areas of the Thalamus**

- “Specific” nuclei of thalamus receive specific sensory or motor input & relay that input to the appropriate sensory or motor region of cortex.
  - VP thalamus \(\rightarrow\) somatosensory cortex
  - Lateral geniculate \(\rightarrow\) visual cortex
  - Medial geniculate \(\rightarrow\) auditory cortex
  - VA & VL thalamus \(\rightarrow\) motor cortex
One Example of Thalamic Projections to Specific Cortical Regions

Areas of the Thalamus
- “Nonspecific” nuclei of thalamus project more widely to regions of the cortex (especially to “association cortex”) & limbic system that have higher cognitive & emotional functions.
  - Dorsal portions of the lateral thalamus
  - Anterior nuclei
  - Medial nuclei
  - Intralaminar and reticular nuclei

The Cerebral Cortex (“bark”)
- The cortex is a layer of gray matter just 1.5-4.5 mm. thick covering the cerebral hemispheres.
- About 70% of it is hidden in the fissures & sulci. It would be about 2.5 sq. ft. unfolded.
- Estimated 15 billion densely packed neurons, 50 billion glia.

White Matter
- Immediately under cortex is thick white matter – the axons carrying input to the cortex as well as the output of the cortex.
- Then we find subcortical structures (basal ganglia, limbic system, thalamus, hypothalamus).

White Matter Fiber Systems
- Commissural fibers – axons linking one hemisphere to the other (e.g. corpus callosum)
- Projection fibers – axons linking cortex to distant (e.g. subcortical or spinal) regions
- Association fibers – axons linking different gyri or different lobes of a hemisphere

Commissural Fibers
• Corpus Callosum

• Projection Fibers

• Corona radiata

• Internal Capsule

• Subcortical Projections

• Association Fibers

• Seizures

• Transient repetitive discharges of some neurons in the brain, which may or may not produce outward signs.

• 1 in 20 will experience one or more isolated seizures – this is not epilepsy.

• Epilepsy = Recurrent seizures; only about 1 in 100 has epilepsy
• Epilepsy

- Occurs in many forms, causing different symptoms
- May be inherited (primary or idiopathic), due to differences in chemical balance of brain (e.g. a shortage of GABA) or in neuron thresholds
- Or may be acquired (secondary) - symptomatic of something that happened to the brain – trauma, tumor, infection, vascular disease, metabolic changes
- Primary epilepsies produce generalized seizures affecting the whole cortex at once.
- Secondary epilepsies often have a localized onset in the area of the brain damage: “partial or focal seizures”

• Generalized Tonic-Clonic (Grand Mal) Seizures

- Loss of consciousness & motor convulsion
- Tonic phase (body stiffens for 15-30 sec)
- Possible epileptic cry
- Clonic phase (30-45 sec bilateral jerking)
- Possible loss of bladder/bowel control
- Muscles relax, breathing normalizes
- Period of post-seizure fatigue, confusion
- Risks: falls, accidents; sustained seizures disrupt breathing

• Status Epilepticus

- Continuous seizure activity of at least 15-20 min duration or a series of seizures that occur in rapid succession over a 20-30 min period with no return of consciousness between seizures.
- Sustained seizure activity is one time seizures can be deadly (impairs respiration). Not limited to epileptics – may occur during drug overdose or drug withdrawal, for example.

• Petit Mal Seizures (Absence Attacks)

- Nonconvulsive generalized seizures
- Seen more often in the young
- Brief (3-30 sec) losses of awareness
- Vacant stare; behavior stops
- May be dozens of brief attacks per day
- Distinctive 3 cps “spike + wave” EEG
- May decrease or change in form as child gets older

• Secondary Epilepsy

- Epilepsy resulting from an identifiable underlying disease, lesion, or scar tissue
- Problem area generates seizure activity; this is the “epileptic focus” & the localized misfiring is a “focal or partial seizure”
- Partial seizures are often preceded by an “aura” experience (warning sign) generated by the beginnings of the abnormal firing activity – a sensation, emotion, cognitive change usually related to the location of the focus.

• Simple Partial Seizures

- Limited to an area of sensory or motor cortex. The seizure produces some sensory or motor effects but usually not a loss of consciousness.
- Examples: visual, somatosensory or auditory seizures, Jacksonian (motor cortex) epilepsy
• Complex Partial Seizures
  - Originate in association cortex or limbic regions. Usually cause loss of normal level of consciousness & complex cognitive, emotional and/or behavioral symptoms. May last several minutes.
  - Temporal (~80%) & frontal (~20%) areas are most common sites.

• Partial Seizures That Spread
  - Strong localized seizure activity may spread from the original focus to adjacent regions or to the cortex as a whole.
  - A simple partial seizure may "evolve" into a complex partial seizure.
  - A complex partial seizure may become a secondarily generalized seizure. This complicates seizure classification & diagnosis requires careful observation.

• Temporal Lobe Epilepsy (Psychomotor Epilepsy)
  - Most common focal epilepsy
  - 40-50% show signs of psych. disorders (only 10% in other epilepsies)
  - Often preceded by olfactory, taste, visceral, or emotional aura
  - May produce automatisms

• Treatment of Epilepsy
  - Anticonvulsants
    - Dilantin (phenytoin)
    - Tegretol (carbamazepine)
    - Luminal (phenobarbital)
    - Depakene (valproic acid)
    - Depakote (divalproex)
    - Valium (diazepam)
    - Ativan (lorazepam)
    - Clonopin (clonazepam)
    - Neurontin (gabapentin)
    - Mysoline (primidone)
    - Zarontin (ethosuximide)
    - Good control achieved in about 70-75%

• Automatisms
  - Oro-alimentary
    - chewing, smacking, swallowing, drooling
  - Mimicry
    - fear, laughter, anger, excitement
  - Gestural
    - tapping, patting, rubbing, fumbling
  - Ambulatory
    - Walking, circling, running (cursive)
  - Verbal
    - humming, whistling, grunting, phrasing
  - Responsive
    - quasi-purposeful behavior

• Other Treatments
  - Vagus nerve stimulation – new approach
    - Stimulating electrode implanted under collarbone to periodically stimulate X.
    - Stimulation may change chemistry or threshold to decrease seizure frequency
  - Vagal side effects (hoarseness, cough, short of breath)
  - Other stimulation approaches under investigation
- **Vagal Stimulation**
  (mostly for grand mal seizures)

[Image: Vagal Stimulation Diagram]

- Ketogenic Diet – children and some adults may benefit from an extreme diet (90% fat, low carbs & protein (RDA only)) causing ketosis. Preliminary evidence suggests the less extreme Adkins diet may benefit some.

- Deep brain stimulation is another option

[Link: http://www.youtube.com/watch?v=sZunT34Wl2o&feature=related]

- **Ketogenic Diet** – children and some adults may benefit from an extreme diet (90% fat, low carbs & protein (RDA only)) causing ketosis. Preliminary evidence suggests the less extreme Adkins diet may benefit some.

- **Other Treatments: Surgery for Some Partial Seizures**
  - After extensive testing to precisely localize the epileptic focus, the cells generating the seizure activity may be removed (small area or lobectomy or even hemispherectomy may be required)
  - If area can’t be removed may do subpial transection, cutting around focus to prevent seizure spread. In some a corpus callosotomy may prevent spread to opposite side.
  - Must weigh seizure frequency, severity, risks against surgical costs, risks and moderate (50-70%) success rate.

- **Cortex**
  - 90% of our cortex is evolutionarily new ("neocortex")
  - Most of the older regions have been covered with neocortex
  - The majority of our neocortex is "association cortex" – not simply involved in primary sensory or motor processing, but involved in integration/higher levels of processing.
The Insula, One of the Hidden Regions of Cortex

Medial View

Book Fig. 13.2

“Brodmann’s Areas”