Lecture 1b: Anatomy of the Nervous System, Continued

Cerebral Cortex = "Cortex" = "Bark", Outermost structure, covering most of brain, Evolutionarily recent, esp expanded in humans
- 6 layers (lamina), Highly convoluted, 2/3 hidden in folds, if unfolded = ~ 2.5 ft^2 sheet, 3 mm thick
  - Bulges: Gyri (singular: Gyrus), Folds: Sulci (singular: Sulcus) or Fissures (if very deep)
    - **Central Sulcus** divides Parietal from Frontal Lobe, **Lateral Sulcus** divides Temporal from Frontal Lobe
- Cerebral Cortex is divided into four lobes: Occipital, Temporal, Parietal, Frontal

Occipital Lobe (ventral posterior): **Visual Processing**-
- Includes primary projection area (**V1** or **Striate**) from LGN of Thalamus & some higher visual areas
  - Divided into separate pathways for Color, Detail, Motion, Depth, etc that move into other lobes

Temporal Lobe (lateral): **Higher Visual, Audition, Emotion & Language Comprehension**
- Includes primary Auditory projection area (**A1**) from MGN of Thalamus & higher Auditory areas including Wernickes Area (in Left hemisphere) involved in language comprehension
- Inferior Temporal (IT) includes higher Visual area, along "*Who/What*" pathway, including Face Cells
- Medial Temporal (MT), part of other main visual pathway (to Parietal), the "*Where/How*" pathway
  - Includes many Motion Sensitive cells, including Optic Flow detectors
- Anterior Temporal implicated in Emotional expression and interpretation, especially Right Hemisphere

Parietal Lobe (dorsal posterior): **Higher Visual, Somatosensory Processing** and **Spatial Mapping**
- Primary projection area (**S1**) for Somatosensory info, from VPN of Thalamus, maps body surface
  - "Penfield Map" of body surface along the Postcentral Gyrus, just posterior to Central Sulcus
- Parietal Lobe also includes higher visual areas of "*Where/How*" pathway
  - e.g. Canonical Cells, that respond to "affordances" of object (how it can be handled, used)
  - e.g. w/Premotor Cortex, part of "Mirror Cell System", that reacts when see self or other do action

Frontal Lobe - (anterior) **Motor Cortex**, **Language Production**, and **Strategy**
- Precentral Gyrus anterior to Central Sulcus = Motor Cortex, (map of body like S1 but for motor control)
- Premotor Areas: Anterior to motor cortex, implicated in preparing to act, Planning
  - Includes "Mirror Cells" (w/Parietal) which respond to seeing self or other perform familiar manual tasks
  - Includes Broca's Area (anterior to ventral motor cortex) specialized for language production
- Prefrontal Cortex most anterior portion, involved in planning, self control. Humans' most developed
  - Damage => deficits in emotional expression, social inhibition, planning, impulse control
  - Prefronal Lobotomy = sever connections, once common treatment for excitable psychotics

- **Corpus Callosum** – Beneath cortex, inferior to Cingulate Gyrus, superior to rest of Limbic System
  = A bundle of axons communicating between the two hemispheres of the Cerebral Cortex
  - Part of "White Matter" of brain, connecting the (grey) cell bodies of "Grey Matter"
    - Brain = 66% White Matter, by volume

The Spinal Cord = 31 segments, each segment has:
1 pair afferent **Dorsal Root** nerves (soma in Dorsal Ganglia outside cord) that carry sensory info from body to brain
and 1 pair efferent **Ventral Root** nerves (soma in Cord) that carry motor info to muscles and glands
- **Bell-Magendie Law**: Sensory info *IN* via Dorsal Roots, motor info *OUT* via Ventral Roots
  - NOTE: For sense organs and muscles in the head, Cranial Nerves of PNS serve this function
- In Horizontal cross-section can see: - Bone and Meninges (described above) that surround & protect nervous tissue
  - **Grey Matter** = Somas and dendrites, including inter-neurons, in center of Spinal Cord
  - **White Matter** = Mainly myelinated axons, ascending & descending tracts to/from Brain, surround Grey Matter
  - **Central Canal** = Hollow space, runs down center of cord, filled with **Cerebral Spinal Fluid** (CSF)

All of above (Brain & Spinal Cord) = Central Nervous System (**CNS**).

The other major division is of the human Nervous System is…

Peripheral Nervous System (PNS)

PNS has two subdivisions, the Somatic NS (interacts with env) and the Autonomic NS (regulates internal systems)

- **Somatic Nervous System** = 31 pairs Spinal Nerves (included in Dosal & Ventral Roots) & 12 pairs Cranial Nerves
  - Spinal: Sensory mainly from body surface & feedback from skeletal muscles; Motor mainly to skeletal muscles
  - Cranial: Sensory (Vision, Audition, Taste, Smell, Tactile for face) & feedback from some organs (e.g. heart, lungs)
    Motor control of eye movement, facial expression, chew & swallow, speech, neck muscles, some organs
- **Autonomic Nervous System** = Receives sensory input from organs, sends motor output to control them.
  - Motor component has two divisions:
    - **Sympathetic** Nervous System = "**Fight or Flight**" - Prepares body for action by increasing heart-rate, blood pressure, etc.
      - Ganglia are near Spinal Cord, form tightly-knit chain, activity is tightly coordinated
      - Most release NE, a few release ACh (e.g. to sweat glands)
      - Usually reflexive, but an be influenced by higher cognition,
        e.g. if believe in "Voodoo Death", learning of curse can over-stimulate and thus stop heart

    - **Parasympathetic** Nervous System = **"Rest & Digest"** system ("Para"="beyond", cells above/below Sympathetic cells)
      - AKA "Craniosacral System" since of Cranial Nerves (esp #10: **Vagus Nerve**) & Spinal Nerves of sacral (lower) spine
      - Opposite effects from Sympathetic NS; e.g. fosters digestion, sex - All release ACh

  - Both PNS systems always active although in opposite proportions, and their activity is complementary:

		Sympathetic vs.	**Parasympathetic**
Effect on:	Eyes	dilate, inhibit tears	constrict pupils, produce tears
	Heart	pump fast	pump slow
	Bronchi (lungs)	open	constrict
	Salivary glands	inhibit salivation	stimulate salivation
	Stomach, Intestines	halt activity	motility & secretion
	Bladder	hold	empty
	Genitals	hinder sexual arousal (altho req'd for orgasm)	facilitate sexual arousal (erect, lubricate)

  - Plus, Adrenal glands & Sweat glands (activated), Liver (stimulate glucose release), Blood vessels (constricted to inc. blood pressure), Hair follicles (pilo-erection) via Sympathetic system **only**
  - **Parasympathetic Rebound** = after radical Sympathetic response, Parasym system gives strong response
    >> Fainting; Ulcers (if cycle repeated)