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 ft² 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 (VI or Striate) from LGN of Thalamus & some higher visual areas
    - Dived 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 Wernicke’s 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
    - Premotor Cortex, 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
    - Prefrontal 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
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 Dorsal & 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)

- **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 “Craniosaereal System” since uses Cranial Nerves (esp #X, Vagus) and Spinal Nerves from sacral (lower) spine
      - Opposite effects from Sympathetic NS; e.g. fosters digestion, sex
      - Ganglia not near Spinal Cord, but near target organs, activity not as coordinated
      - All release ACh

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

<table>
<thead>
<tr>
<th>Effect on:</th>
<th>Sympathetic</th>
<th>vs.</th>
<th>Parasympathetic</th>
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<tbody>
<tr>
<td>Eyes</td>
<td>dilate, inhibit tears</td>
<td>constrict pupils, produce tears</td>
<td></td>
</tr>
<tr>
<td>Heart</td>
<td>pump fast</td>
<td>pump slow</td>
<td></td>
</tr>
<tr>
<td>Bronchi (lungs)</td>
<td>open</td>
<td>constrict</td>
<td></td>
</tr>
<tr>
<td>Salivary glands</td>
<td>inhibit salivation</td>
<td>stimulate salivation</td>
<td></td>
</tr>
<tr>
<td>Stomach, Intestines</td>
<td>halt activity</td>
<td>motility &amp; secretion</td>
<td></td>
</tr>
<tr>
<td>Bladder</td>
<td>hold</td>
<td>empty</td>
<td></td>
</tr>
<tr>
<td>Genitals</td>
<td>hinder sexual arousal</td>
<td>facilitate sexual arousal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(altho req’d for orgasm)</td>
<td>(erect, lubricate)</td>
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- 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, Parasymp system gives strong response
  
  >> Fainting; Ulcers (if cycle repeated)