Brief Neuroscience Review

Anatomical Terms referring to Orientation/Positioning

Dorsal = toward the top of the brain	**Ventral** = toward the bottom of the brain
Rostral / Anterior = toward the front end	**Caudal / Posterior** = toward the rear end
Superior = above another part	**Inferior** = below another part
Lateral = toward the sides, away from the midline	**Medial** = toward the midline, away from the sides

Brain has three major divisions- Hind, Mid & Forebrain

HINDBRAIN: Medulla, Pons & Cerebellum
- Medulla & Pons, at base of brain, just atop Spinal Cord
  - Control primal reflexes (breathing, coughing, etc) and arousal (orienting reflex, sleep, etc)
- **Cerebellum** = "Little brain", contains >½ brain's neurons
  - Motor Programs, esp for rapid, co-ord'd movements that require precise **timing** and/or **aiming**
    - i.e. "Procedural Memory" for well-practiced moves, simple to complex athletic/manual acts
    - Receives from sensory (visual, acoustic, vestibular for balance, etc) & from/to motor centers
    - Also involved in shifts of attention, and fine-tuning adaptations to changing conditions

MIDBRAIN: **Tectum** (Sensory Colliculi: Superior and Inferior) and **Tegmentum** (Motor pathways)
- **Superior Colliculus** = Processes visual info (esp re: location of stimuli) & integrate w/motor output
  - e.g. "Blindsight" Human w/damage to higher visual areas is "blind" but can point to moving stim.
- **Inferior Colliculus** = Processes auditory info (esp location), & integrate with motor output
  - Together, Colliculi coord their "maps" of motion in vis & auditory world, so thing seen = thing heard
  - NOTE: Midbrain is primary S/M area in more primitive brains, cortical areas dominate in higher mammals

FOREBRAIN: Includes Thalamus, Limbic System, Cerebral Cortex & many other structures
- **Thalamus** = Primary relay for sensory/motor & arousal to/from brain
  - Has separate nuclei (cell clusters) for processing visual (**LGN**), auditory (**MGN**), arousal (etc. info
  - Sits atop Brainstem, Hypothalamus just below it, Midbrain below that, Pons & Medulla at base

- **Limbic System** = AKA "Rhinencephalon" (Nose Brain) Set of structures that form "border" around Brainstem
  - Emotional / Motivational system, evaluates situation, mediates reactions, reinforces learning/memory
  - Includes: **Amygdala** (Emotion, esp anger & fear; Mediates both expression & interpretation of others')
  - **Olfactory Bulb** (Smell receptors; Smells - e.g. of food, mates - often influence motivation & memory)
  - **Cingulate Gyrus** ("Re-entrant" system, monitors cortical/subcortical interactions, evaluates +/- of events)
  - **Hippocampus** - Involved in Memory and Spatial Mapping
    - Damage => Anterograde amnesia, inability to form new memories (ala *Memento, 50 First Dates*)
      - Reciprocal connections to several cortical areas (except primary sensory areas)
    - Also important for **Cognitive Map**: e.g. "Place Cells" fire when rat in diff parts of familiar maze
      - e.g. Active when a Primate is navigating well-learned real or virtual environment
        - Unlike rats, Primates respond as well to looking at a place as to actually being there

- **Cerebral Cortex** = Most recent, outer layer, highly convoluted (folded) in Primates (and Cetaceans)
  - Sulcus/Sulci are the grooves (folded surface, not visible); Gyrus/Gyri are the bulges (visible)
  - **Corpus Callosum** = bundle of fibers connecting the two cortical hemispheres
  - Cortex divided into "Lobes" that specialize in different sensory &/or motor processes
    - In Humans: - **Occipital** (rear): Vision (primary, secondary, color)
      - **Parietal** (Top rear): Somatosensory, Visual-haptic localization, Spatial Maps
      - **Temporal** (sides): Auditory, Language Comprehension, Visual Identification
      - **Frontal**: Motor, Planning, Language Production, Strategy & Self Control
  - Sensory surface (e.g. skin, retina of eye) is "mapped" across its corresponding area of cortex
    - If sensory area has high concentration of receptors for detailed discrimination (e.g. fovea, fingertips) that area is "**magnified**" = mapped onto disproportionately large area of cortex

Sleep – per EEG (measure of brain activity), Stages 1-4 show increasing synchrony of brain activity
- Stages 1 & 2 => "Theta" waves; Stages 3 & 4 => "Delta" waves (deepest, "Slow Wave" sleep)
- Every 90 minutes, Primate moves thru Stages 1,2,3,4,3,2, REM… Typically 5-6 cycles (7.5-9 hours)
- **REM**= Rapid Eye Movement, dreams, highly desynch'd brain activity but atonia (paralyzed)
  - Deprived of REM, will Rebound (i.e. REM more) else anxious, poor conc, hallucinations, death!