Biopsychology

Gross Brain Anatomy Part 2:
Terminology, Structure, Function and Location

CNS: Brain-stem and Brain
Brain

- We have worked our way through the PNS-into spinal cord--meninges and ventricular system
- Now we focus on major brain areas and some of their functions
- A little about cortical organization
Chap. 2

MYELENCEPHALON (MEDULLA)

HINDBRAIN

METENCEPHALON

1. Cerebellum: involved in motor coordination, fine motor movements, and habit learning (ex., riding a bike).
2. Pons: associated with several cranial nerves (especially for hearing), several tracts, and pontine reticular formation.
**Medulla/melencephalon**

- Composed largely of fiber tracts
- Contains the reticular formation – Role in arousal, sleep, attention, movement, muscle tone, cardiac, circulatory, respiratory reflexes (100 or so nuclei)

**Metencephalon**

- Ascending and descending fiber tracts—create the pons on the ventral surface
- Cerebellum on the dorsal surface – Sensorimotor structure, fine motor movement
- Contains as many neurons as both cerebral hemispheres (ipsilateral control unlike the cerebrum)
MIDBRAIN

MESENCEPHALON (MIDBRAIN)

1. **Tectum:**

2. **Tegmentum:**
1. **Thalamus:** dorsal part of diencephalon - important relay of all types of information (vision, hearing, pain, touch, temperature, proprioception) from all over the body (spinal cord) to neocortex.

2. **Hypothalamus:**

**Thalamus:** Many different pairs of nuclei that serve as relays between sensory input to the cortex (Lateral geniculate: visual Medial geniculate: auditory, Ventral posterior nuclei: somatosensory).

**Hypothalamus:** below thalamus: Regulation of motivated behavior: sex, feeding. Regulates the release of hormones into the circulation via the pituitary.
Telencephalon

- Basal Ganglia: voluntary motor responses. Striatum: caudate and putamen, Globus Pallidus. It is the loss of DA to some of these structures that underlie Parkinson's disease.

- Limbic system: circle the thalamus. Hippocampus: learning and memory; 3 layer organization.
- Amygdala (fear): 4 F’s (fleeing, fighting, feeding, foraging).
FOREBRAIN. TELENCEPHALON

BASAL GANGLIA: motor learning, feedback, and control
- Caudate/Putamen (also called Striatum; receives dopaminergic axons from Substantia Nigra)
- Globus Pallidus
- Nucleus Accumbens (ventral striatum; involved in drug addiction and reward mechanisms; Dopamine, endogenous opiates neuropeptides)
**FOREBRAIN. TELENCEPHALON**

**LIMBIC SYSTEM**: involved in emotions, memory, and social behaviors

- **Medial Prefrontal Cortex**: social behaviors, "working" memory, and other "executive" functions.

- **Hippocampus (<L**: Learning and memory, stress.

- **Amygdala (< “almond”):** Aggressiveness, fear, anxiety and other emotions.
Cingulate cortex (limbic cortex)

Temporal lobe

Amygdala

Hippocampus (buried in temporal lobe)
**Cortex**

- 4 lobes named for the skull bones over them:
  - Frontal: planning, working memory
  - Parietal:
    - Precentral gyrus: motor
    - Postcentral gyrus: somatosensory
  - Temporal: auditory
  - Occipital: visual

- Largest division of brain--all complex cognitive functions: voluntary movement, learning, speaking, problem solving

- Convulated cortex: increase surface area--w/o change in volume (wrinkles and IQ?)
The Cerebral Cortex

**Parietal Lobe**
Postcentral gyrus (“primary somatosensory cortex”)

Processes and integrates information about eye, head and body positions from information sent from muscles and joints.

**Temporal Lobe**
Auditory information
Processing spoken language
Some aspects of vision including movement and some emotional and motivational behaviors

**Occipital Lobe**
Posterior
Striate cortex or primary visual cortex
Damage can result in cortical blindness
Primary Cortical Regions

Primary Motor Areas

- Primary motor cortex (precentral gyrus)

Primary Sensory Areas

1. Primary somatosensory cortex (postcentral gyrus)
2. Primary visual cortex
3. Primary auditory cortex
4. Insular (gustatory) cortex
5. Olfactory cortex

- primary sensory areas receive input directly from sense organs
POSSIBLE COMPLEXITIES OF NEUROPHYSIOLOGY

- Each cortical area could be grossly different in its structure and cells.
- Instead, remarkable similarity in the cytoarchitecture between areas.
- Cells could be randomly distributed throughout the hemispheres.
- Instead, consistent separation of white and grey matter.
- Consistent laminar organization.
- Millions of cell types depending on function.
- Instead, only a few main players in all areas.
- Cell function could vary in millions of ways depending on task.
- Instead, only a "few" functional mechanisms that govern all cells.

Grey matter (processing) on outer rind of cortex... how convenient for electrophysiologists.

- All areas of grey matter have 6 layers:
  - 1-3 = "supragranular layer" = local processing
  - 4 = "granular layer" = input from thalamus
  - 5-6 = "infragranular" = output

- All cortical regions begin as "Tabla Rasa", thickness of layers and interconnectivity determined by later processing demands.

The archetypal surface evoked potential 10 msec.
Damage to the posterior association cortex interferes with awareness of one’s body and of the space in which it moves.

**Disrupted INTEGRATION of senses:**
- Normal visual acuity but unable to reach for an object of interest
- Cannot verbally describe visual scene
- Cannot verbally describe touched object

Lesion on one side results in **contralateral neglect**
Prefrontal Cortex:

1. Working memory: memory of the world that persists in the mind in the absence of sensory input - allows for a dissociation between immediate stimulus and immediate response - "auto pilot" allows one to drive a car and hold a conversation simultaneously - slow to develop in children: performance on "Simon says" increases 50% between ages of 4 and 6
Prefrontal Cortex:

1. Working memory
2. Decision making - “executive role”
   - capable of initiating action in the absence of direct sensory input
3. Social context - “social self”
   - concept of right and wrong

Phineas Gage: Ability to plan activities (movements) diminished, Judgment is impaired (right or wrong), Ability to solve novel problems is impaired, Working memory is impaired