

- **Neuroanatomy and Basic Principles:**

- How does the organization of the nervous system (CNS vs. PNS, Hindbrain, Midbrain, Forebrain, Lobes of the Cerebral Cortex, Limbic System, Basal Ganglia, etc.) relate to its functions in behavior and cognition?
- Explain the relationship between the brain and the mind from a monist perspective as presented in the source material. How do the structures and functions described in the lectures provide a "materialist description" of the brain?
- Describe the structure and function of a neuron, including its processes (dendrites, axon, terminals), membrane properties, and key organelles. How does the neuron's selective permeability enable the generation of resting and action potentials?
- How do neurons communicate at the synapse? Explain the process of neurotransmitter release (Exocytosis), binding to receptor sites, and the resulting effects (EPSP, IPSP) on the postsynaptic cell. How is the message terminated?
- What is **summation** (Temporal and Spatial) and why is it critical for neural computation? How can neural messages be modified (e.g., agonists, antagonists, spontaneous activity)?
- How does the concept of **Across-Fiber Coding** apply across different sensory systems (e.g., audition, vision, somatosensation)? Provide examples.

- **Development and Plasticity:**

- Trace the early embryonic development of the nervous system from the ectoderm through the formation of the neural tube.
- Describe the processes of **proliferation, migration, and differentiation** of neurons during development. What role do **Neurotrophins** and the concept of **Synaptic Competition** and **Apoptosis** play in shaping neural circuits?
- Explain the principle "**Cells that Fire Together, Wire Together**" and how correlated activity influences circuit development.
- How does postnatal experience, particularly in infancy, continue to shape brain development and plasticity? Discuss examples like dendritic branching, myelination, and selective adaptation in sensory systems. What distinguishes development from ongoing learning and memory processes in terms of neurogenesis?

- **Sensory Systems (Vision, Audition, Somatosensation, Vestibular):**

- Compare and contrast the mechanisms of **transduction** in the auditory system (Hair Cells, Basilar Membrane) and the visual system (Photoreceptors, Isomerization). What are the key differences in the ions and processes involved?
- Describe the organization of the **Retina**, including the different cell types (Receptors, Bipolars, Ganglions, Interneurons) and their connectivity patterns. How do **Convergence** and **Lateral Inhibition** contribute to processing visual information like sensitivity, acuity, and edge detection?
- Explain the concept of **Receptive Fields** and how they are structured in the visual system (e.g., Center-Surround, Simple, Complex cells). How do different visual cortical areas process specific features like orientation, motion, and spatial frequency?

- Discuss the two main visual processing streams: the **Ventral ("What/Who")** and **Dorsal ("Where/How")** pathways. What types of information do they process, and where are their primary destinations? How do they integrate with other brain areas?
- How is **color** coded in the visual system? Explain the **Trichromatic** and **Color Opponency** theories.
- How is **frequency** coded in the auditory system? Explain **Place Coding** and **Temporal Coding** (including the **Volley Principle**).
- How do the auditory and visual systems use **disparity** between bilateral inputs to process spatial information (localization and depth)?
- Describe the role of the **Vestibular System** (Semi-Circular Canals and Otolith Organs) in detecting movement and maintaining balance. How does it interact with other systems (e.g., visual, motor)?
- What are the different types of **Somatosensory Receptors** (Free Nerve Endings, Encapsulated Nerve Endings) and what kinds of stimuli do they respond to (Temperature, Pain, Touch, Proprioception)?
- Compare and contrast the **Spinal-Thalamic** and **Medial Lemniscal** pathways for somatosensory information. How do nerve fiber properties relate to the speed of transmission in these pathways?
- Describe the organization of the **Somatosensory Cortex (S1)**, including the **Penfield Map** and the **Magnification Factor**.
- **Motor Control:**
 - How do **Muscles** (specifically Striate muscle fibers) contract in response to neural signals? What neurotransmitter is involved at the Neuro-Muscular Junction?
 - Describe the function of different types of **Reflexes** mediated by the Spinal Cord (Stretch, Golgi, Pain Withdrawal, Scratch). What are **Central Pattern Generators**?
 - Compare and contrast the **Cortico-Spinal** and **Ventro-Medial Tracts** in terms of their origin, termination, pattern of crossover, and the types of movements they control.
 - What is the role of the **Cerebellum** in motor control? How does its internal structure (Purkinje Cells, Deep Nuclei) contribute to the timing of movements? How does cerebellar damage affect behavior?
 - Describe the functions of the **Basal Ganglia** in organizing and selecting movements. How is this system implicated in conditions like Parkinson's Disease and Obsessive-Compulsive Disorder?
 - Explain the organization and roles of the different areas of **Motor Cortex** (Primary, Premotor, Supplementary), including concepts like the Mirror Cell System.
- **Emotion:**
 - Summarize the major **Theories of Emotion** (James-Lange, Cannon-Bard, Schacter-Singer) and the evidence supporting aspects of each. How do these theories differ in the proposed relationship between physiological arousal, cognitive appraisal, and the subjective experience of emotion?
 - Describe the role of the **Amygdala** in processing emotional stimuli, particularly fear and aggression. How is it involved in the **Startle Reflex** and **Conditioned Fear**?
 - How does the Amygdala interact with other brain regions, such as the **Frontal Cortex** and **Hippocampus**, in emotional processing and memory formation?

- Discuss the impact of damage to the **Amygdala** (e.g., Urbach-Wiethe Disease) and the **Prefrontal Cortex** (e.g., Phineas Gage) on emotional behavior and social functioning.
- How do specific **Neurotransmitters** (Serotonin, GABA, CCK) influence emotional states like anxiety, aggression, and mood?
- **Arousal and Sleep:**
 - Identify the main brain systems involved in maintaining **Arousal** (Reticular Formation, Locus Coeruleus, Basal Forebrain) and the neurotransmitters they use.
 - Describe the different stages of sleep (**Wakefulness, Sleep 1-4, REM**) based on **EEG** patterns (Frequency and Voltage) and associated physiological characteristics.
 - Explain the concept of **Neural Synchronization** vs. **De-synchronization** as reflected in EEG patterns.
 - Discuss the features of **REM sleep** that make it "Paradoxical". What is **Atonia** and what brain areas are involved in causing it?
 - Outline the progression through a typical **90-minute sleep cycle** and how the duration of different stages changes throughout the night.
 - Discuss the consequences of sleep and REM deprivation.
 - Identify key brain areas (Hypothalamic nuclei, Pons, Raphe Nuclei) and neurotransmitters (GABA, Histamine, ACh, Serotonin, Orexin) involved in the neural control of sleep stages. Explain the **PGO Wave** and its role in initiating REM.
 - Describe the interplay between the **Suprachiasmatic Nucleus (SCN)** of the Hypothalamus and the **Pineal Gland** in regulating **Circadian Rhythms**. What is a **Zeitgeber** and how does light influence this system (Retino-Hypothalamic Path)?
- **Sexual Development and Behavior:**
 - Explain the difference between **Organizing Effects** and **Activating Effects** of hormones.
 - Describe the crucial role of **Testosterone** (or its absence) during a critical fetal period in the development of **sexual anatomy**. Discuss the roles of the Wolffian and Mullerian ducts, the Testis-Determining Factor (TDF), and Anti-Mullerian Hormone. What happens in cases of Androgen Insensitivity or exposure of an XX fetus to Testosterone?
 - How do hormones influence the development of **secondary sexual characteristics** at adolescence, including the roles of GnRH, LH, and FSH from the Hypothalamus and Anterior Pituitary?
 - Discuss the concept of **Sexual Dimorphisms** in the brain, including the **Sexually Dimorphic Nucleus (SDN)** and INAH3. How is early Testosterone involved in the development of areas like the Medial Preoptic Area (MPOA) and Ventro-Medial Hypothalamus (VMH)?
 - Outline the key neural circuits involved in the **activating effects** of hormones on sexual behavior in males and females, including the roles of the MPOA, VMH, VTA, Nucleus Accumbens, and Basal Ganglia.
 - Describe the role of **Pheromones** and the **Vomerolnasal Organ (VNO)** in mediating sexual behavior, particularly in mammals, and the evidence for their influence in humans.
- **Learning and Memory:**
 - Define **Learning** and **Memory** as presented in the sources.

- Explain the concept of **Hebbian Cell Assemblies** and the principle "**Fire Together: Wire Together**" as the fundamental neural basis of learning. What cellular mechanisms (e.g., NT changes, structural changes) are responsible?
- Describe the process of **Long-Term Potentiation (LTP)**, focusing on the role of **AMPA** and **NMDA** receptors and calcium influx in the hippocampus. How does this relate to structural changes at the synapse (e.g., dendritic spines, receptor changes)?
- Compare and contrast different types of memory (**Spatial, Procedural, Declarative - Episodic and Semantic**) and the brain areas primarily associated with them (Hippocampus, Cerebellum, Striatum, Thalamus, Cortex).
- Discuss the role of the **Hippocampus** in spatial memory (Cognitive Map, Place Cells) and in consolidating **Declarative Memories**. What evidence supports this role (e.g., animal studies, H.M.)?
- Explain the findings from the **Gambling Task** study and what they suggest about the roles of the Amygdala and Prefrontal Cortex in decision-making related to potential gains and losses.
- How does **emotion facilitate memory formation**? Which brain structure (Amygdala) plays a critical role in the consolidation of emotional memories?
- **Language and Lateralization:**
 - Define **Lateralization** and discuss how the **Wada Test** is used to determine hemispheric dominance.
 - Describe the typical pattern of **lateralization** for language, visio-spatial tasks, and socio-emotional processes.
 - Explain the functions of **Broca's Area** and **Wernicke's Area** and the language deficits (Aphasias) that result from damage to each. Use terms like **Agrammatism, Anomia, Fluent/Nonfluent speech, Comprehension deficits**.
 - What is the role of the **Arcuate Fasciculus** and what happens when it is damaged (Conduction Aphasia)? How does this relate to the concept of a **Phonological Loop**?
 - Discuss the specializations of the **Right Hemisphere**, including global pattern recognition, narrative organization, music perception, spatial abilities, and socio-emotional expression/perception.
 - How do studies of **Split-Brain Patients** reveal the distinct capabilities and limitations of each hemisphere when communication between them is severed?
 - Acknowledge that **both hemispheres and multiple cortical and sub-cortical areas participate in language**.