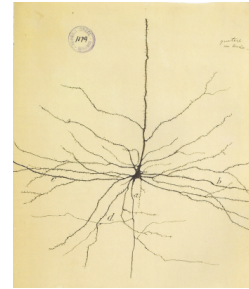


# The Human Brain - Structure and Function

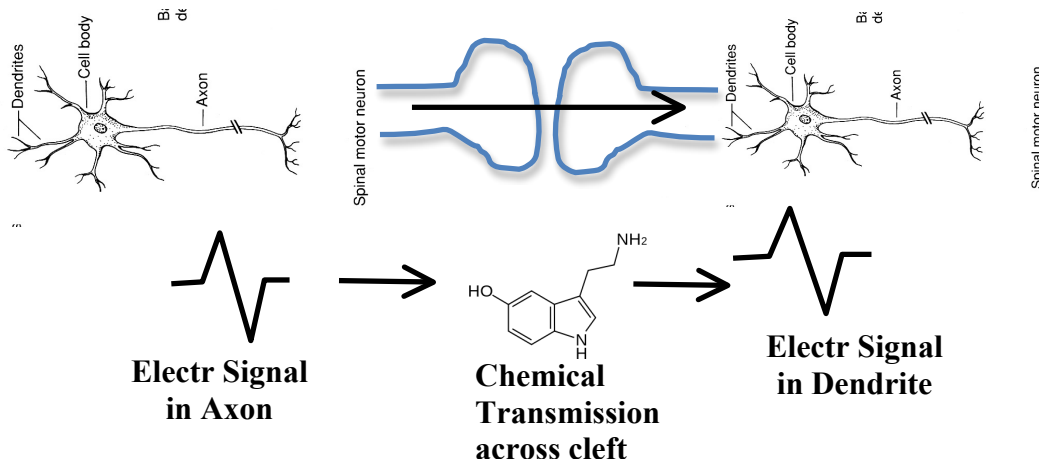
## Lessons from History

Paul Broca (1824 – 1880) demonstrates that highly localized brain (damage) correlated with specific cognitive dysfunctions for the Injuries to a small area in the frontal lobe of the cortex on the left only resulted in speech impairment. Korbinian Brodmann (1868- defines 52 discrete cortical areas exclusively based on regional in appearance that also corresponded to specific functions. Camillo Santiago Ramon y Cajal establish today's fine anatomy of nervous identifying principal cell types, i.e. neurons and glia cells, and the innervation pattern typical for the entire nervous system. With advanced imaging technologies, these findings were corroborated in the living brain.

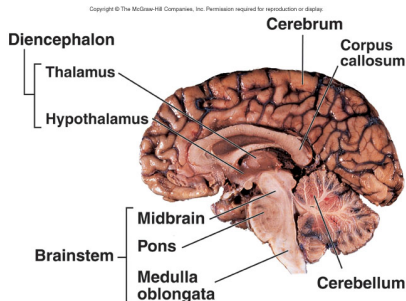


lesions patient. hemisphere 1918) differences Golgi and system fundamental today's

1. The brain processes complex task in rather small, highly localized areas (Broca and Broadman).
2. Neurons connect among each other through long processes.
3. DENDRITES receive information form other neurons.
4. AXONS deliver information to other neurons.
5. Neurons pass electrical signals
6. A synapses is the connection between the axon of one neurons (providing information) and a dendrite of another neurons (receiving information)
7. Each dendrite receives input from hundred of other neurons through a specialized structure – SPINES.

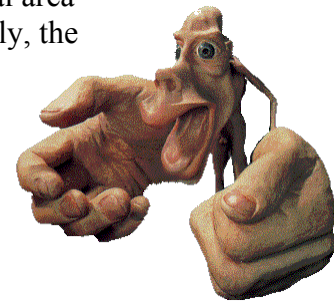


## The Cerebrum



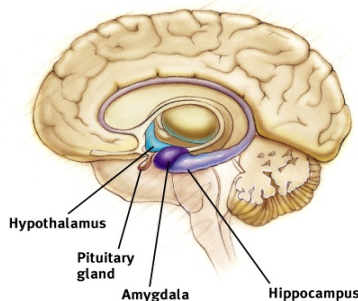
The Cerebrum is the largest and “newest” part of the human brain and is made up of the cortex. Major regions of the cortex are responsible for the processing of our sensations, how we receive the world. The **Frontal Lobe** is implicated in motor control, complex thoughts, associations, and social thinking. The **Parietal Lobe** is key for all our perceptions. The **Occipital Lobe** processes all visual input, the **Temporal Lobe** processes both auditory (hearing) and olfactory (smell) input.

The Homunculus is the somatotopic organization of our brain. The size of each cortical area need to process a sensation and the degree of skill are represented in proportion. Clearly, the enormous dexterity of hour hands are occupying a vastly larger cortical area compared to our legs.



## The Limbic System

This system is composed of the Hypothalamus, Pituitary gland, the amygdala, and the hippocampus. These structures are necessary for basic survival functions as well as emotions (fear) and account to as some of the most primitive part of our brain. Notably, all sensory information is processed at least partially in our limbic system. Therefore, the notion of objectivity is compromised. Humans are unable to receive sensory input or stimuli from the surrounding world without instantaneously associating emotions.



## The Hippocampus

This relative small structure of the limbic system is absolutely vital for learning and memory in all mammals. This brain regions has a highly complex innervation patters and takes on the shape of a “sea horse”, i.e. hippocampus. Learning and memory formation parallels the continuous restructuring and adding or new connections involving SPINES. Spine morphology is very dynamic in response to stimuli whether those are beneficial or detrimental. Many adverse stimuli (alcohol, additive drugs) including chronic stress have devastating consequences for spine formation and dynamics and reflect cognitive dysfunction or even failure.

