**INTRO TO BRAIN SCIENCE**-

1. BRAIN V/S MIND-The brain is a tangible, biological structure while the mind is an abstract concept that encompasses the various mental processes that the brain carries out. Brain is a physical organ in the body that is responsible for controlling bodily functions and processing sensory information. The mind, on the other hand, refers to the collection of cognitive and mental processes that take place in the brain, including consciousness, perception, memory, thought, and emotion.

2.FUNCTIONAL LOCALIZATION- It is the idea that specific functions in the brain are associated with specific regions or areas. This concept is based on the idea that different parts of the brain are specialized for different tasks or functions. For example, the primary visual cortex in the occipital lobe is responsible for processing visual information, while the prefrontal cortex is involved in activities like decision making and planning.

3.SUBCORTICAL REGIONS- Subcortical regions are areas of the brain that are located beneath the cerebral cortex, which is the outermost layer of the brain. These regions include the thalamus, hypothalamus, basal ganglia, and brainstem. These are evolutionarily the oldest structures in the brain.

4.NEURONS-Neurons are specialized cells that transmit electrical and chemical signals in the nervous system. The human brain has around 86 billion neurons. On changing the conductance its membrane, the neuron reacts with a voltage deflection which is called an action potential. An action potential is the currency of information processing in the brain. Neural connections, also known as synapses, are the points of communication between neurons in the nervous system. When an action potential reaches the end of an axon, it triggers the release of chemical messengers called neurotransmitters into the synapse, which then bind to receptors on the dendrites or cell body of the receiving neuron. This results in the generation of a new electrical signal in the receiving neuron, which can then be transmitted to other neurons in the circuit.

There are two main types of neural connections: chemical synapses and electrical synapses. Chemical synapses are the most common type of synapse, where neurotransmitters are released into the synapse to signal the next neuron in the circuit.However, electrical synapses allow electrical signals to pass directly between neurons through gap junctions.

Dales's dogma- Dale's dogma states that a neuron is capable of releasing only one neurotransmitter, either excitatory or inhibitory.

5.CONNECTIVITY IN THE BRAIN- The brain organizes in 6 layers, which have a very specific inter-layer connectivity. Within a layer, the chances of two neurons connecting decreases with their distance. But neurons do form patchy connections over long distances. These connections are what make the barin complex, not the number of neurons. The brain can be thought of as a networks of networks, wherein all the networks have their own connectivity rules.

**HUMAN PSYCHOPHYSICS**-

Psychophysics is a branch of psychology that studies the relationship between physical stimuli and the sensory experience they produce. It explains how physical stimuli are perceived by the human brain, and how subjective experience relates to objective physical properties. Psychophysics is concerned with the measurement of sensory perception, including the thresholds at which stimuli can be detected (absolute threshold) and the smallest difference between stimuli that can be detected (just noticeable difference).

Weber-Fechner law- the law states that the perceived magnitude of a stimulus is proportional to the logarithm of the ratio of the physical intensity of the stimulus to a reference intensity. This means that as the physical intensity of a stimulus increases, the change required to produce a noticeable difference in perception also increases.

BEHAVIOUR READOUTS- It is important to read behaviour in order to know- the strategy behind the behaviour, the types and quality of memory, the perception of sensory stimuli, and to connect the known information to neural activity. Behavioral readout refers to the measurement and analysis of observable beh aviors, actions, and responses in order to gain insight into an individual's thoughts, emotions, or mental processes.

1.Behavioral readout of decision-making -The two alternative forced choice task (2AFC)-is a type of psychophysical test used to measure sensory discrimination ability. It involves presenting two stimuli to a participant and asking them to choose which one is different or which one matches a reference stimulus.

2.Behavioral readout of learning/memory- The Morris water maze is a behavioral test used in neuroscience research to study spatial learning and memory in rodents. The test is considered a valuable tool for studying the hippocampus, a brain region that is responsible for spatial navigation and memory.

3.Behavioral readout of fear- Responses to fear in natural environment are used to analyse the reactions to fear-generating stimuli in a lab,e.g mice freeze in times of danger.

**LIVE IN LAB-**

Various methods are used to study the activities taking place in the dorsal cortex when animals are making decisions. Some of them are as follows-

1. EPHYS recording- Neuropixel system are used to measure ephys recordings, while also recording the movement of the animal from above.

2. Wide field imaging- is a technique used in microscopy to capture images of large areas or entire specimens with high spatial resolution. The technique involves using a low magnification objective lens to capture images of a large field of view, which can then be stitched together to create a high-resolution image of the entire specimen. wide field imaging has the ability to image large areas of the brain, such as the entire cortex or a whole hemisphere, in a single experiment. This allows neuroscientists to study the organization of neural circuits and the functional interactions between different brain regions.

**BRAIN SIGNALS: SPIKING ACTIVITY-**

1.Action potential- Action potentials arise due to differential distribution of ions on the two sides of the membrane, which creates a potential across the membrane. This potential on achieving a certain threshold allows for the influx of Na+ ions and the efflux of K+ ions, which creates the action potential.Between any two action potentials, there is a time delay.

2.Recording the spikes- Certain neuronal properties are used to record spikes-

1.To record a spike, the action potential threshold must be reached.

2.Voltage gated channels are the basis of spikes.

3.Each neuron has a maximum firing frequency.

4.There are leaky channels in the membrane.

Studying spiking activity can help us understand the functions of neurons, the plasticity of the neural network, the effects of drugs on neurons and the effect of neuronal manipulations on its activity.

3.Connection- Neurons can be connected in the following ways- 1.Forward excitation

2.Feedforward inhibition

3.Feedback inhibition

4.Feedback excitation .

.