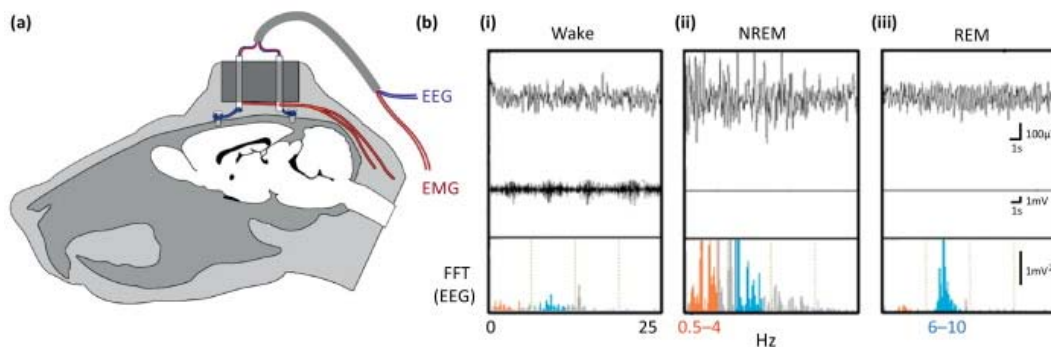


Sélection Internationale

Biology as the Secondary discipline. July 2013.

- 1.- What is an electrical synapse? What kind of molecules support this function? Which are their properties? (1.5p)
- 2.- What is a metabotropic receptor? How can they ensure signal transmission? (1p)
- 3.- Formulate the Nernst equation (1p)
- 4.- Why a biological membrane is a capacitor and what are the physiological consequences of it in neurons. (1p)
- 5.- Compare the function of a bursting neuron and a tonic neuron. What ion channels underlie these different types of firing? (2p)
- 6.- Enumerate the different types of glutamate receptors (1p).
- 7.- Describe the structure and function of the myelin (1.5p)
- 8.- In which part of the encephalon is the cerebellum? How is its overall organization? Which are its inputs and outputs? Which is the function of the cerebellum? (2.5p)
- 9.- Sleep bioassay system for rodents.

To monitor electroencephalogram (EEG) signals, stainless steel screws are implanted epidurally over the frontal cortical area and the parietal area of one hemisphere. In addition, electromyogram (EMG) activity is monitored via teflon-coated wires bilaterally placed into both trapezius muscles.



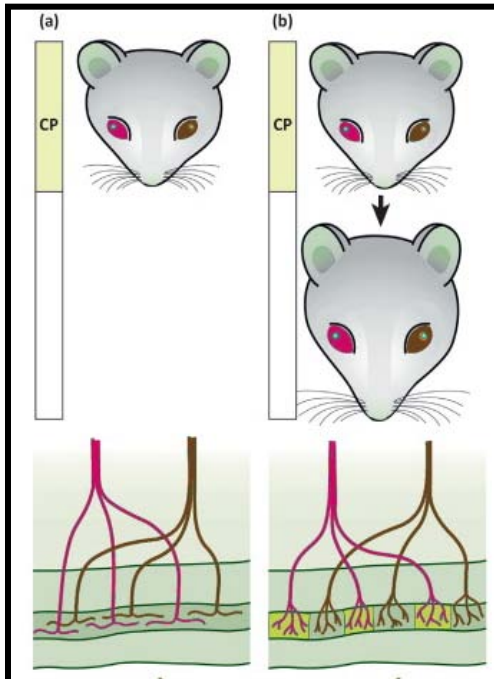
Describe EEG and EMG activities during the different phases: wake, no-REM sleep (NREM), REM sleep (1.5p)

Which is the origin of the signals measured in the EEG? (1.5p)

Why performing the spectral power analysis of the fast Fourier transformation (FFT) of the EEG? (1p)

Which is the origin of these rhythmic activities? (1p)

10.- The primary visual cortex as an example of experience-dependent plasticity.



(a) Soon after eye-opening, inputs that mediate visual information from the left (brown) and right eye (red) diffusely innervate the entire layer IV of the primary visual cortex.

(b) During the postnatal critical period (CP), activity-dependent competition leads to the segregation of inputs from either eye into eye-specific regions, the ocular dominance (OD) columns. As a consequence, at the end of critical period, cortical neurons within a single column in layer IV receive innervation predominantly from a single eye. This segregation requires vision-induced neuronal activity such that axonal branches from one eye withdraw from the regions initially dominated by the other eye and elaborate connections in their own territory. It should be noted that the OD columns cannot be detected in the primary visual cortex as visible structures, even though they are differentially colored in the figure for the sake of clarity.

What kind of experimental manipulations can be performed to study the critical period for ocular dominance? (1.5p)

How to measure cortical connectivity? (2p)