



The Scripps Research Institute

Animal Core Facility

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“LET’S TALK ABOUT SLEEP”

WHAT IS THE SLEEP ?



Sleep is a complex biological process that typically happens for several hours every night, in which the eyes are closed, the postural muscles relax, the activity of the brain changes, and consciousness of the surroundings is practically suspended.

WHY DO WE SLEEP?

Ancient Theories About Sleep

- In ancient Greece it was believed that there were two gods related to sleep: **Hypnos** who induced sleep in gods and humans and his son **Morpheus** who caused dreams while they slept.
- A Greek physician named **Alcmaeon** said that sleep was a spell of unconsciousness brought on by the lack of circulation to the brain.
- While **Aristotle** thought that sleep was due to the reduction of consciousness in the heart, which, at the time, was thought to be the place for sense and sensibility.



It was not until the 20th century when

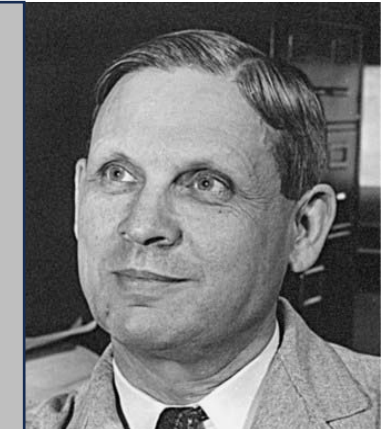


- In 1911, Henri Piéron found that sleep-deprived animals secreted a sleep-inducing molecule into the cerebrospinal fluid which could make alert dogs fall into a deep sleep when injected into them. This was termed 'hypnotoxin'.

- In 1916, Constantin von Economo, studied patients with encephalitis who displayed sleep abnormalities and identified the region of the brain called the hypothalamus as the center of sleep and wake activity.



- By 1925, Nathaniel Kleitman, discovered the existence of rapid eye movement (REM) sleep and went on to study sleep and wakefulness.

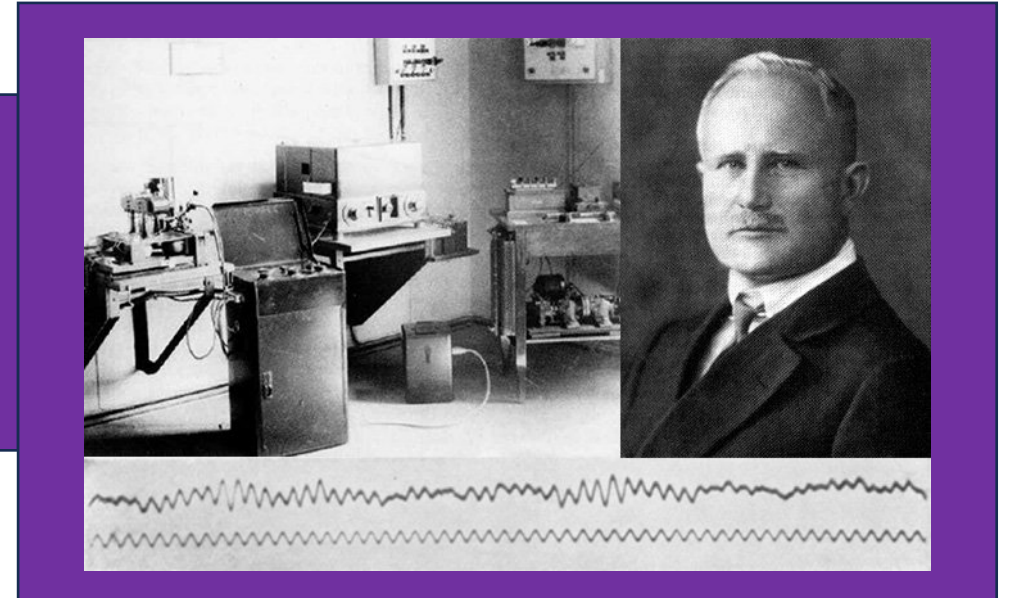


WHY DO WE SLEEP?

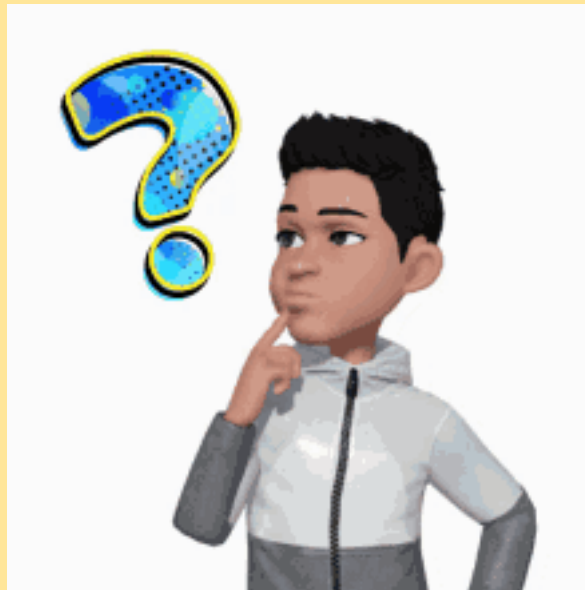
- **Energy conservation and storage.** During the day, cells throughout your body use stockpiled resources to keep doing their jobs. While you are asleep, your body uses less energy. That lets those cells resupply and stock up for the next day.
- **Self-repair and recovery.** Being less active makes it easier for your body to heal injuries and repair issues that happened while you were awake.
- **Regulation of emotions, and body functions.** Sleep deprivations causes irritability, anxiety, depression. Moreover, during sleep deprivation, either total or chronic partial, significant decremental effects on physiology are observed, e.g., decreased immune function, decreased glucose tolerance, decreased cognitive and memory functions, decreased motor skills, and increased sleepiness and fatigue.
- **To survive.** In a classic series of studies, Rechtschaffen (1989) and colleagues demonstrated that sleep deprivation in rats produces a consistent behavioral and physiological syndrome leading to death within 2–3 weeks.

How do we study Sleep?

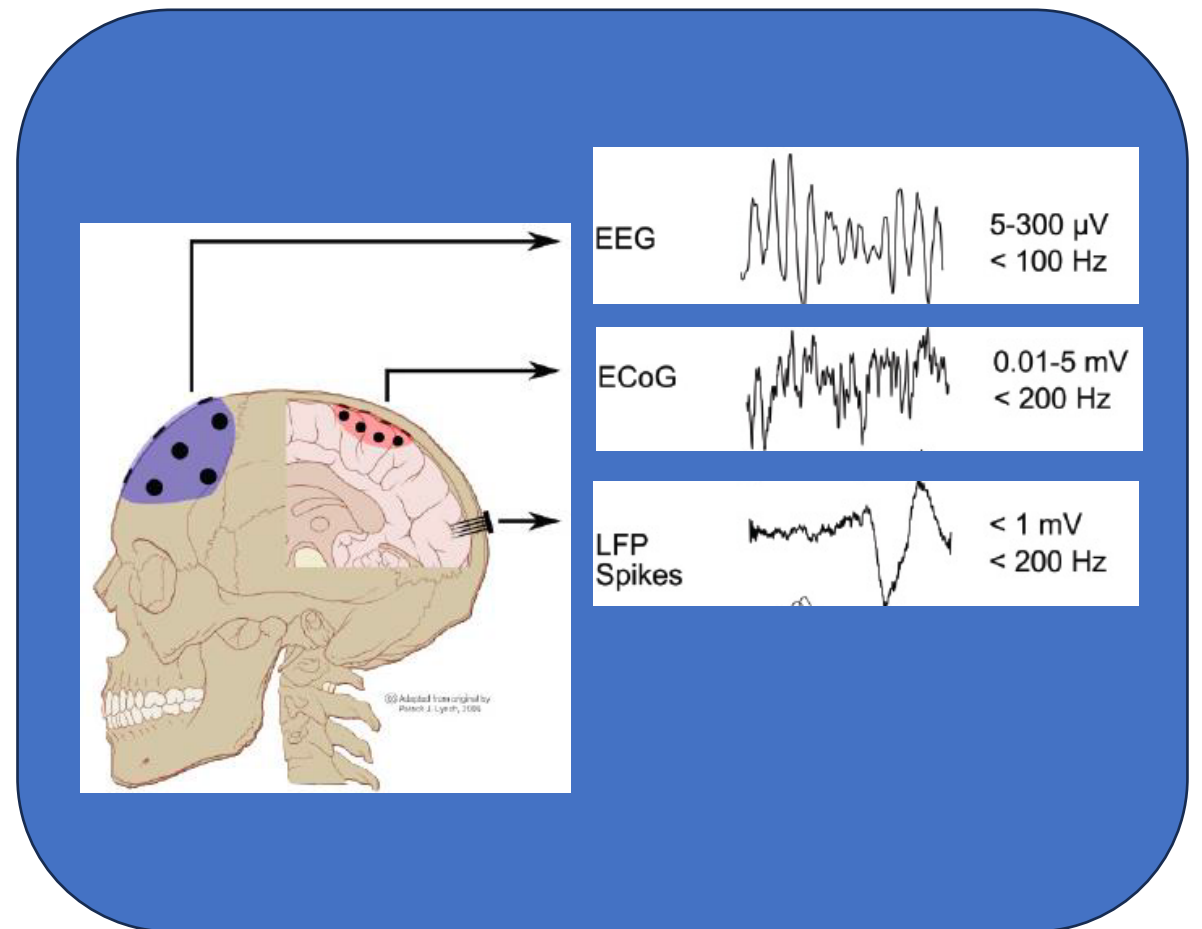
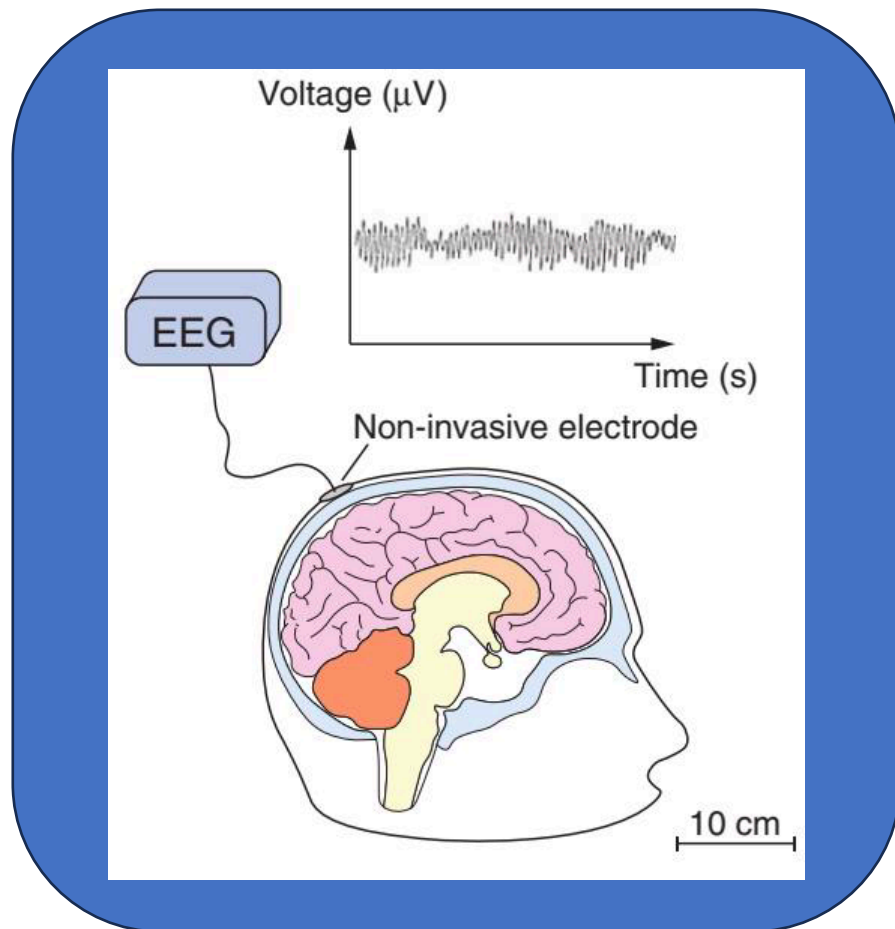
- ❖ In 1924, the German psychiatrist **Hans Berger** invented the **electroencephalogram** (EEG), and the differing brain electrical waves during sleep and wakefulness were discovered.



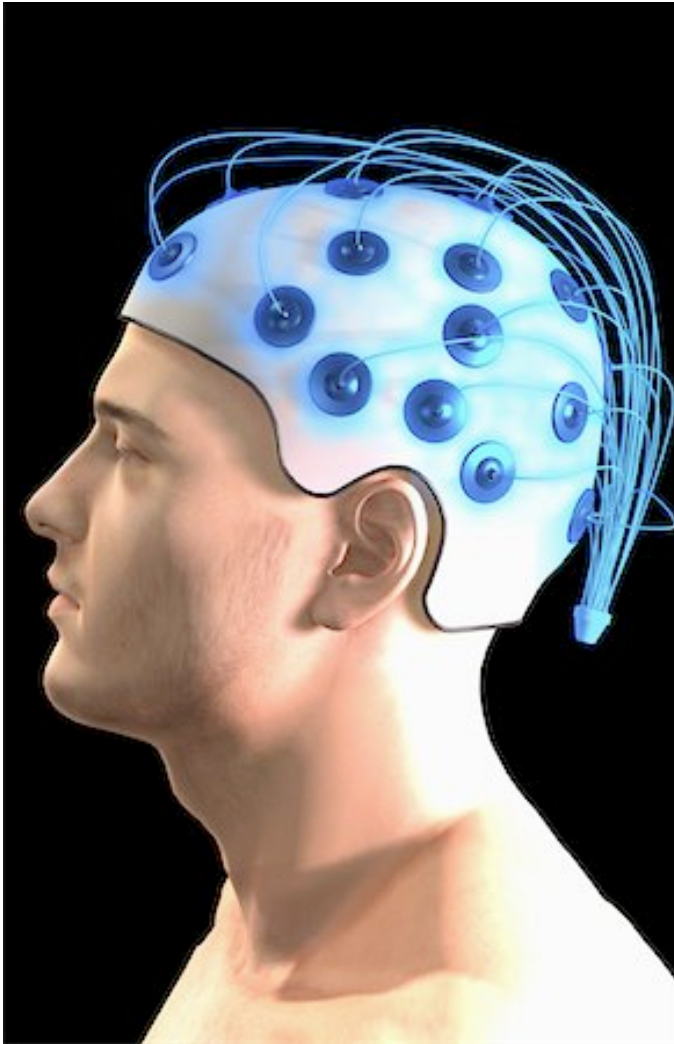
What is
EEG?



The EEG is an imaging technique that records scalp electrical activity (voltage) generated by brain structures across time.



Brain Waves (EEG Tracings)

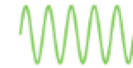


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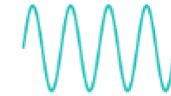
gamma (30–90 Hz)



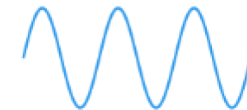
beta (15–30 Hz)



alpha (10–15 Hz)



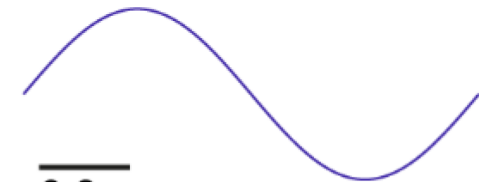
theta (4–10 Hz)



delta (1–4 Hz)

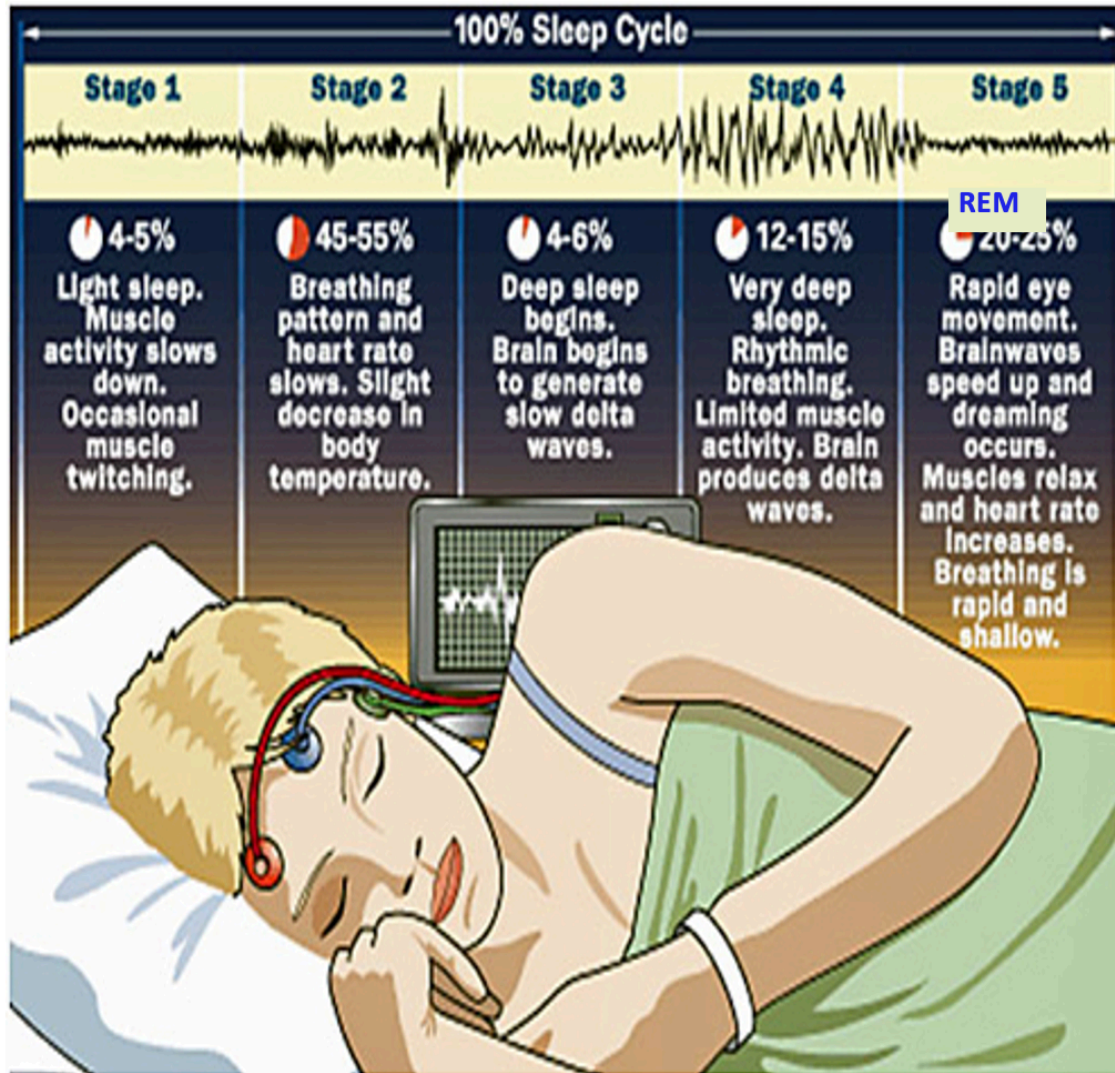


slow (<1 Hz)



0.2 s

Does brain activity change when we sleep?



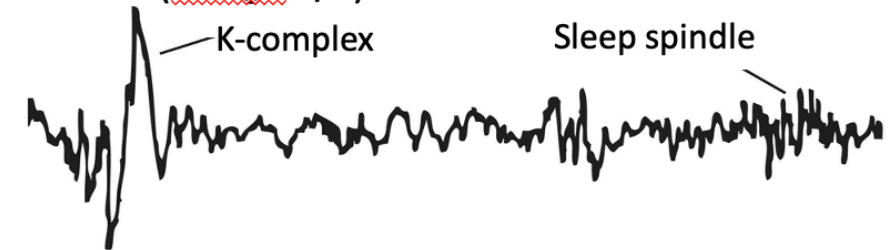
Wakefulness



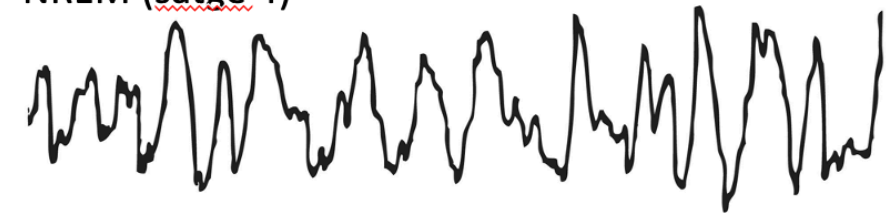
NREM (stage 1)



NREM (stage 2/3)



NREM (stage 4)



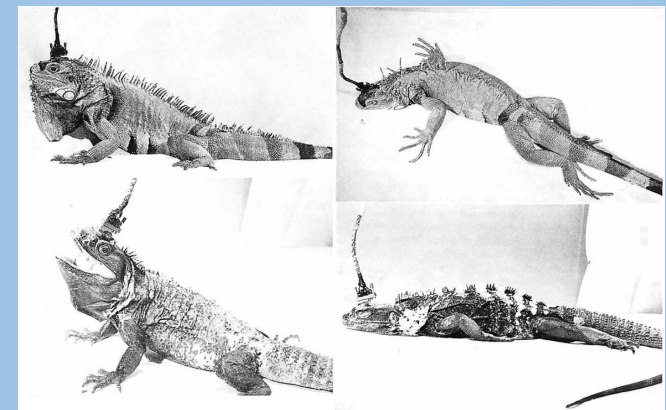
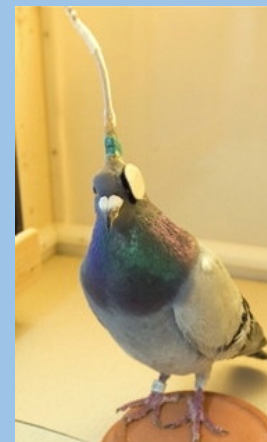
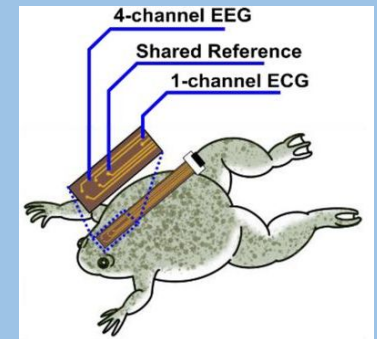
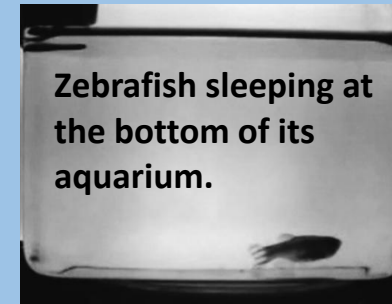
REM



50 μ V | 1 sec

Do All Animals Sleep?

- The phenomenon of sleep is not confined to humans. All mammals and birds, as well as in most (but not all) reptiles, amphibians, fish and even insects regularly undergo something which may be described as sleep, although sometimes this may be a profoundly different phenomenon from our usual conception of it.
- It is generally thought that sleep in some form exists across the animal kingdom, although not all scientists agree (this partly depends on the definition of sleep used). It is certainly true that sleep patterns, habits, postures, and locations vary greatly among different species.



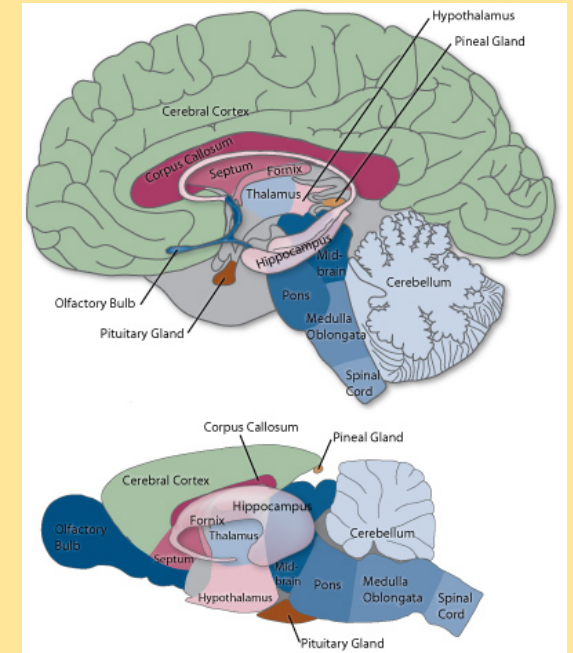
What model system would be appropriate to study a sleep-like state and its regulation?

The candidate species should be:

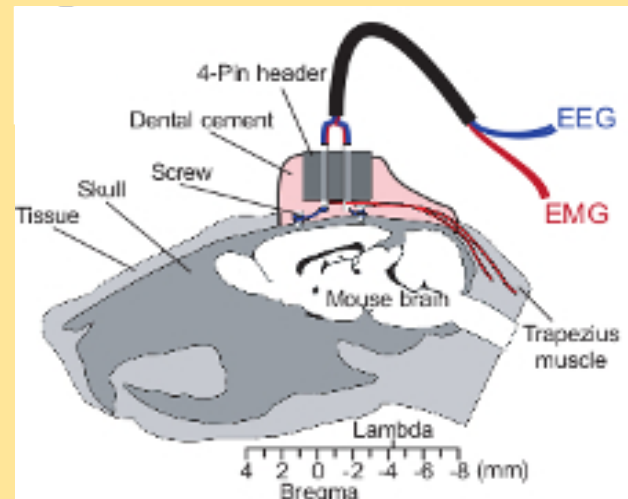
- 1.- A common, inexpensive.
- 2.- Plentiful animal.
- 3.- To have enough information about their molecular genetics.
- 4.- An accessible central nervous system with anatomical analogies to the mammalian system.



Human brain



Rat or mouse brain





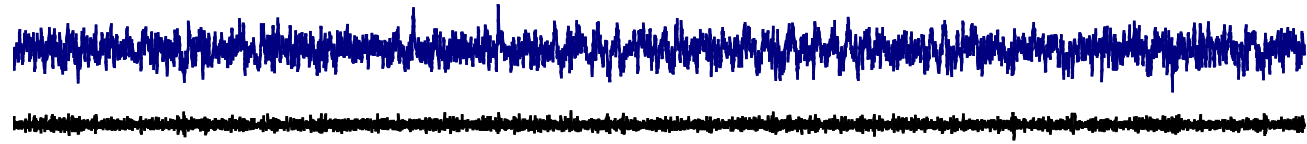
Scripps
Research



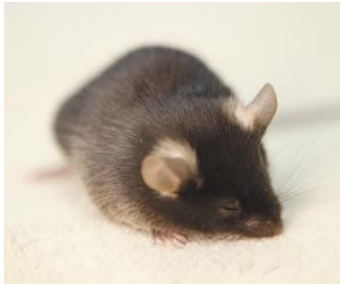
Behavioral, electrophysiological patterns, and neuronal regulation of Sleep in Mice.



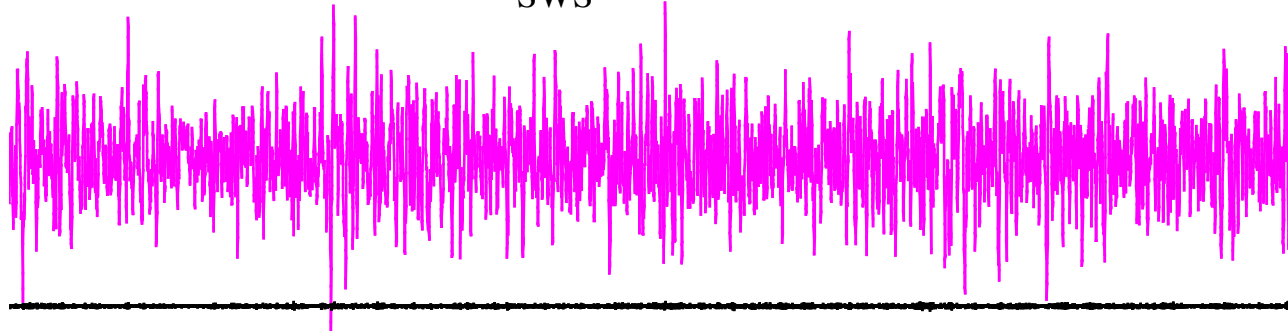
Wakefulness



EEG
EMG



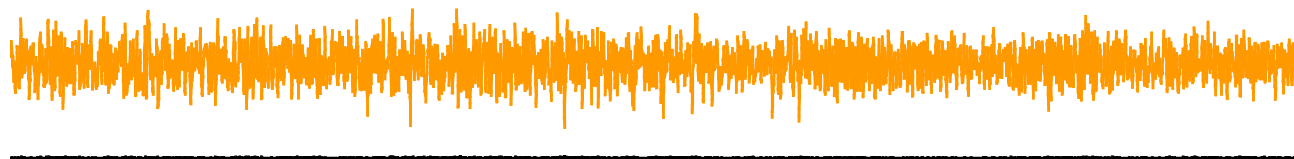
SWS



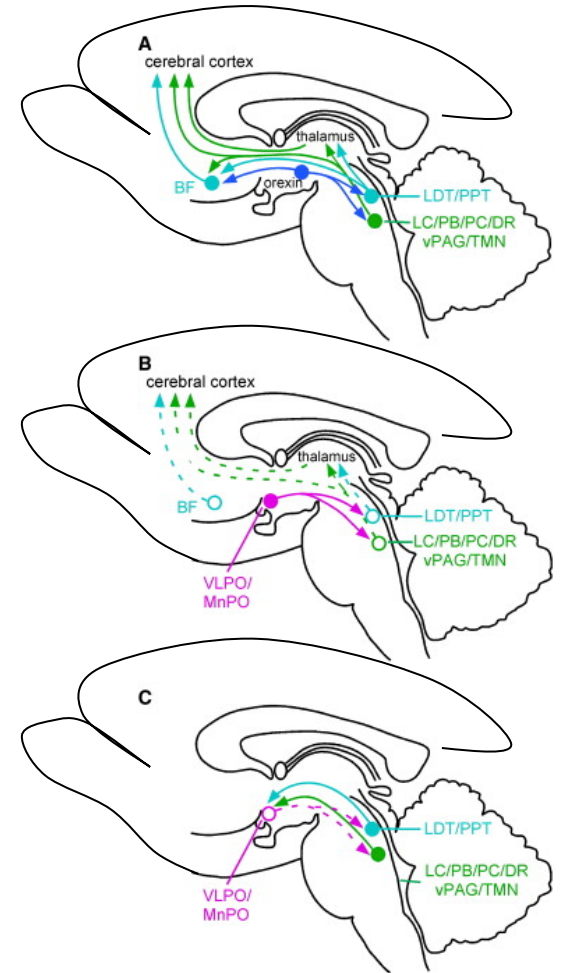
EEG
EMG



REM sleep



EEG
EMG

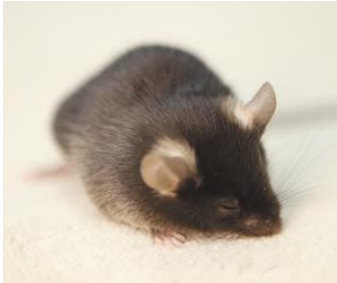


EEG Power Density

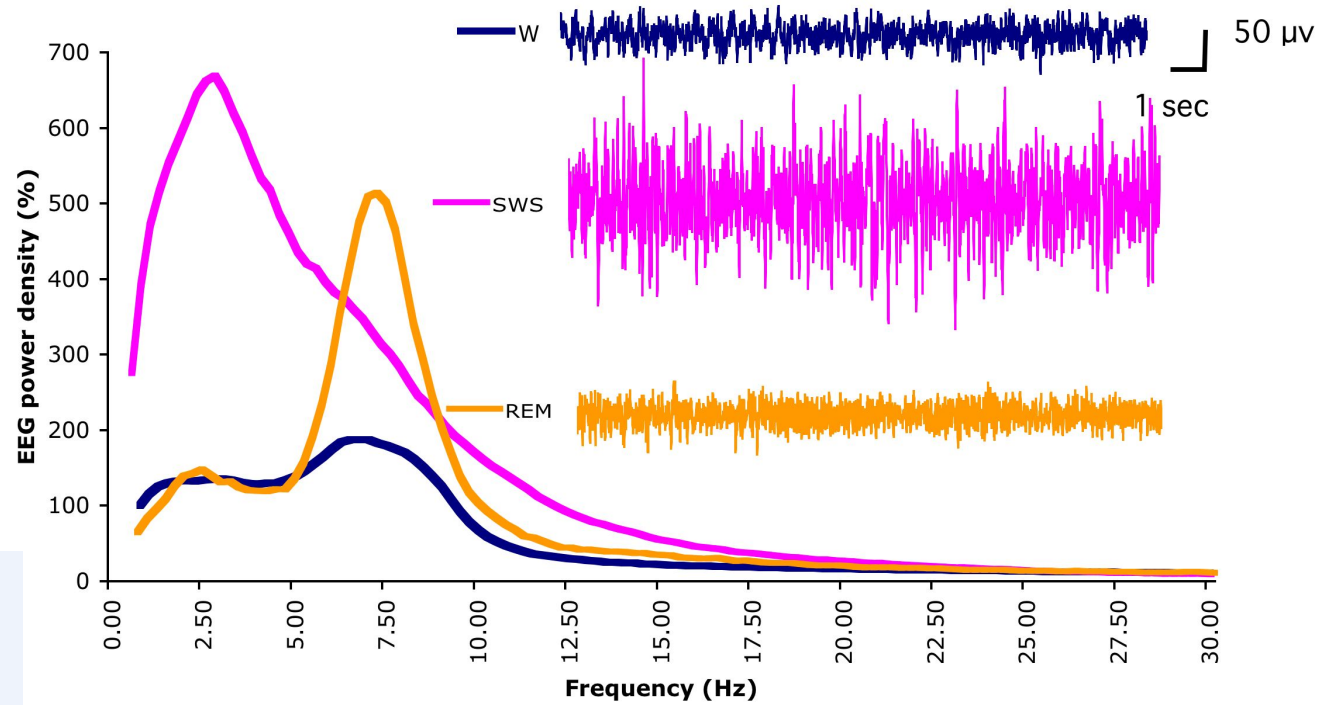
W



SWS



REM



Myths About Sleep

❖ Never wake up a sleepwalker.

The common claim is that if you wake a sleepwalker, they might have a heart attack or even die. This is not true

❖ Your brain shuts down during sleep.

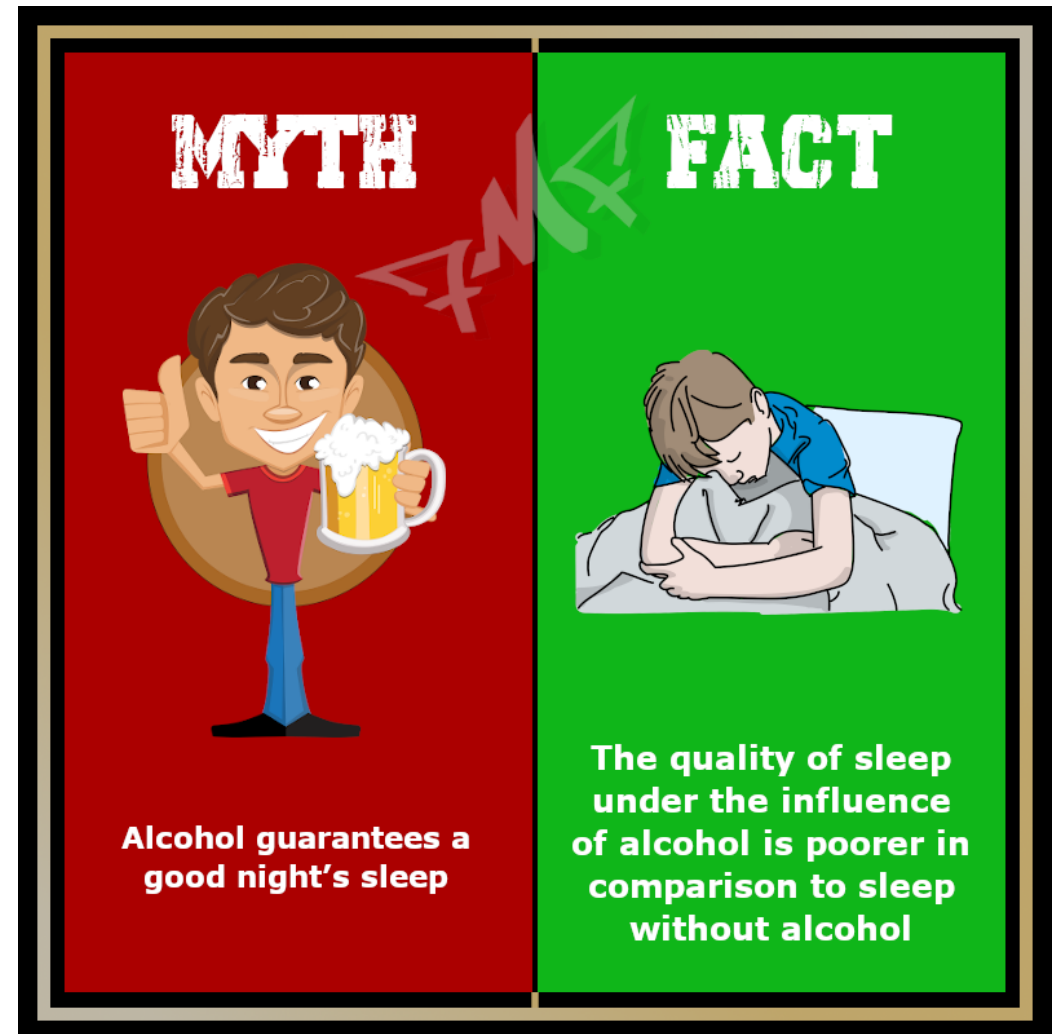
While we sleep, our brain shows specific brain wave patterns and neuronal activity.

❖ If you remember your dream, you slept well.

Most people dream every night, yet we often don't remember them.

❖ Alcohol guarantees a good night's sleep.

This is not the case. The quality of sleep under the influence of alcohol is poorer in comparison to sleep without alcohol.



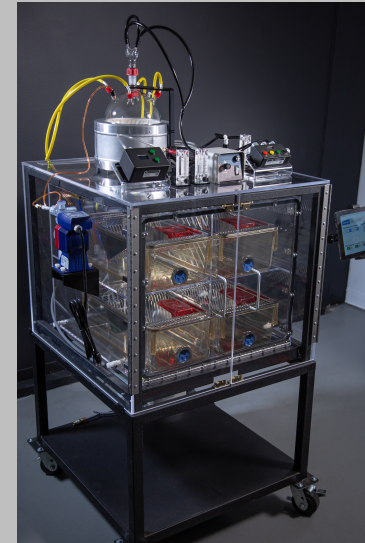
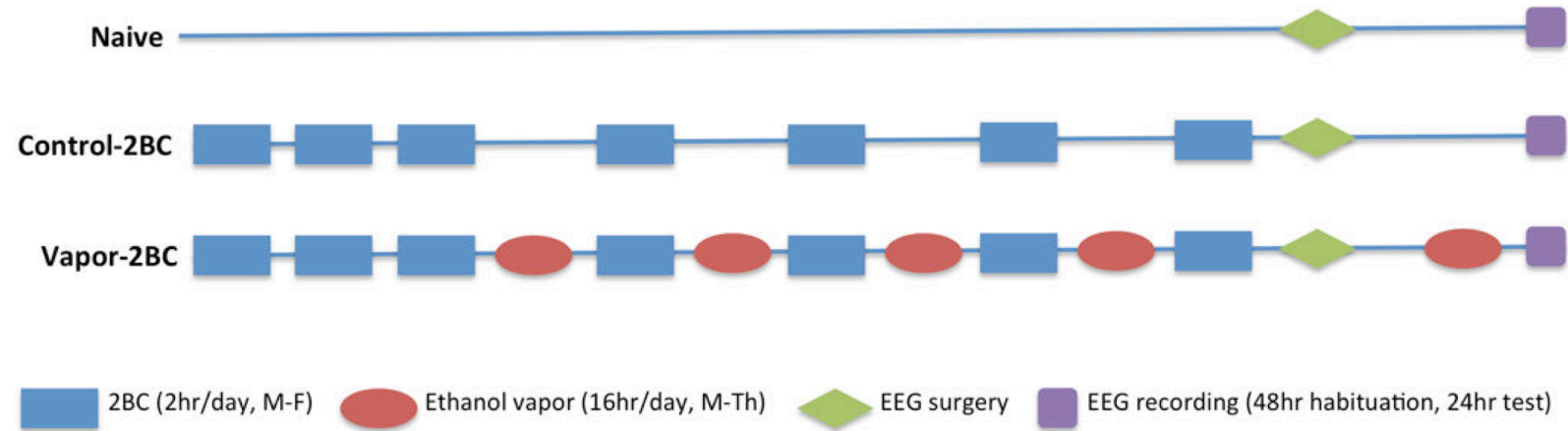
In Summary

- ❖ Sleep is not a passive phenomenon.
- ❖ Different brain waves characterize wakefulness, slow-wave sleep, and REM sleep.
- ❖ Different brain nuclei and neurotransmitters are related to triggering and maintaining sleep.
- ❖ Rodents are a good animal model to study the mechanisms related to sleep and wakefulness.

Chronic Intermittent Ethanol Exposure Protocol

Huitron-Resendiz et al. 2018

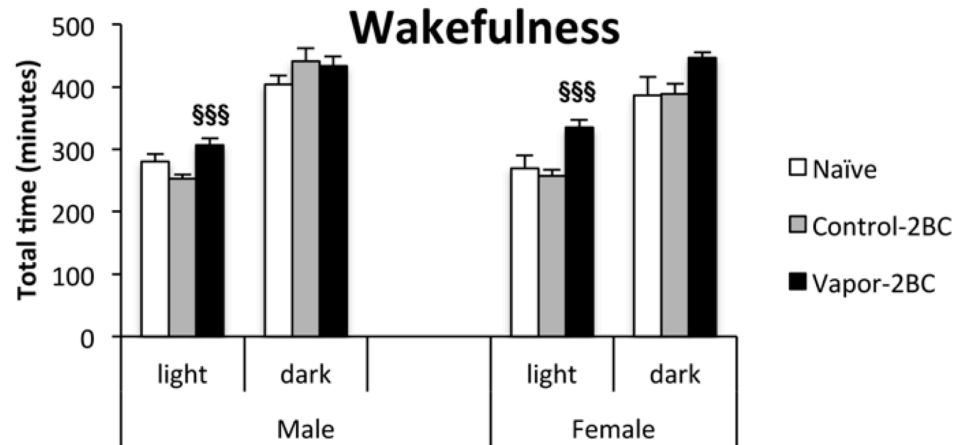
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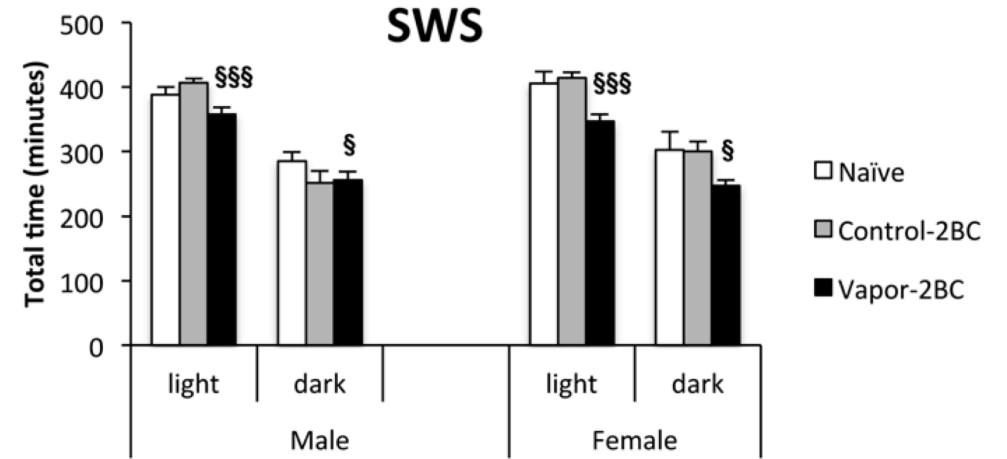
Effects of Alcohol on sleep in CIE mice

Huitron-Resendiz et al. 2018

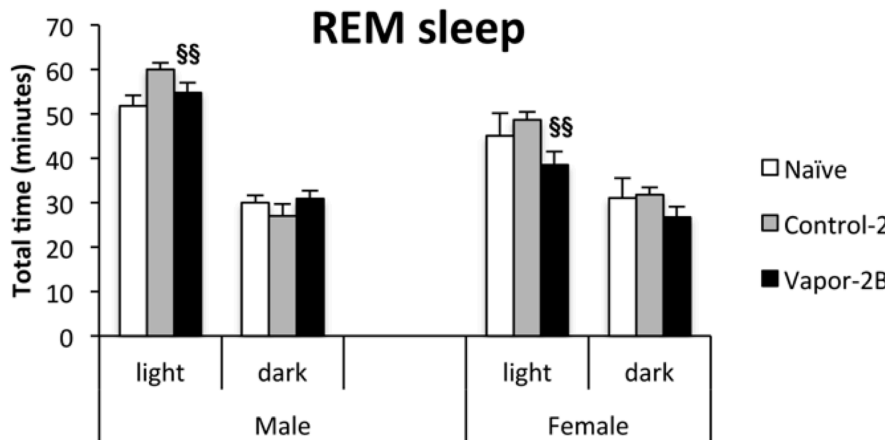
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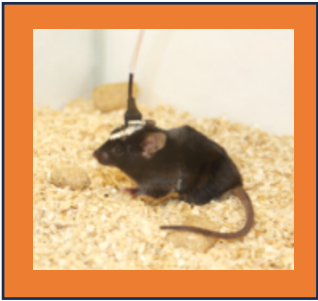
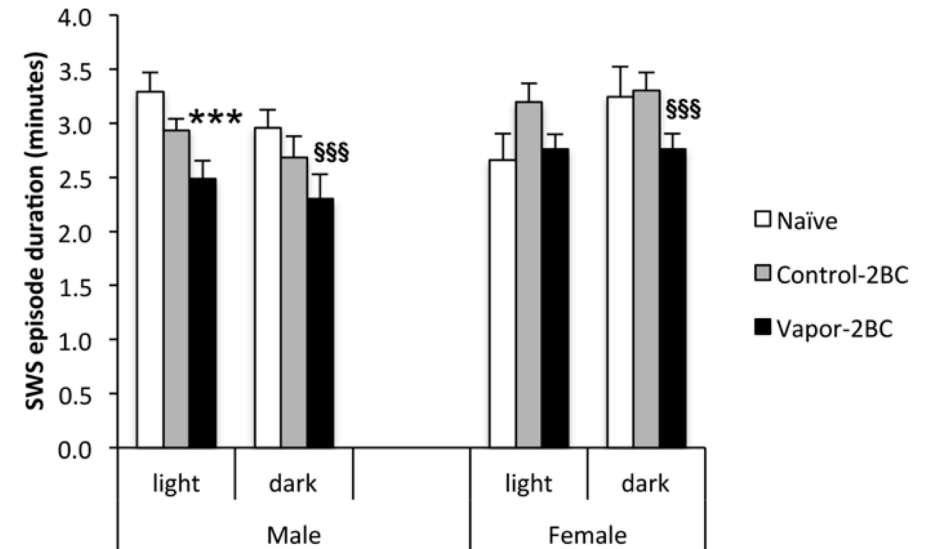
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C



D



Effects of Alcohol on sleep in CIE mice

Huitron-Resendiz et al. 2018

