Sleep

* Why do we sleep?
* Adaptive evolutionary function: to save energy (because we used to be bears according to the theory). Or to be safe
* Restorative function
* Brain plasticity: we need to sleep to let the brain clean itself.
* How do we wake up?
* What makes us wake up and activates the cortex is what we call "reticular activating system"
* Located in the reticular formation in the brain stem
* Formed of the nuclei which are present in the brain stem: nuclei of acetylcholine, serotonin, norepinephrine, histamine
* These nuclei are present in the brain stem and the base of the brain
* They activate the cortex and responsible for waking up
* The previous system has a turning on, and turning off:
* **Turn on:** *hypocreatin* (orexin), it is a peptide neurotransmitter, present in the hypothalamus, activates the nuclei mentioned previously
* Sensation can also activate those nuclei (we mentioned before that sensation can activate the modulators, like when you drink a cold cup of water you activate a certain nuclei and feel awake)
* **Turn off:** *GABA* (present in the ventrolateral preoptic area in the hypothalamus)
* **Note:** VLPO inhibits the activating system, also, the activating system inhibits the VLPO, hypocreatin activates the activating system and inhibits the VLPO, VLPO inhibits the hypocreatin. The stronger dominates.
* Norepinephrine, histamine, dopamine, serotonin, acetycholine 🡪 waking up
* GABA 🡪 sleep
* GABA tries to inhibit the wake-up neurotransmitter, and hypocreatin
* So there is a sleep-promoting and wake-promoting areas, there is an inhibition relationship between them, the stronger area dominates
* If the waking up activators increased above normal levels 🡪 we will have hyper waking up 🡪 **insomnia**
* If waking up neurotransmitters decreased, or sleep neurotransmitters increased above normal 🡪 hyper sleeping 🡪 **narcolepsy**
* **Melatonin** inhibits the activating system, so acts like GABA, helps in sleeping
* Melatonin has a very important role in the day-night cycle
* Connection between **pineal gland, suprachiasmatic nucleus** and hypothalamus, is the main clock that regulates our cycle and has to do with sleep
* Retina will receive light, send it to the suprachiasmatic nucleus and activate it
* When activated, suprachiasmatic nucleus will inhibit the release of melatonin from pineal gland
* When there is no light, melatonin will inhibit the suprachiasmatic nucleus and the activating system, and induce sleep
* Suprachiasmatic nucleus and melatonin are a helping factor to the sleep and activating systems that help us regulate our sleep-wake cycles
* (suprachiasmatic nucleus, melatonin) is our biological clock
* Suprachiasmatic nucleus has a very important role in regulating the sleep-wake cycle, any lesion or mutation in it will disturb the cycle
* In the rat example:
* The lesion cause a disturbance, the rat still sleeps for example 6-7 hours, but not at once, they because distributed all day long (over the 24 hours)
* The mutation made the sleep cycle in the rat a 20-hour cycle instead of a 24-hour one
* ATP (adenosine triphosphate)
* Adenosine is one of the neurotransmitters in the brain
* When too much ATP is broken, adenosine level will rise
* Adenosine has receptors, for example A1, inhibitory receptors
* So when we consume ATP during the day, adenosine levels will rise, inhibits acetylcholine, activating system is being inhibit, we will go to sleep
* Caffeine is A1 antagonist, adenosine will not bind to it, acetylcholine is not inhibited, body stays awake
* Types of sleep:
* Slow wave sleep (NREM)
* Rapid eye movement sleep (REM)
* It is called rapid eye movement because the EEG will show high activity, but the eyes will also be moving right and left
* Stages of NREM: **"look at the slides for more details and focus on the waves present in each stage"**
* Stage 1: we are still awake but begin to sleep, sleep will affect brain, muscles, vital signs (pressure, heart rate, respiration)
* Stage 2:
* Stage 3: muscle tone decrease, brain is mixed between sleep and awake, sleep walking occurs in this stage, dreams in this stage, "yetgallab" in this stage
* Stage 4: when delta is above 50%, body temperaturereached the lowest, heart rate, respiration reach the lowest values
* When the person enters stage 4, he goes back to REM sleep
* From the beginning of stage 1, to the end of REM 🡪 1 sleep cycle
* The brain works the most in REM sleep
* Beta activity is the most in REM sleep
* Respiration, blood supply, are the most to the brain in REM
* REM = 20-30% in normal person's life, cycles from 5-6
* REM in active people who study and so on, REM % is more, in older people REM is less
* On average, a person has 5 cycles, 3 dreams every night
* There are many factors that determine if we remember a dream or not:
* If we wake up before the brain has cleaned the dream or not
* Blood flow during the dream: high blood flow will help you remember the dream
* Dream theories and sleep disorders are enough from the slides
* **Sleep walking:** before we enter REM sleep we must enter stage 4 and turn from theta to delta, if some neurotransmitters are unbalanced, and we didn’t make this transition, the brain will start functioning and giving orders like walking