How to study and Measure Sleep (8.1)

→ Sleep: Absence of overt behavior, absence of consciousness
  ♦ -> Measure are 'indirect'
→ Methods to measure sleep
  ♦ ElectroMyoGram (EMG): muscle activity (face), legs
  ♦ ElectroEncephaloGram (EEG): Brain activity
  ♦ ElectroOculoGram (EOG): eye movements
  ♦ Air flow measurements: breathing
  ♦ Heart rate...

EEG measurements of sleep
Sleep has different stages characterized by different EEG waveforms (frequency content)

Sleep has stages
→ Sleep stages and Rhythms
  ♦ Stage 1: Drowsiness, heavy on eyes, last 10 minutes
  ♦ Stage 2: sensory disconnect. Sleep spindles and K complexes, last 15 minutes
  ♦ Stage 3/4: loss of consciousness, last 60 minutes also called Slow wave sleep
  ♦ REM: dreaming, loss of muscle tonus, rapid eye movement, activity in sexual organs, desynchronized, last 25 minutes also called paradoxical sleep
EEG and single neurons
- During slow wave sleep neurons undergo up and down states: periods of activity/silence, 1 period/second
  ◦ Down state: rest
  ◦ Up state: neurons are firing. Memory consolidation.

Sleep is a cycle: free running sleep/wake cycle
- In class video
  ◦ Experiment: room/cave without windows, free food, entertainment, no clocks
  ◦ Measure: the amount of time awake and asleep
  ◦ Result: sleep and wake cycle is not the same as day and night cycle

Sleep has cycles
- Sleep is a cycle
  ◦ Free running awake/sleep cycle; 25 hours
  ◦ REM and non-REM cycles every 90 minutes. Controlled by internal clock
  ◦ REM sleep has a refractory period of 1 hour. Increase metabolic activity in CNS, decrease of activity in PNS. Sexual organs activity. Dynamic dreams.

Why do we sleep (8.6)
- Sleep as a behavior (adaptive response): all animals have SWS, but only mammals and birds have REM. Sleep as a ‘protective behavior’ : it is dangerous to move at night
- Sleep as a restorative process. Resting of the brain (but not related to body activity)
  - Evidence:
    ◦ Cortex: metabolic activity and blood flow decrease by 25% (during SWS)
    ◦ Highest activity (when awake)
  - highest delta + lowest activity during sleep
- Sleep needs vary with development

Sleep is a need (genetic basis)
- Different species have different sleep needs
  ◦ -human infant ~16hrs asleep
  ◦ -human adult ~8hrs
  ◦ -human elder ~5.5hrs
  ◦ -owl monkey ~17hrs
  ◦ -rhesus monkey ~11.8hrs
  ◦ -baboon ~10.3hrs
  ◦ -squirrel monkey ~9.9hrs
  ◦ -chimpanzee ~9.7hrs

Sleep duration in humans
- Sleep needs vary among humans (4-10hrs)
- Sleep starts in utero (womb)
- Sleep needs vary along life span. Need less and less sleep as we age
24 hours sleep deprivation: no 'rebound' in sleep duration

Sleep: SWS (8.8)
- Deprivation studies:
  - No significant physical consequences (human)
  - Loss of weight + death (rats)
  - Not a proportional function of recuperation
- SWS need is not related to physical exercise
  - Brain metabolic activity decreases by 25%. *Delta* occurs in the regions that were the most active in the awake state
  - Related to mental activity and 'declarative memory' consolidation
- Nap after learning...
  - Related to body temperature
- Aspirin/ibuprofen lower temp -> prevents slow wave sleep.
- Cytokines (immune response) raise temp -> increases slow wave sleep
  - Dreams: static images

Sleep: REM sleep (8.7)
- Deprivation studies:
  - Significant consequences on cognitive performance
  - REM shows rebound phenomenon after deprivation
- Brain metabolic activity increases
  - In infants: REM= 70% of sleep, developmental role?
  - In adults: REM= 15% of sleep, learning and memory, consolidation?
  - Forgetting
  - Dynamic dreams

Sleep disorders
- Insomnia: problem *falling* asleep. May be due to stress, psychological factors or drug rebounds (valium or antibiotics)
  - Sleep needs are variable (4-8hrs). Depends on genetic and environmental factors (health, day activity, mood). 'insomnia' criteria depends on individual
  - Quantity of sleep vs. quality of sleep (sleep apnea)
- REM sleep disorders
  - Sleep attack (low arousal, few minutes, sleep)
  - Cataplexy (high arousal, no loss of consciousness)
  - Sleep paralysis (awake atonia): just before/after sleep.
  - Hypnagogic: hallucinations (awake, dreaming, usually nightmares)
  - REM without atonia (a.k.a REM sleep behavior disorder). Act out dreams
- Narcolepsy: genetic and hormonal (orexin) bases
  - [https://www.youtube.com/watch?v=MZeLca_2QPw](https://www.youtube.com/watch?v=MZeLca_2QPw)
- SWS sleep disorders
  - Sleep walking (15% children age 5-12 do it at least once)
  - Eyes open, no arms stretched, stage of half consciousness
  - Usually no walking
-sleep-related eating disorder
  - Sleep talking (hypnosis, truth serums)
  - Night terror (fear of losing consciousness? No memory for the event)
  - Fatal familial insomnia, damage to thalamus. Insomnia, paranoia, hallucinations, dementia, related to mad cow disease. No cure. Genetic

What if you had a quiz
  - (T/F) our natural sleep/wake cycle is always exactly 24 hours.
  - (T/F) the brain is much less active in REM sleep then in SWS.
  - You dream full dynamic stories during _____ sleep. Sleep attacks may occur during _____ sleep.
  - Research shows that REM sleep is involved in:
    - Patients suffering from cataplexy
    - Sleep walking
    - In Slow wave sleep
    - All of the above

Answers:
  - False
  - True; opposite
  - REM, REM
  - A