Sleep - 10/05

How to study and measure sleep
- Sleep: absence of overt behavior, absence of consciousness
  o Measures are indirect
- Methods to measure sleep characteristics:
  o Electromyogram (EMG): muscle activity (face), legs.
  o Electroencephalogram (EEG): brain activity.
  o Electrooculogram (EOG): eye movements.
  o Air flow measurements: breathing
  o Heart rate.

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

Sleep has stages
- **Stage 1**: drowsiness, heavy eyes. Theta oscillations. lasts – 10 minutes
- **Stage 2**: sensory disconnection. Sleep spindles and K complexes. Lasts 15 minutes
- **Stage ¾**: loss of consciousness. Lasts 60 minutes. Also, called **slow wave sleep**
- **R.E.M.**: dreaming, loss of muscle tonus, rapid eye movements, activity in sexual organs.
  Theta and beta desynchronized. Lasts 25 minutes. Also, called **paradoxical sleep**.

EEG and single neurons
- During slow wave sleep neurons undergo up and down states:
  o Periods of activity/silence, 1 period/second
  o **Down state**: resting state
  o **Up state**: neurons are firing, and memory consolidation

Sleep is a cycle: free running sleep/wake cycle
- **Experiment**: room/cave without windows, free food, entertainment, no clocks.
- **Measure** the amount of time awake/sleeping
- **Result**: sleep/wake cycle is not the same as day/night cycle
  - free running awake/sleep cycle: 25 hours
  - REM/non-REM cycles every 90 minutes. Controlled by internal clock
  - Rem cycle has a refractory period of 1- hour. Increase of metabolic activity in CNS,
    decrease of activity in PNS. Sexual organs activity. Dynamic dreams.

Why do we sleep?
- **Sleep as 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 + lowest activity (during SWS)
- Sleep need vary with development

Sleep duration in humans
- Sleep needs vary among humans (4-10 hours)
- Sleep stars in utero (in the womb)
- Sleep need vary along life span. Need less and less sleep as we age.

Deprivation results
- 24 hours' sleep deprivation: no rebound in sleep duration
- **Record**: 264 hours (11 days), by a 17 yo high school student. 2 days rebound only

Sleep: Slow wave sleep
- **Deprivation studies**:
  - No significant physical consequences (human)
  - Loss of weight + death rats
  - Not 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 most active in the awake state.
- Related to mental activity and declarative memory consolidation
  - Nap after learning
- Related to body temperature
  - Aspirin/ibuprofen decreases temperature -> prevents slow wave sleep.
  - Citokines (immune response) increase temperature -> increases slow wave sleep.
- **Dreams**: static images

Sleep: REM sleep
- **Deprivation studies**:
  - Significant consequences on cognitive performance
  - REM sleep show bound 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

Sleep disorders
- **Insomnia**
  - Sleep needs are variable (4-8 hours). Depends on genetic and environmental factors (health, day activity, mood). Insomnia criteria depends on individual
o Insomnia: problem falling sleep. May be due to stress, psychological factors or drug rebounds (after benzodiazepines (valium or barbituates (anxiolitics))
   o Quantity of sleep vs. quality of sleep (sleep apnea)
- **REM sleep disorders**
  o Sleep attack (low arousal, few mins. Sleep)
  o Cataplexy (high arousal, no loss of consciousness)
  o Sleep paralysis (awake atonia): just before/after sleep.
  o Hypnagogic hallucinations (awake, dreaming, usually nightmares)
  o REM without atonia (a.k.a. REM sleep behavior disorder). Act out dreams
- **Narcolepsy**: genetic and hormonal (orexin) bases

**SWS sleep disorders**
- **Sleep walking** (15% children age 5-12 do it at least once)
  o Eyes open, no arms stretched, state of half consciousness
  o Usually no walking
  o 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, death. Related to mad cow disease. No cure. Genetic
- **Bed-wetting.** Primarily in children. Partly genetic, partly environmental. Usually transient

T/F our natural sleep/wake cycle is always exactly 24 hours (false) 25 hours
T/F the brain is much less active in REM sleep than in SWS (false) the opposite

You dream full dynamix stories during ________ sleep. Sleep attacks may occur during ________ sleep. (REM,SWS)

Research shows that rem sleep is involved in
  - **Patients suffering from cataplexy**
  - Sleep walking
  - SWS
  - All of the above