

Sleep

Intro Psychology
Georgia Tech
Instructor: Dr. Bruce Walker

Today

- What is Sleep?
- Why do we sleep?
- Dreams

What is Sleep?

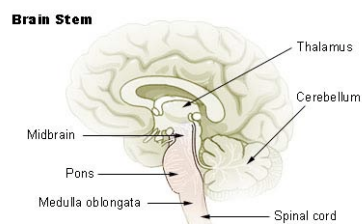
- A natural and periodic state of rest during which consciousness of the world is suspended
- Characterized by inactivity of the body, and by changes in the patterns of brain activity, as compared to active or awake periods

Circadian Rhythms

- Sleep is periodic--it is required, on average, about every day
- Humans, like all mammals, have a 24 hour biological clock
 - If people are placed in an environment without any access to daylight, clocks, etc, they follow an activity/rest cycle of about 24.5 hours (Kleitman, Mammoth Cave Study)

Control of Cycles

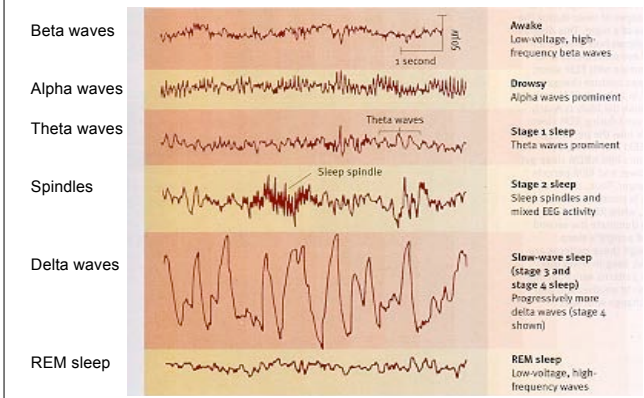
- Sleep/wake cycle seems controlled by suprachiasmatic nucleus (SCN) of Pons.
 - Lesions eliminate sleep/wake cycle



Description of Brain Waves

- Two basic parameters
 - Frequency - waves per second (Hertz, Hz)
 - Amplitude
- Synchronization
 - Synchronized waves are aligned with each other (e.g., different brain areas)

Brain Waves



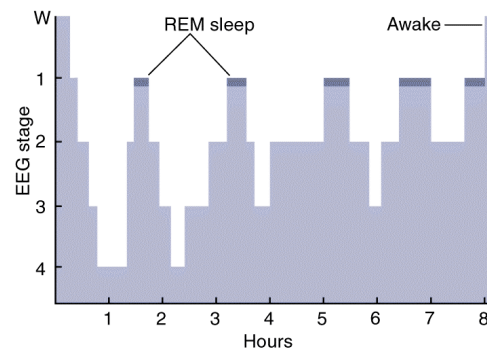
Non-REM Sleep

- Alpha, delta, theta activity in the EEG
 - Stages 1 and 2: theta
 - Stages 3 and 4: delta activity (synchronized)
 - Termed **slow-wave sleep (SWS)**
- Light, even respiration
- Muscle control is present (toss and turn)
- Very little dreaming seems to occur

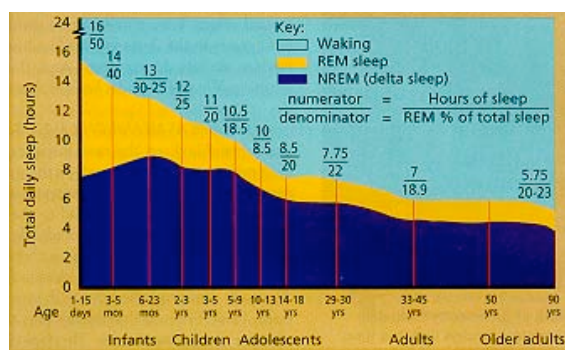
REM sleep

- Presence of beta and theta activity (desynchronized)
- Enhanced respiration and blood pressure
- Rapid eye movements (REM)
- Loss of muscle tone (paralysis)
- Vivid, emotional dreams
- Signs of sexual arousal

► Typical Pattern of the Stages of Sleep During a Single Night



Ratio of Sleep Stages



Sleep in Bottle-Nose Dolphins

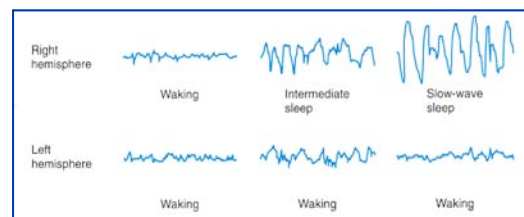


Figure adapted from Mukhametov, L.M. in *Sleep Mechanisms*, edited by A.A. Borbély and J.L. Valatx. Munich: Springer-Verlag, 1984.

What is the Function of Sleep?

- Sleep as an adaptive response?
 - Found in all vertebrates (REM in mammals)
 - Kept our ancestors out of predators way?
- Restoration and repair?
 - Reduced brain activity during Slow Wave Sleep
 - Changes in sleep during prolonged bed rest (no real changes in SWS)
 - Exercise (temperature inc. => inc. SWS)
 - Mental activity increases SWS

Sleep deprivation

- Animal studies report that rats die after 2 weeks of total sleep deprivation
 - Specific physiological cause is open to dispute
 - May be decreased immunological functioning that causes increased rate of infections of normally benign pathogens
- No human deaths in sleep deprivation studies lasting as long as 11 days.

After Sleep Deprivation

- Subject kept awake for 264 hours
- After deprivation – night 1 slept 15 hours, night 2 – 10 hours, then back to normal.

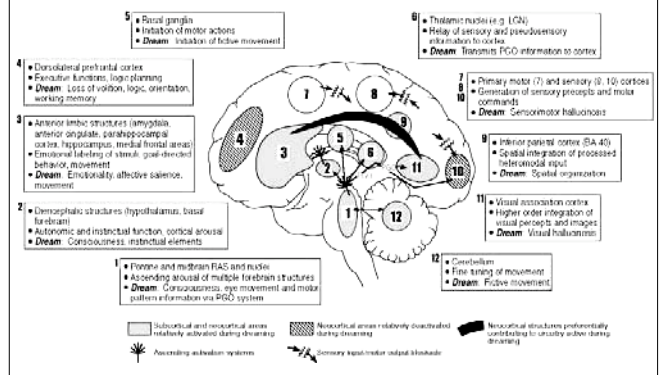
REM Sleep seems necessary

- Normally about 20% of total sleep
- Research participants that are woken up as soon as they enter REM sleep show **REM rebound** on subsequent days (e.g., proportion may rise to 50-60% of sleep time)
- Rebound also seen when **REM sleep inhibitors** (alcohol, sleep aids) are discontinued.

REM and Dreams

- Subjects woken during REM sleep report vivid dreams
- Subjects woken during slow-wave sleep report very vague disconnected dreams, if anything (but it takes a long time to wake someone up...)

FOREBRAIN PROCESSES IN NORMAL DREAMING - INTEGRATED MODEL



Memory Functions of Sleep?

- Wilson & McNaughton
 - Simultaneous recording from more than 100 cells in hippocampus.
 - In rats, hippocampus cells selectively fire as the rat moves about the environment.
 - Ensemble of cells that code a location should get more cohesive (e.g., code location better) with learning.

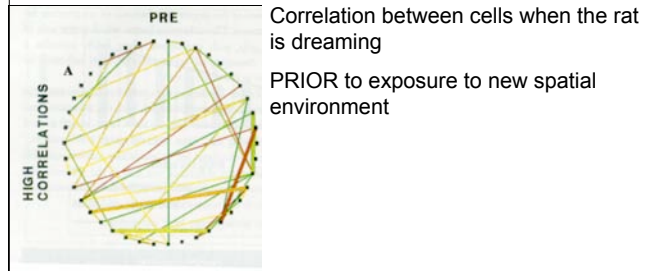
Memory Functions?

- Interesting coincidence?
 - Long term potentiation – strengthening of synapses between hippocampus cells
 - Most effective when cells are stimulated at the “theta” rhythm (same frequency as found during REM sleep)
 - Could REM sleep function as a consolidation of learning during the day?

Do Rats Dream?

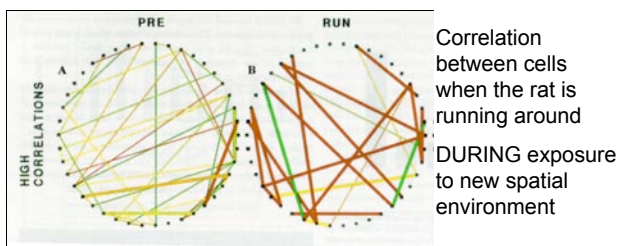
- Back to Wilson & McNaughton
 - Record 100 cells in hippocampus.
 - Compute correlation of cells (e.g., when one cell fires, what other ones do?)
 - Correlation – ensembles at work.

Do Rats Dream?



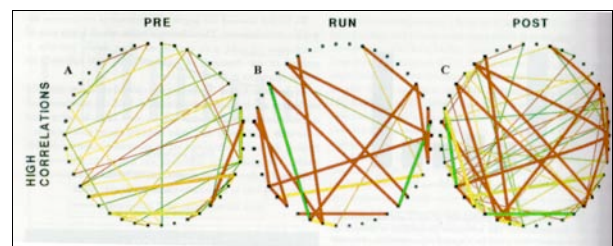
Do rats dream?

- Back to Wilson & McNaughton



Do rats dream?

- Sleep reactivates (strengthens) existing connections



Upcoming

- Learning
- Sensation & Perception