

Sleep

- Methods used to investigate sleep:
 - EEG – brain activity;
 - EMG – Muscle activity;
 - EOG – Eye Movement.
 - neuroimaging...
 - experimental methods to test performance when sleep deprived versus good sleep

Brain wave activity

- **Awake** Alert Beta 13-30 Hz
- Resting Alpha 08-12 Hz
- **Sleep** Stage 1 Theta 3.5-7.5 Hz
- Stage 2 Theta/Spindles/Kcomplexes
- Slow/ Stage 3 Delta 20%-50% < 3.5 Hz
- Wave Stage 4 Delta 50% +
- **Dreams** Theta/Beta/Rapid Eye Movement
- Muscle paralysis

Sleep is an Adaptive Response

- All animals; birds; fish; reptiles have quiescent periods.
- Warm blooded creatures mammals/birds all sleep and dream.
- safety; saving energy; avoiding predators, etc?
- Cattle and large herd animals sleep very little.

Sleep, just an Adaptive Response?

There are arguments against the idea that sleep is simply about adaption to environment

- Some animals sleep although they would be safer without it – Indus dolphins
- In bottlenose dolphins and porpoises the hemispheres of the brain sleep independently
- Many birds sleep with one eye open and there are several species who stay in flight for extended periods

The restorative role of sleep

- Sleep deprived individuals have difficulty functioning.
- Sleep deprived individuals will make up $\frac{3}{4}$ of lost stage 4 sleep and on $\frac{1}{2}$ of lost Rem.
- Metabolic rate and blood flow slows to 75% of waking during slow wave sleep
- brain also clears out waste when we sleep
- Secretion of growth hormone occurs only during delta wave activity.

What happens to the Frontal Cortex

- the sleep deprived prefrontal cortex slows down affecting the abilities for
 - planning
 - decision making
 - attention control
 - and reasoning and problem solving

Sleep deprivation

Studies of the Frontal Cortex show that sleep deprivation

- reduces productivity and work efficiency
- reduces ability to respond to changing circumstances and affects ability to adopt and modify strategies quickly
- reduces creativity and problem solving ability
- affects ability to consider alternative solutions

Why do we dream?

- Generally it's believed that dreaming plays an important role in learning.
- It has been suggested that new information is consolidated and integrated into our memories when we dream
- Infants spend most of their sleep time dreaming.
- Students dream more during exam time.
- Children with intellectual disability appear to dream less than average while gifted children dream more.

Sleep and Learning

- Slow wave and REM sleep are important for memory formation and consolidation
- the processing of short into long term memory happens when we dream
- REM simulates scenarios and plays around with information
- Insights and creative ideas can come from dreams
- in non-rem deep sleep the brain replays things that happen during the day super fast back and forth

metabolic maintenance - weight

Weight gain, appetite and also weight loss (muscle vs fat) are affected by lack of sleep

- ghrelin
- leptin
- Other hormones affected are
- melatonin
- cortisol
- growth hormone