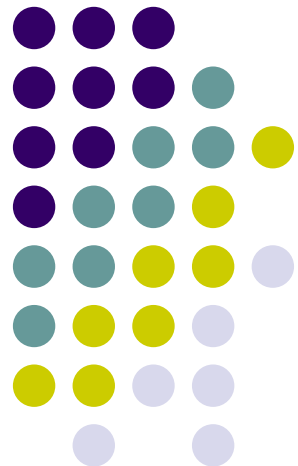
9.01 Introduction to Neuroscience
Fall 2007

What you wish you were doing right now…….. ……..sleep.

David Purger

9.01 Review

12/15/07



Brain rhythms

- Thalamus controls brain rhythms using pacemaker neurons and collective activity

  - **Beta** (>14 Hz) – cortical activity
  - **Alpha** (8-13 Hz) – quiet wakefulness
  - **Theta** (4-7 Hz) – some sleep
  - **Delta** (<4 Hz) – deep sleep

Sleep cycle

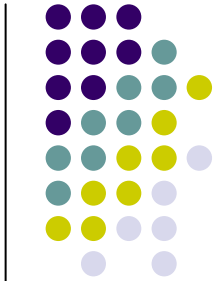
- Awake – 1 – 2 – 3
  - 4 – 3 – 2 – REM – 2 – 3
  - 4 – 3 – 2 – REM – 2 – 3
  - 4 – 3 – 2 – REM – 2 – 3
  - …repeat every ~90 minutes until waking

  - As time asleep increases, REM periods lengthen, NREM periods shorten
    - At least 30 minutes between REM periods

NREM sleep

- Stages 1-4 (lightest to deepest)
  - Slow high-amplitude EEG
  - Dull/absent sensation
  - Logical, repetitive thought
  - Occasional involuntary movement
- Parasympathetic NS decreases HR, breathing
- Little/no dream recall

REM sleep

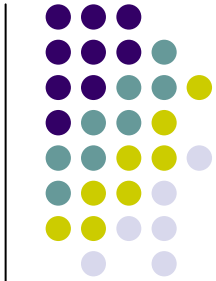


- Brain activity resembles wakefulness
  - Fast low-amplitude EEG
  - Vivid internally generated sensation
  - Vivid, illogical, bizarre thought
  - Muscle paralysis (movement commanded but not initiated)
- Sympathetic NS increases HR, breathing
- Dream recall normal and accurate
- Contrast with wakefulness: sensation is externally generated, thought is logical, muscles are not paralyzed

Functions of REM sleep

- "*At this point, you are probably confused about the functions of dreaming and REM sleep. So are we*." – Our brilliant textbook
  - Dreams hypothesized to be due to random activation of cortex by the pons
  - REM deprivation (not sleep deprivation) impairs learning, can be fatal

Neural mechanisms of sleep



- Awake
  - Ascending reticular activating system: synapses onto cortex, thalamus
  - Depolarizes neurons, increases excitability, suppresses rhythmic firing
- Falling asleep (awake→NREM)
  - Rhythmic activity generated by thalamus directed into cortex
- REM sleep
  - Increased extrastriate, limbic activity; decreased forebrain activity
  - Brain stem inhibits spinal motor neurons (atonia)
  - REM sleep behavior disorder: disruption of atonia

Circadian rhythms

- Usually, zeitgebers set rhythm to 24 hours
- In absence of zeitgebers, suprachiasmatic nuclei (in hypothalamus) internally generate 24.5-25.5 hour rhythm
  - Internal clock can be reset by light (some retinal ganglion cells are light-sensitive, synapse onto SCN
  - Lesions disrupt circadian rhythms for activities like feeding, but sleep continues with light-dark cycle cues

Experiments

- Lesions
  - Most important neuroscience experiment
- Pharmacology
- Scans (EEG, MEG)